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# Use of electroconvulsive therapy in psychiatry

**NTNU**
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Doctoral Thesis

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# Use of electroconvulsive therapy in psychiatry

Thesis for the degree of Philosophiae Doctor

Trondheim, January 2015

Norwegian University of Science and Technology
Faculty of Medicine
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## Bruk av elektrokonvulsiv terapi i psykiatrien

Elektrokonvulsiv terapi (ECT) er en behandlingsmetode hvor man utløser et epileptisk anfall ved hjelp av elektrisitet påført mot pasientens hode under narkose og muskelrelakserende medikamenter. Risikoen for meget alvorlige bivirkninger eller mortalitet er lav og effekten er veldokumentert for alvorlige depresjoner, men også for andre psykiske lidelser som mani og noen former for schizofreni. Kjente bivirkninger er hodepine og forbigående hukommelsesproblemer. Forskjell i behandlingsmåte kan skyldes noen av bivirkningene.

Dette arbeidet handler om kartlegging av bruk, demografiske data, diagnoser, praksis, samt holdninger til ECT, i Norge og verden.

I vårt material fant vi variasjon i bruk av ECT mellom land og regioner. I Norge var det 2.4 per 10,000 innbygger per år som fikk ECT. Verden over varierte bruken av ECT fra 0.11 til 5.1 per 10,000 innbygger per år. ECT uten narkose ble brukt i Asia, Afrika, Latin-Amerika, Russland, Tyrkia og Spania. Det var flest eldre kvinner med depresjon som fikk ECT i vestlige land, mens yngre menn med schizofreni dominerte i asiatiske land. Norske psykiatere uttrykte positive holdninger til ECT.

Vi konkluderte med at det er stor forskjell i bruk av ECT både når det gjelder antall pasienter per 10,000 innbygger, og praksis i Norge, men også verden over, tross internasjonale aksepterte retningslinjer. Stor variasjon i den praktiske bruken av ECT viser behov for fortsatt å dele kunnskap om og refleksjoner rundt ECT.

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# Contents

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# List of publications

The following publications are in the text referred to by their Roman numerals I-IV.

I. Jarosch-von Schweder, L., Lydersen S., Bergsholm P., Ottesen Kennair L.E., Linaker O.M. Electroconvulsive therapy at a county hospital: Rates of use, demographics and diagnoses. (Submitted).

II. Schweder, L.J., Lydersen, S., Wahlund, B., Bergsholm, P., Linaker, O.M. 2011a. Electroconvulsive therapy in Norway: rates of use, clinical characteristics, diagnoses and attitude. J. ECT. 2011Dec; 27(4):292-295.

III. Schweder, L.J., Wahlund, B., Bergsholm, P., Linaker, O.M. 2011b. Questionnaire study about the practice of electroconvulsive therapy in Norway. J. ECT. 2011Dec; 27(4):296-299.

IV. Leiknes, K.A., Jarosch-von Schweder, L., Høie, B. Contemporary use and practice of electroconvulsive therapy worldwide. Brain Behav. 2012 May;2(3):283-344.

# Abbreviations

| | |
|---|---|
| **A-ECT** | Ambulatory ECT |
| **AD** | Antidepressant |
| **APA** | American Psychiatric Association |
| **AvE** | Average ECT number |
| **BDNF** | Brain Derived Nerve Factor |
| **BF** | Bifrontal |
| **BH** | Bjørg Høie |
| **BL** | Bilateral |
| **BW** | Bjørn Wahlund |
| **CORE** | Consortium for Research in ECT |
| **C-ECT** | Continuation ECT |
| **DBS** | Deep brain stimulation |
| **DPC** | District psychiatric centre |
| **DSM V** | The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition |
| **EAR** | ECT administration rate |
| **ECG** | Electrocardiogram |

| | |
|---|---|
| **ECT** | Electroconvulsive therapy |
| **EEG** | Electroencephalography |
| **EMG** | Electromyography |
| **ICD 10** | International Statistical Classification of Diseases and Related Health Problems, Tenth Revision |
| **iP** | Inpatient prevalence |
| **KAL** | Kari Ann Leiknes |
| **LJVS** | Lindy Jarosch-von Schweder |
| **MADRS** | Montgomery and Aasberg Depression Rating Scale |
| **MAO** | Monoamine oxidase inhibitor |
| **MDD** | Major depressive disorder |
| **M-ECT** | Maintenance ECT |
| **MRI** | Magnetic resonance imaging |
| **MRSI** | Magnetic resonance spectroscopic imaging |
| **OML** | Olav Morten Linaker |
| **PD** | Parkinson's disease |
| **PB** | Per Bergsholm |
| **RCT** | Randomized controlled trial |

| | |
|---|---|
| **RUL** | Right unilateral |
| **ST** | Seizure threshold |
| **SSRI** | Selective serotonin re-uptake inhibitors |
| **TCA** | Tricyclic antidepressant |
| **TPR** | Treated person rate |

# Summary


### Introduction

Electroconvulsive therapy (ECT) has been used to treat mental disorders since its introduction in 1938, and it is available in many countries on all continents. However, there are large variations in practice and in rates between countries and regions within those countries, despite internationally accepted guidelines. The ECT intervention is an application of electrical current to the scalp in order to provoke a generalized epileptic seizure, for the purpose of alleviating psychotic and depressive symptoms. Initially ECT was performed without anaesthesia and muscle relaxant (termed unmodified ECT), which among other things, incurred risks of bone fractures and tendon or muscular damage. ECT practices have developed since then; modification of the technique minimizes adverse effects without reducing efficacy. This includes the use of unilateral electrode placement, the adjustment of stimulus intensity to the seizure threshold of each patient, and use of anaesthesia and muscle relaxant (termed modified ECT). ECT still remains controversial, despite well-documented efficacy, especially for major depression, but also for mania and some forms of schizophrenia, and low serious adverse events. Common side effects are transient headaches and memory impairment, whilst long term memory impairment is uncertain and widely debated. Differences in ECT technique may account some for these variances.

This thesis explores the topic of electroconvulsive therapy in terms of variations in rates of use, demographics, diagnoses/ indication, outcome, practice, adverse effects as well as attitudes, primarily in Norway but also worldwide. The aims of the present series of studies were to describe: the prescription rate of use of ECT, demographics and diagnoses of the patients at a county hospital in Norway over a period of 11 years (Paper I); the use of ECT,

demographics and diagnoses, as well as attitudes among psychiatrists in Norway (Paper II); the practical use of ECT in different psychiatric hospitals in Norway as well as side effects and outcomes (Paper III); the contemporary (1990 to November 2010) worldwide (by continent, country, region, large city hospitals and/or country hospitals) ECT utilization, parameters and practice, in psychiatric establishments, both inpatient and outpatient (Paper IV).

**Material and methods**

The thesis consists of four papers. Paper I is based on data from patients admitted to the psychiatric unit of a county hospital between 1993 and 2003, and treated with ECT during their hospitalization. Data were collected retrospectively from specific ECT journals and medical records. The following data were collected: number of patients treated, number of treatments per course, gender, age and diagnoses. Papers II and III are based on answers to a 40-item questionnaire (Appendix I) about the use of ECT in Norway in 2004. Data were collected from psychiatric hospitals, district psychiatric centres (DPC), and child and adolescent psychiatric units. Data included in paper II were number of patients treated, demographics (gender and age), diagnoses and psychiatrists' attitudes. Data in paper III address the practical uses of ECT, side effects and outcomes. Paper IV is based on information from systematic search of studies published in 1990 through November 2010 in the databases Medline, Embase, PsycINFO, SveMed and EBSCO/Cinahl, in collaboration with the Norwegian Knowledge Centre. Studies reporting original data on ECT utilization and practice in continents, countries, regions, cities or local hospitals were included.

**Results**

We found that there were variations in use of ECT between regions of Norway and between countries worldwide. The rate of ECT in Norway was 2.4 / 10,000 inhabitants per year and varied between health regions from 1.83 to 3.44 per 10,000 inhabitants per year (Paper II), whereas worldwide the rate varied from 0.11 to 5.1 per 10,000 inhabitants per year (Paper IV). In Norway, there were twice as many women as men who received ECT, and depressive disorders were the most common diagnostic indication (Papers I and II). Psychiatrists expressed generally positive attitudes towards ECT (Paper II). Unilateral electrode placement was preferred, while antidepressant, lithium and antipsychotic medication during ECT was often continued and continuation/maintenance ECT was used (Paper III). Most patients benefitted from ECT. Side effects such as memory impairment and headache were frequent, but not reported as serious adverse effects (Paper III). In the last study (Paper IV) we found that worldwide practices, indications and use of ECT varied considerably. Unmodified ECT was used in Asia, Africa, Latin America, Russia, Turkey and Spain. In Western countries, the majority of ECT treated patients were older women with depression, versus younger men with schizophrenia in Asian countries. Preferred electrode placement was generally bilateral, excepting some places (Europe and Australia/New Zealand). General trends were often inadequate training, and international guidelines not being followed. Mandatory reporting and overall country ECT register data were sparse.

**Discussion**

Methodological challenges and bias influencing the data results are discussed, on the background of use of retrospective data (information depends on the quality of documentation), use of a questionnaire study design, and a systematic review providing a Worldwide picture relying on published data from 1990. We found that many countries have

no monitoring or reporting and poor/old data, or data from questionnaire studies. Reasons for differences in rates and practice in Norway and worldwide are discussed. One reason could be economic, another attitude, as well as patient and health personnel knowledge about ECT.

**Conclusion**

There are widespread differences in ECT utilization, administration and practice in Norway and worldwide. Most patients who receive ECT in western countries are women and elderly, and depression is the most common disorder. Most patients in Norway are reported to benefit from ECT and adverse effects are reported to be minor problems. Many patients are still treated with unmodified ECT today. Large global variation in ECT utilization, administration, and practice advocates a need for worldwide sharing of knowledge about ECT, reflection, and learning from each other's experiences.

# Sammendrag

**Bakgrunn:**

Elektrokonvulsiv terapi (ECT) ble introdusert i 1938 og har siden den gang blitt tatt i bruk i mange land verden over. Litteratur tyder på at det er stor variasjon mellom land og innad regioner i et land selv om det finnes internasjonale aksepterte retningslinjer. Behandlingen består i at man utløser et epileptisk anfall ved hjelp av elektrisitet påført mot pasientens hode for å behandle psykiske symptomer. I begynnelsen ble ECT gitt uten narkose og muskelavslappende medikamenter, noe som kunne medføre risiko for beinbrudd eller muskelskader. Gjennomføring og teknikk av ECT har blitt endret siden den gang for å minimere bivirkninger uten å redusere effekten. Dette inkluderer bruk av unilateral elektrodeplassering, justeringer innen dosering av energi, samt bruk av anestesi og muskelrelakserende medikamenter (modifisert ECT). ECT er fortsatt sett på som en kontroversiell behandling, selv om risikoen for meget alvorlige bivirkninger eller mortalitet er lav og effekten er veldokumentert for alvorlige depresjoner, men også for andre psykiske lidelser som mani og noen former for schizofreni. Kjente bivirkninger er hodepine og forbigående hukommelsesproblemer, men hvorvidt det forekommer langtidshukommelseproblemer debatteres fortsatt. Forskjell i behandlingsmåte kan skyldes noen av disse bivirkningene.

Denne avhandlingen dreier seg om ECT og inkluderer bl.a. kartlegging av dens bruk, demografiske data, diagnoser, effekt, bivirkninger, ECT praksis, samt holdninger til ECT, fortrinnsvis i Norge, men også verden over. Målet med arbeidet er å se på følgende problemstillinger: Undersøke bruk av ECT ved et sykehus i Norge over en tidsperiode på 11 år (Paper I); undersøke bruk av ECT i Norge, demografi, diagnoser/indikasjoner og

psykiaterens holdninger til ECT (Paper II); se på den praktiske gjennomføringen ved norske sykehus, samt bivirkninger og effekt (Paper III); undersøke hvordan ECT verden over (kontinent, land, regioner, byer, sykehus) brukes (fra 1990 til novemeber 2010); utbredelse, parametere og praksis ved psykiatriske institusjoner (hospitaliserte og polikliniske pasienter) (Paper IV).

**Material og metode**

Dette arbeidet inneholder 4 artikler. Den første artikkelen (Paper I) er basert på opplysninger om pasienter som var innlagt psykiatrisk avdeling ved et sykehus i perioden 1993-2003 som fikk ECT. Data ble samlet inn retrospektivt fra både ECT journal og pasientens egen journal. Det ble samlet inn opplysninger om antall pasienter behandlet, antall behandlinger per pasient, kjønn, alder og diagnoser. Artiklene to og tre handler om bruk av ECT i Norge. Studien er basert på innsamling av data om bruk av ECT i Norge ved hjelp av et spørreskjema med 40 spørsmål. Dette spørreskjemaet ble sendt ut til sykehus, distrikts psykiatriske sentre, samt barne- og ungdomspsykiatriske avdelinger. Opplysninger som ble samlet inn var: antall pasienter behandlet, kjønn, alder, diagnoser, holdninger (Paper II) og ECT praksis, bivirkninger og effekt (Paper III). I den fjerde artikkelen ble det gjort et systematisk søk ved hjelp av databaser som omhandler bruk av ECT verden over. Det ble samlet inn opplysninger fra og med 1990 til november 2010 ved hjelp av Medline, Embase, PsycINFO, SveMed and EBSCO/Cinahl. Studier som primært rapporterte bruk av ECT og dens praksis i kontinent, land, regioner, byer og sykehus ble inkludert (Paper IV).

**Resultater**

I vårt material fant vi variasjon i bruk av ECT mellom land, regioner og innad i et sykehus. I Norge var det 2.4 per 10,000 innbygger som fikk ECT med en variasjon mellom helseregionene fra 1.83 til 3.44 per 10,000 innbygger (Paper II), mens verden over var

variasjonen fra 0.11 til 5.1 per 10,000 innbygger (Paper IV). Det var dobbelt så mange kvinner enn menn som fikk ECT og depresjon var den hyppigste indikasjonen (Paper I og II). Norske psykiatere uttrykte positive holdninger til ECT (Paper II). Unilateral elektrodeplassering var hyppigst brukt, antidepressiva, litium og antipsykotika ble ofte kontinuert, og vedlikeholdsbehandling med ECT ble tilbudt (Paper III). Bivirkninger som ble rapportert var mild hodepine og forbigående hukommelsesproblemer. De fleste erfarte god effekt av ECT (Paper III). I den siste studien (Paper IV) fant vi at det var forskjell verden over i bruk av ECT. ECT uten narkose ble brukt i Asia, Afrika, Latin-Amerika, Russland, Tyrkia og Spania. Det var flest eldre kvinner med depresjon som fikk ECT i vestlige land, mens yngre menn med schizofreni i asiatiske land. Unilateral elektrodeplassering ble foretrukket i noen land (Europa og Australia/New Zealand), mens bilateral elektrodeplassering ble mest gitt verden over. Generell trend var; ofte inadekvat opplæring, internasjonale retningslinjer ble ikke fulgt, samt lite innrapportering av tall til ECT registre eller myndigheter.

**Diskusjon**

Metodologiske svakheter og styrker diskuteres, som inkluderer bruk av: retrospektiv studiedesign (avhengig av kvalitet på dokumentasjon), spørreskjema (beskriver ikke nøyaktig praksis) og systematisk oversikt (artikler fra og med 1990, manglende innrapportering, eller at gamle data er rapportert). Det ble diskutert årsaker for variasjon i bruk og praksis av ECT i Norge og verden over. En årsak kan være økonomi, annen årsak kan være holdninger blant pasienter og helsepersonell vedrørende ECT.

**Konklusjon**

Det er stor forskjell i bruk av ECT både når det gjelder antall pasienter per 10,000 innbygger, administrasjon og praksis i Norge, men også verden over, tross internasjonale aksepterte

retningslinjer. De fleste pasienter som fikk ECT var eldre kvinner og depresjon var den hyppigste indikasjonen. Det ble rapportert at de fleste pasietene i Norge hadde god effekt av ECT og erfarte få bivirkninger. Det praktiseres fortsatt ECT uten narkose i flere land. Stor variasjon i den praktiske bruken av ECT viser behov for å fortsatt dele kunnskap om og refleksjoner rundt ECT.

# 1. Introduction

This dissertation is about electroconvulsive therapy (ECT), its variations in rates of use, demographics, diagnoses, indication, practice, outcomes, adverse effects as well as attitudes, primarily in Norway but also worldwide.

## 1.1 History of convulsive therapy

Knowledge about the impact of convulsions on illness has been understood as far back as ancient Greece, where the use of the electric torpedo fish, causing convulsions, was described in classical Greek writings as a treatment for the pain of arthritis and headache (1, 2). Convulsive therapy, known to many as shock therapy, has been used to treat mental disorders since the 16th century, when Paracelsus used camphor by mouth to induce seizures to treat severe mental illness (3). In 1774 Auenbrugger used camphor to the point of convulsions to treat "mania vivorum" (4). In 1785 an account appeared in the London Medical Journal of camphor-induced seizures for the treatment of mania (5), and further reports have been found of this treatment in Europe and Russia from the middle of the 18th to the middle of the 19th century. Convulsive treatment seemed to have been forgotten for nearly a hundred years. In this period, until the early 1920s, little could be offered to those with severe mental illness except for different sleep-inducing therapies and calming medications, isolation, fresh air and light (sun) therapy, work therapy, and sudden "shock" such as cold therapy and cold and hot water baths.

Between 1917 and 1938 four physical treatments were developed for the induction of marked physiological "shock" to treat mental disorders (6):

In 1917 Julius Wagner-Jauregg injected malaria infected blood to treat patients with tertiary syphilis, resulting in therapeutic fever cramps (7). He received the Nobel Prize in medicine in 1927 for this malaria-induced fever therapy (8).

In 1933 Manfred Sakel injected insulin to induce hypoglycaemic coma as a treatment for patients with schizophrenia (9). Occasionally unintentional convulsions occurred.

In 1934 Ladislas von Meduna successfully treated patients with catatonia and other forms of severe mental illness and denoted schizophrenia with chemical convulsion therapy by injecting camphor and later Cardiazol (pentylenetetrazol) (10).

In 1938 the first patient treated with electroconvulsive therapy (ECT) was reported (11).

## 1.2 History of electroconvulsive therapy

ECT was first developed by Ugo Cerletti and Lucio Bini in Rome, Italy, in 1938 (12) . They experimented in the 1930s by administering electric current to dogs between one electrode in the mouth and one in the anus, but half of the dogs died. The idea of placing electrodes to the head was conceived after visiting slaughterhouse where pigs received electroshock to induce coma before they were slaughtered (13). The first human patient to receive ECT was a 39-year-old man from Milan who was found wandering the streets of Rome in a psychotic state. He received 11 treatments with great success (12). ECT soon replaced chemical convulsion therapy and spread rapidly from Europe to other continents, including the United States, due to the displacement of psychiatrists during the Second World War (11). ECT was easier to control, was cheaper, had fewer side effects and was more convenient than the pharmaco-convulsive treatments. ECT became a first-line treatment for schizophrenia and affective

disorders (14, 15). Cerletti and Bini were nominated for a Nobel Prize in 1950 (www.nobelprize.org), but did not receive it.

ECT first came to Norway in 1942 at Neevengården and Valen hospital and soon spread to other psychiatric clinics (16). ECT was at this time a standard treatment for depressive disorders (17), and in the years from 1944 to 1947 about half of inpatients received ECT (18).

ECT was originally used in the treatment of schizophrenia. In 1940 Cerletti reported that ECT was even more effective for patients with mood disorder, of whom 90 % recovered (19). Initially, ECT was performed without anaesthesia and muscle relaxants (unmodified ECT), with the risks of adverse effects including bone fractures, tendon and muscle injuries. Unmodified ECT was given as late as the 1970s in Norway, but is now considered unacceptable (20). After introduction of psychoactive drugs in the 1960s for the treatment of depression, mania and schizophrenia, the use of and attitudes toward ECT radically changed (21, 22). Many came to believe that ECT was a barbarous and outdated treatment which should be discontinued, and the use of ECT declined in the 1970s (21). In the 70s there was a strong movement against institutionalized psychiatry, the antipsychiatry movement, which denounced ECT together with psychosurgery (23). However, psychotropic drugs were not as effective as expected, and for patients with medication resistant severe depression ECT was still found to be effective (24, 25).

## 1.3 Electroconvulsive therapy today

The intervention of ECT, per se, that is, the application of electrical current to the scalp to induce a generalized cerebral seizure for the purpose of alleviating psychotic and depressive symptoms, is still much the same today as it was in the beginning. Modifications of Cerletti and Bini`s original bitemporal electrode placement and constant 120 Volt sine-wave electrical current (12) included the development of brief-pulse constant current devices and unilateral (UL) placement of electrodes. The use of sine wave constant voltage is declared unjustified due to the reported trade-off effect between effectiveness and memory impairment (26). In the attempt to reduce cognitive side effects, many countries (Scandinavia, Australia and New Zealand) adhere to unilateral electrode placement as first choice, but also practice switching to bitemporal placement when the clinical response is judged as too poor (27).

ECT is often administered in a course or series of around 8 to 12 treatments, either 2 or 3 times weekly.

ECT is most effective in severe depression and catatonia, and is used when medication and other therapies have not been effective, cannot be tolerated, or will not help the patient quickly enough. The main indication has transformed during the years from first-line treatment of severe depression to last-resort treatment for pharmacotherapy-resistant depression, and for some patients who prefer ECT. However, ECT is still a first-line treatment for very severe life threatening clinical conditions (28, 29), and the American Psychiatric Association (APA) 2001 guidelines state that ECT should not be reserved for use only as a last resort (26).

## 1.4 Prevalence/rates of use

Literature on the usage of ECT during the last decade is available from many countries (30-36). There are large variations in practice and rates between countries and between regions within a country, despite internationally accepted guidelines (37, 38). The reasons for such variations seem to be differences in economy, health policy, and knowledge and attitudes about ECT among patients and health personnel (38-40).

Worldwide, it has been estimated that about one million patients receive ECT annually (29). ECT seems to have become a widely available treatment for mental disorders on all continents. In a recent textbook (41) ECT practice is described from USA/Canada and Latin America (42, 43), Western Europe (44, 45), Russia (46), Africa and Asia (47). Even so, empirical evidence about worldwide contemporary frequency rates, prevalence and practice has been scant. The 2009 study by Van Waarde et al. from the Netherlands includes data from nine other countries (48). A 2009 review by Gazdag et al. of ECT utilization in the past 10 years includes thirteen studies (34). These studies give the impression of an overall paucity of ECT utilization surveys.

Among the Scandinavian countries ECT has been used more seldom in Norway than in Denmark and Sweden (49). Data on ECT use in Norway have been limited, and the Norwegian Ministry of Health and Social Affairs has no statistics on its rate of use. There have been three earlier studies on ECT in Norway (20, 30, 50). The overall practice of ECT in Norway has not been investigated since the study by Volden and Götestam in 1978 (20). They reported an ECT rate of 0.98 patients per 10,000 populations per year, and that 2.8% of inpatients received ECT. Moksnes et al. studied the rate and characteristics of ECT practice in the Ullevål sector of Oslo during the years 1988-2002 (30). They found that the rate had

gradually increased in the Ullevål sector, more like that of Denmark and Sweden, because of a simultaneous decrease in these countries (30, 33). At the present time there are no formal training programs or supervision standards for ECT in Norway. There are no national guidelines for its use. However, the physicians who specialize in psychiatry are required to have knowledge about ECT, and existing internationally accepted guidelines are likely used.

## 1.5 Mechanism of action of ECT

The clinical practice of ECT is well established, although the complete mechanism of action is not known. ECT is used because it works. The therapeutic effect is coupled with the induction of a generalized cerebral seizure, i.e., repeated and synchronous firing of neurons in most of the brain for a period of at least 30 seconds. This is usually followed by a period of coma and disorientation, from which the patient only gradually recover (51), usually within 10 to 50 minutes (52). Possible mechanisms of the action of ECT have been extensively studied, and no reasonable signs of brain damage have been found (53-57). A lot of effects on neurotransmitters and receptors have been found, resembling those of antidepressants. Most interesting is that ECT increases dopaminergic function much more than any other antidepressant treatment (58, 59).

The mechanism of action research focus today is mostly on ECT`s potential effects on brain neuroplasticity and chemical substances influencing this. ECT has been found to increase neurogenesis, angiogenesis, dendrite arborisation and synaptic proliferation in the hippocampus and frontal cortex, and thus counteracts effects that can be induced by depression in animal models (60). In humans these changes are related to increased hippocampus volume after ECT found on Magnetic resonance imaging (MRI) (61) and normalisation of a low choline signal on Magnetic resonance spectroscopic imaging (MRSI)

(55). These changes may be induced by increases in growth factors like Brain Derived Nerve Factor (BDNF), peptides like neuropeptide Y and other substances like nitrogen oxide (62). At the same time, down regulation of an often hyperactive hypothalamus-pituitary-adrenal axis may be important (63-65).

## 1.6 Indications and efficacy

ECT was first introduced for patients with schizophrenia. At that time psychotic affective disorders, especially those of bipolar type, were often diagnosed as schizophrenia. As early as 1941, ECT was also reported to be highly effective in the treatment of typical mood disorders (19).

The main indications for clinical use of ECT today are severe major depressive disorders, especially delusional depression and catatonia, but ECT is also effective in patients with mania, mixed states, some forms of schizophrenia, other psychoses, neuroleptic malignant syndrome, and Parkinson's disease (3, 26). In the early years, ECT was also attempted for use in the treatment of alcoholism, drug addiction, phobias, and even for homosexuality, which contributed to the stigma of ECT. ECT use today is more stringent on the basis of empirical evidence. A study from the USA in 1994-95 showed that 86.5 % of the indications were evidence based (66). Sienaert has recently published a review on ECT and its relevance for the practicing psychiatrist, describing indications as well as impediments and risks (67).

### 1.6.1 Depression

The most common indication for ECT is severe depressive disorder. Generally, ECT is regarded as a second line treatment. However, in severe depression it is also a first-line option, especially when psychotic features, high suicidal risk, catatonic stupor, inanition, and

severe vegetative dysregulation are present (26, 68, 69). Moreover, ECT is often preferred when a rapid response is needed because it has shorter response latency than antidepressants (26, 70, 71). Relative indications for ECT as a first-line choice also include prior good response as well as the patient's own request (26), as discussed in the editorial by Beale and Kellner with title "ECT in treatment algorithms: no need to save the best for last" (72). Goodwin and Jamison (2007) also emphasize the importance of timing, and state: "It is unfortunate that ECT is often relegated to last-resort status in treatment guidelines and protocols. We believe the clinician should not hesitate to recommend ECT to severely ill patients as a first-line treatment. For the delusional and suicidal patient – indeed, for any depressed patient who is so ill that only the most reliable and rapidly effective treatments should be considered – ECT is the clearly superior alternative. ECT should also be offered to patients with treatment-resistant depression who have a history of adverse reaction (increased cycling, induced mania or agitation) whenever their symptoms threaten to become chronic or begin to have a significant negative impact on family or on occupational or academic functioning" (69).

Response (partial reduction in symptoms after treatment) and remission (few or no symptoms after treatment) rates depend on the degree of treatment resistance to pharmacotherapy before ECT. Thus, the response rates are 80-90 % in patients who receive ECT as a first treatment and have not received antidepressants during the depression (26). Remission rates are also high in such patients, 60 to 90 % (71, 73-75). In resistant depression acute response rate to ECT is 60 to 90 %, but the remission rate is down towards 30 % (76-80).

Patients with psychotic depression have higher response and remission rates than nonpsychotic patients (81). In one study the response rate was 92 % in patients with delusional depression, compared with 55 % in patients without delusions (76). In another

study remission rates after bitemporal ECT in psychotic (n=77) and nonpsychotic (n=176) major depression were 95 % and 83 %, respectively (71). ECT is effective in bipolar as well as unipolar depression (74, 75, 82, 83). In one study remission rates were 65.3 %, 56.7 % and 70.5% in bipolar I, bipolar II and unipolar depression, respectively (84).

ECT has been found to be significantly more efficacious than placebo and antidepressants in the treatment of unipolar depression (27, 85). However, only one study has compared ECT to a combination of drugs in acute depression. Dinan and Barry (1989) compared bilateral ECT twice weekly to lithium augmentation in 30 severely depressed tricyclic nonresponders. Ten patients were improved within two weeks in both groups, but lithium augmentation worked faster than ECT (86).

### 1.6.2 Catatonia

The first patients to be treated with chemical convulsive therapy by Meduna in 1934 had severe catatonia (87). Catatonia is also highly responsive to ECT, with either bilateral or high dose right unilateral electrode placement (88, 89). However, as time passed, schizophrenia was not regarded as a primary indication for ECT in Western countries. Since catatonia was partly linked to the diagnosis of schizophrenia, catatonia was often not recognized as an indication for ECT. In order to bring catatonia to the forefront, it has received its own chapter and code numbers in DSM-5 (90).

### 1.6.3 Mania

ECT is highly effective in patients with acute mania (91-93). One review found an 80 % improvement rate overall and 60 % in drug-resistant patients (91). Licht claimed in 1998 (94) that “ECT is the most powerful antimanic treatment known today (95). ECT is generally used only when patients are intolerant or refractory to pharmacological treatment (26) .

However, in severe cases, ECT may be the first choice, as in delirious mania: “ECT is regarded as the definitive treatment for delirious mania, particularly in its malignant form” (96). In a Brazilian sample, psychotic features, violent behaviour and chronicity (previous admissions, duration of disease) predicted the choice of ECT in mania, and ECT reduced the risk of readmission (97). With optimal dosing, right unilateral (d’Elia) and bifrontal ECT are as effective as bitemporal ECT (98-102).

### 1.6.4 Schizophrenia

Literature suggests that ECT is effective in patients with schizophrenia with acute onset of psychoses, with short episode duration and with positive or affective symptoms (26, 103-105). However, there is no sharp border between schizophrenia and psychotic affective disorders, and the choice of diagnosis may depend on the diagnostician’s preferences. To cite Abrams (3): “There is little doubt that many patients diagnosed as having acute or schizo-affective schizophrenia respond remarkably well to ECT … there is also little doubt that most of these patients are misdiagnosed manics”. In middle-aged and elderly patients with intractable catatonic schizophrenia the short-term efficacy of ECT was excellent, but the relapse rate was high (103).

There is some evidence that ECT combined with antipsychotic drugs provides acute benefit to medication-resistant schizophrenic patients (106-108). The combination of ECT and neuroleptic therapy is found to be effective in preventing relapse (109). Adjunctive ECT can be efficacious in clozapine nonresponders suffering from schizophrenia (110).

### 1.6.5 Other psychoses

In 1899 Kraepelin tried to dichotomize psychoses into dementia praecox (later schizophrenia) and manic-depressive illness. Later, definitions of psychoses in between these

two groups have proliferated (111). In ICD-10 they are rubricated under "schizoaffective disorder" and "acute and transient psychotic disorders." The latter includes polymorphic psychoses, which correspond to cycloid syndromes, according to Ottosson (112). He writes in his Swedish textbook that it is a rather unanimous clinical experience that ECT is superior to psychotropic drugs for cycloid syndromes with confusional or depressive elements. Dramatic response is often seen after 3-4 treatments, but additional treatments may be necessary for consolidation (112). Case reports support the now long-term clinical experience (113, 114). Postpartum psychoses typically present as polymorphic syndromes, and early ECT is strongly recommended (115-117). However, the confusing nomenclature has made controlled studies difficult to perform. In the DSM system, cycloid or polymorphic psychosis does not even exist, but mostly corresponds to schizophreniform psychosis and brief psychotic disorder. Moreover, these psychoses bear resemblance to psychotic bipolar mixed states and delirious mania, both strong indications for ECT (96, 118).

### 1.6.6 Neurological disorders

ECT improves psychiatric disorders in patients with Parkinson's disease (PD) to the same extent as in other patients. In addition, ECT improves parkinsonian motor dysfunction in 50-60 %, regardless of the presence or absence of psychiatric comorbidity (119-121). The improvement usually lasts only 2-3 weeks (122). However, maintenance ECT for up to four years has been reported with good response in a few patients (123). "It is unfortunate that ECT has never gained favour with neurologists in the treatment of PD. In fact, the treatment is not even mentioned in any current treatment guidelines or exhaustive reviews on the subject," write Popeo and Kellner (124). ECT has also been reported effective in drug-induced Parkinsonism, tardive dyskinesia and dystonia (125).

Moreover, ECT is effective in neuroleptic malignant syndrome and toxic serotonin syndrome, viewed as malignant catatonia, and also when benzodiazepines have failed (88, 105, 126).

ECT has antiepileptic properties both in human beings and experimental animals by inducing endogenous production of an antiepileptic opioid (127). ECT has been used in refractory status epilepticus. In 80 % of reported cases cessation of status epilepticus was obtained, and in 27 % complete recovery was achieved (128).

### 1.6.7 Predictors of efficacy

Predictors for good outcomes with ECT have been reported to include factors such as severity and type of disorder, chronicity, medication resistance, medical and psychiatric comorbidity, use of medication, as well as electrode placement and stimulus dose (129).

Patients with depression respond better to ECT than patients with other disorders. As detailed in 1.6.1, patients with psychotic depression respond better than those without psychosis (81), and medication resistance predicts reduced response rate (77, 130). However, the latter has not been found in all studies (79, 131, 132). Dombrovski et al. found lower rates of remission in patients with major depression to be associated with chronicity and medication resistance, but not with age or burden of physical illness (133). Longer episode duration, comorbid personality disorder, and schizoaffective disorder were associated with poorer outcome in a study by Prudic et al. (134). Comorbid psychiatric conditions as predictors of poorer outcomes have also been found in other studies (135). Debattista and Mueller (136) found that depressed patients with a personality disorder, particularly borderline personality disorder, may have a poorer outcome on some measures. However,

the available data suggests that depression in these patients can be effectively treated with ECT (136).

The degree of response to the first few treatment sessions, especially the first one, predicts the final response as long as the electrical dose is sufficient (129, 137, 138).

## 1.7 Special populations

### 1.7.1 Older age and medical/neurological comorbidity

Previous literature indicates a predominance of elderly women with affective disorder receive ECT in Western countries (30, 139-141). Several studies suggest that ECT is both effective and safe for the elderly (142-145), and elderly with depression are more likely to have had ECT than younger patients (146, 147). Older patients (147) and those who are more severely ill (129) are also more likely to benefit from ECT than from other treatments.

In some patients with medical or neurological comorbidity, ECT may be a treatment of choice due to fewer side effects and speed of onset. A recent review recommends ECT for depression in Parkinson's disease, dementia and cerebrovascular disease, as well as for refractory behavioural symptoms in dementia (148), although randomised evidence does not exist (143).

### 1.7.2 Children and adolecents

Data on the use of ECT for children and adolescents is scarce. Existing literature in this field suggests that ECT is also effective in this group for treating depression, mania and schizophrenia (149). ECT for children and adolescents should be considered when symptoms

are severe; including life-threatening symptoms, medication resistant conditions (150), and in patients intolerant to other treatments (26, 151, 152).

### 1.7.3 Mental retardation and autism

Several case reports and series have demonstrated that ECT is effective for affective disorders and particularly catatonia, including agitation and self-destructive behaviour, in patients with mental retardation and autism. This is important because ECT-responsive symptoms may often be thought of as merely behavioural disorders due to the organic brain disorder (153-155).

### 1.7.4 Pregnancy and post-partum period

ECT is also regarded as an effective treatment for severe mental illness during pregnancy and the postpartum period, notably psychotic depression, psychotic mania and mixed states and polymorphic psychosis (115, 156, 157). Consideration of risks and benefits of ECT compared to other treatment must be taken into account, including the risk involved for the foetus/unborn child (158). In the postpartum period ECT can induce rapid remission and facilitate continuing breast feeding.

## 1.8 ECT and medication

Antidepressants (AD) and antipsychotics are usually continued during ECT (26, 159).

### 1.8.1 Antidepressants

Current guidelines regarding concomitant use of AD during ECT vary in recommendations (26, 160, 161). According to the APA ECT guidelines, concurrent use of AD medication and ECT should be considered particularly for patients with medication resistance (26). Lauritzen et al. suggested that concomitant antidepressant medication, in this case adding imipramine to ECT, resulted in superior efficacy compared to adding paroxetine; however, during continuation-ECT (C-ECT) relapse rates were reduced in patients receiving paroxetine relative to imipramine or placebo (162). Baghai et al. also found a significant enhancement of therapeutic effectiveness in concomitant medication during ECT; in their retrospective study patients received several classes of AD (163). In a prospective, randomized, placebo-controlled study, patients with major depressive disorder referred to ECT (n=319) were randomized to concomitant nortriptyline, venlafaxine or placebo (164). The remission rates exceeded placebo by 14.5 % and 12.5 % with mean doses of 67 mg nortriptyline and 187 mg venlafaxine, respectively. This was statistically significant for nortriptyline. Relative to placebo, nortriptyline reduced the cognitive side effects of ECT, whereas venlafaxine tended to worsen them. The noradrenergic effect of the optimal dose of nortriptyline may have accounted for this, while the dose of venlafaxine was suboptimal. At the end of the ECT series, the placebo group was randomized to nortriptyline or venlafaxine, and lithium was added in all groups. Starting the antidepressant medication at the beginning versus the end of the ECT-series had no impact on post-ECT relapse, which was comparable for nortriptyline plus lithium and venlafaxine plus lithium. However, another study did not find advantage for concurrent antidepressant treatment (165).

### 1.8.2 Antipsychotics

There are many studies supporting the use of concurrent antipsychotics and ECT. A recent Cochrane review found ECT, including continuation/maintenance-ECT, added to antipsychotics to be superior to antipsychotics alone in schizophrenia (106). The combination was particularly useful when rapid improvement was desired. The review also concluded that "even though this initial beneficial effect may not last beyond the short term, there is no clear evidence to refute its use for people with schizophrenia." An open review of eleven Indian studies (n=651) and a meta-analysis of four Indian controlled trials (n=113) indicated a main benefit of the combination in the first few weeks of treatment of schizophrenia due to an acceleration of treatment response (107) . In a retrospective study of patients with either depression (75.4 %) or schizophrenia/schizoaffective disorder (19.9%) the combination of ECT and atypical antipsychotics was significantly more effective than ECT and typical antipsychotics and ECT without antipsychotics (166). Some authors have given preference to clozapine in combination with ECT to patients who have not responded to clozapine alone (110, 167).

### 1.8.3 Lithium

Guidelines recommend lithium for prevention of relapse after successful ECT, but during ECT it should be considered only after a risk/benefit analysis, due to possible neurotoxic effects in combination with ECT (26, 168, 169). However, studies have also found this combination to be safe (170, 171). If lithium is continued during ECT, Sackeim has recommended not giving lithium the day before each ECT session (172).

### 1.8.4 Anticonvulsants

Anticonvulsant prescribed for mood disorders should be discontinued before ECT, because they may increase seizure threshold and shorten seizure length (26). However, a review of Sienaert et al. found that ECT most often can be safely and effectively administered to patients treated with various anticonvulsants, but there was no evidence to combine the two treatment modalities to augment therapeutic efficacy (173, 174).

### 1.8.5 Benzodiazepines

The use of benzodiazepines during ECT may shorten seizure duration and compromise the response (175-178). However, in one study 22.5 mg oxazepam at night did not shorten seizure duration (179).

## 1.9 Relapse rates and relapse prevention

Relapse rates following ECT are high (180, 181). Relapse is "the exacerbation of an ongoing episode after an initial suppression of symptoms" (182). Without prophylactic treatment 80-90 % of patients relapse within six months after ECT (183). Continuation therapy might be necessary (184, 185). Continuation therapy is the treatment that occurs during the months immediately after resolution of an acute episode of illness with the primary purpose of preventing relapse (182). Patients that were medication-resistant before ECT, female patients, and those with more severe residual depressive symptoms following ECT had more rapid relapse (183).

### 1.9.1 Continuation pharmacotherapy (C-Pharm)

The most common practice after successful treatment with ECT is to continue with medication to prevent relapse (26). Earlier studies on the use of concomitant AD in combination with ECT found that combining ECT with AD resulted in more likely remission, and that treatment with Tricyclic antidepressants (TCA) or Monoamine Oxidase Inhibitor (MAOI) reduced post- ECT relapse within six months (relapse rate with TCA - 20%, relapse rate with controls - 50%) (186, 187). However, later studies document higher relapse rate with C-Pharm. In a community setting, relapse rate during 24-week follow-up was 64.3%, and the median time to relapse was 8.6 weeks (134). Comorbid substance dependence and treatment with benzodiazepines or antipsychotics during the follow-up period were associated with increased risk of relapse/recurrence (188). Sackeim et al. randomized 84 patients with major depressive disorder in remission after ECT to placebo, continuation nortriptyline or continuation nortriptyline plus lithium for 24 weeks; relapse rates were 84 %, 60 % and 39 %, respectively (183). Kellner et al. randomly assigned patients in remission after ECT to continuation ECT (N=75) or continuation nortriptyline plus lithium (N=74) for 24 weeks (184). Relapse rates were 37 % in both groups. Thus, the relapse rates with the combination of nortriptyline and lithium in the two studies were comparable, 39 % and 37 % in 24 weeks, respectively (183, 184). In another study where patients received treatment "care as usual" after responding to ECT administered in a controlled trial, 51% relapsed within six months after ECT. All but one "usual care" patient received some form of C-Pharm post-ECT, one received Continuation- ECT (C-ECT) alone (189).

### 1.9.2 Continuation ECT (C-ECT)

C-ECT is ECT given immediately after an ECT series to prevent relapse of the episode and it lasts up to six months, whereas maintenance ECT (M-ECT) is a course that begins after the end of C-ECT and is intended to prevent recurrence of a new episode. C-ECT and M-ECT should be considered in patients who have responded to ECT if pharmacotherapy alone has not been effective in the prevention of relapse, if pharmacotherapy cannot be safely administered, or if the patient prefers treatment with ECT (190). Goodwin and Jamison write that "maintenance ECT is considered an appropriate choice for patients who consistently relapse when attempts are made to stop ECT and do not maintain remission with medications. This has been incorporated into some of the international guidelines …" (69).

Combining C-ECT and C-pharm may be more effective in relapse prevention after a successful treatment with ECT than pharmacotherapy alone. A two-year randomized study about continuation/maintenance treatment with nortriptyline (CM-NT) versus combined nortriptyline and ECT in late-life psychotic depression found a relapse rate of 11.8 % with CM-NT and a relapse rate of 5.9 % with C-ECT and NT (191). Another study found the cumulative probability of surviving (by using the Kaplan-Meyer surviving curves) without relapse or recurrence at two years to be 93 % for C-ECT and medication, and 52 % for medication alone (192).

Prospective studies have failed to show higher efficacy for a fixed-schedule C-ECT as monotherapy than pharmacotherapy for relapse prevention after a successful treatment with ECT. Individualized intervals between ECT sessions instead of a fixed schedule and concomitant medication may reduce relapse rate and morbidity compared with standard procedures with abruptly terminated ECT after remission of symptoms (193).

C-ECT has been used for patients with bipolar disorder or schizophrenia as well (109, 194). There are no guidelines about the duration of C-ECT, but one study suggests that it should be open-ended (93).

## 1.10 Adverse effects

As with other medical interventions, there is a risk of adverse effects. The most common adverse effects of ECT are somatic complaints such as headache, transient cardiovascular complications such as transient heart rhythm abnormalities, transient elevation in heart rate or blood pressure and neuropsychiatric adverse effects such as cognitive changes. Adverse effects are associated with general anaesthesia, convulsions/seizure and concomitant use of medication during ECT and other aspects. Adverse effects can be reduced by pre-ECT evaluation and use of modified ECT technique. The most common adverse effects of ECT are usually temporary and well tolerated.

### 1.10.1 Mortality

Among more than 8,000 patients who received 49,048 ECT treatments in Texas between 1993 and 1998, only one death could be linked to the associated anaesthesia. An additional four deaths might possibly have been associated with the anaesthesia, for which the calculated mortality rate is 2-10 per 100,000 treatments. No deaths were linked to the ECT stimulus or seizure (195). Among 2,279 patients given 17,394 ECT treatments in Minnesota during the period 1988-2001 there were no deaths during or immediately after ECT (196). The mortality rate in elderly patients during an ECT series is estimated to be far below that of elderly community residents in the general population during a six week period (3).

### 1.10.2 Somatic adverse effects

Cardiovascular complications are the main potentially serious medical complication of ECT. Transient cardiac arrhythmias are common, especially in patients above 50 years of age. However, even in older age and in patients with cardiac disease, serious events "virtually never occur during the procedure" (3) as long as cardiac function is stable before ECT. Common side effects are headache, nausea and muscle pain, which usually lasts several hours, sometimes longer (67). Post-ECT headache occurs in up to 48 % of patients, but can be treated with analgesics prophylactically (197, 198), whereas antiemetic medication can reduce nausea. Tooth injuries can occur despite use of bite block.

### 1.10.3 Neuropsychiatric side effects

An effective ECT seizure is succeeded by a comatose stage from which consciousness and orientation are gradually regained (51), usually within 10 to 50 minutes (52). Disorientation is shortest for person, longer for place, and longest for time (199), which is displaced backward in years from the correct response (200). After a single seizure this may resolve fairly rapidly. However, during an ECT course, recovery from one seizure may be incomplete before the next, so that the effects accumulate (26, 201). Retention of memories is impaired for the treatment period and close to it. A temporal gradient appears, i.e., memory increasingly improves distant to the treatment period (Ribot's law) up to some weeks or possibly a few months. However, the view that events occurring closest to ECT are most disrupted is controversial, because such memory problems may represent a partial consequence of depression before treatment (202). Anyway, significant improvements take place over the weeks and months after ECT. There is no lasting impairment of executive function and learning capacity, which is often improved (3, 26, 202-204).

The degree of cognitive deficits depends on both treatment and patient factors (201, 203, 205-207). In general, it increases with seizure duration, number and frequency of treatments in a series, and dosage of anaesthetic agents. Pulse current requires less energy than sine wave current to elicit a seizure and therefore gives less cognitive disturbance. For the same reason, ultrabrief (≤0.3 ms) pulse stimulation may possibly give less disturbance than brief (0.5-1,5 ms) pulse stimulation (208). Cognitive disturbance is less pronounced with unilateral and probably bifrontal than with bitemporal electrode placement. Women show more deficits than men, probably due to lower seizure threshold. High age, low premorbid intellectual function and brain disease are associated with greater cognitive deficits. However, in such patients ECT often results in improved global cognitive status as a function of symptomatic response when the transient deficit wanes (26). In the elderly, postictal confusion can take several days or even weeks to resolve. Nevertheless, the global results of ECT are at least as good as in younger patients (26, 209). In general, poor symptomatic outcome of ECT is also associated with greater cognitive deficits, due to the combination of cognitive impairment of persistent depression and ECT (210).

#### *1.10.3.1.Objective cognitive change*

The extent and duration of objective cognitive change associated with ECT in depressed patients were recently meta-analysed by Semkovska & McLoughlin (211). Twenty-four cognitive variables from 84 studies with 2,981 patients were included. However, no standardized retrograde amnesia tests were identified. Abnormalities in other functions were mainly limited to the first three days after the treatment series, when significant decreases with effect sizes from – 1.10 to – 0.21 were observed in 72% of variables. Delayed recall was more affected than immediate recall, episodic verbal more than episodic visual memory, unstructured more than organized and contextualized information. Four to 15 days after ECT, all but one variable were normalized or improved, the one exception only present in

patients having received sine-wave ECT. After 15 days no negative effect sizes were observed, and 57% of variables showed small to medium size improvement beyond baseline, including processing speed, working memory, anterograde memory, and some aspects of executive function. As regards retrograde amnesia, the general view is that personal autobiographical memory is more affected than impersonal memory (202). On the other hand, Lisanby et al. found that impersonal public events are more affected than personal events (212). However, Abrams (3) pointed out that this was based on non significant trends, and that the data only showed that, two months after ECT, neither personal nor public memory performance differed significantly from pre-ECT baseline, regardless of stimulus dose or electrode placement.

In a second meta-analysis of 39 studies with 1,415 patients, Semkovska et al. (203) found that, up to three days after final treatment, unilateral ECT was associated with significantly smaller decreases in global cognition, delayed verbal memory retrieval, and autobiographical memory, compared to bitemporal ECT. In unilateral ECT, higher electrical dosage predicted larger decreases. However, more than three days after the ECT series, no significant differences remained between the two electrode placements, and electrical dosage no longer predicted cognitive performance in unilateral ECT. Cognitive functioning improved with increasing time after final treatment, this interval being a more useful predictor of cognitive function than electrode placement and electrical dosage.

All but two studies included by Semkovska et al. (203) that measured retrograde amnesia for information learned shortly before ECT or for autobiographic memory presented results in percentage recalled from a baseline of 100% for everybody. This excluded true effect sizes to be generated (203). The reported range of percentage loss in consistency of recalled memory a few weeks or months after ECT was found to be 25-40%, nearly the same as the

28-40% reported in the healthy population after a similar interval (203, 213, 214). The two studies that quantified retrograde autobiographical amnesia so that effect sizes could be calculated, demonstrated improvement in autobiographical memory at follow-up after unilateral ECT (215, 216).

Only one randomized study comparing long-term consistency loss of retrograde autobiographical memory after right unilateral and bitemporal ECT has used depressed patients not receiving ECT as a control group (217). At six-month follow-up patients treated with either brief pulse (n=8) or sine wave (n=9) unilateral ECT were comparable to controls, with about 20% consistency loss. Patients treated with bilateral ECT had significantly higher loss, 30% with brief pulse stimulus (n=9) and 38% with sine wave stimulus (n=11). However, Abrams (3) pointed out that these results cannot be considered definitive because of insufficient publication of details and lack of peer-review process, and that subsequent investigators had not been able to confirm the results. No study up to the year 2000 had detected persistence of memory deficits with brief pulse ECT even as early as 1-2 months post-treatment (3).

However, in 2007 Sackeim et al. (210) published the largest (n=347) prospective observational study on cognitive effects of ECT, this being consistent with the results of Weiner et al. (217). At six-month follow-up, there was improvement relative to baseline on all tasks, including autobiographic memory, after pulse right unilateral ECT. After bitemporal ECT most tasks were improved or unchanged, except autobiographic memory was reduced. With sine-wave bitemporal ECT, one measure of reaction time was also reduced. Retrograde amnesia increased linearly with the number of bitemporal treatments, but was unrelated to the number of unilateral and bifrontal ECT. However, patients were not randomized. Therefore, patients with more severe depression may preferentially have been

prescribed bitemporal ECT and required a larger number of treatments (202). Moreover, at six-month follow-up 53% of the main cognitive outcome data were missing (203, 210).

### *1.10.3.2. Subjective cognitive change*

Reports of subjective cognitive complaints after ECT appeared from the early 1940s (218). In 1975 Squire and Chace compared 38 patients who had received bilateral ECT, right unilateral ECT, or hospitalization without ECT six to nine months previously (219). Six objective memory tests revealed no memory impairment after ECT. Nevertheless, the group that received bilateral ECT reported subjective memory impairment significantly more often than the two other groups. Squire and Chace hypothesized that the marked memory impairment initially associated with bilateral ECT may cause some individuals to become more alert to subsequent memory failures and then to underestimate their memory abilities. Alternatively, occasional failures of recall that are not detected by objective tests may persist after ECT.

Patient self-assessment of memory after ECT was reviewed in 2000 by Prudic, Peyser and Sackeim (218). They found that older studies reported bilateral ECT resulted in increased subjective memory complaints. However, studies after about 1980, when brief pulse ECT became more prevalent, showed little effect of electrode placement and general improvement in subjective memory evaluations within a few days after ECT. Subjective memory assessment was poorly related to objective findings, but strongly influenced by mood state, as recently confirmed in a cohort study of aircraft maintenance personnel (220).

In a 2003 review of patient perspectives, Rose et al. (28) came to the opposite conclusion of Prudic, Peyser and Sackeim (218). Based on seven studies, they found that at least one third of patients reported persistent memory loss after ECT, mostly concerning bilateral ECT,

However, the study of Rose et al. was re-evaluated by Bergsholm (221), who found it severely flawed, making their results inconclusive and misleading. For example, one study evaluating memory problems within 48 hours of an ECT series was included as representing persistent memory loss; one study had only 37% valid responses, and two studies, probably overlapping, selected patients from advocacy network groups and was likely biased against ECT.

The latest review reported patient knowledge, experience and attitudes toward ECT from 75 studies (222). A vast majority perceived ECT to be helpful and had positive views regarding the treatment, whereas a sizeable minority was quite critical. Thirty of the studies reported rates of subjective memory impairment from three to 100%, while autobiographical memory impairment evaluated by objective measures is relatively short term (<six months post treatment), whereas impairment evaluated by subjective accounts is more persistent (>six months post-ECT) (202). Some individuals who have received ECT report that their ability to remember old or even new material never returns to "normal" following ECT (223, 224). A small number of patients complain of severe cognitive impairment and sometimes even personality change after ECT. Such cases have not been reported in any carefully controlled follow-up studies (225). Often cited is Ann B. Donahue, who reported profound patchy memory loss that extended back at least five years after 33 ECT sessions, initially unilateral and then bilateral (226). Nevertheless, she stated that ECT saved her mental health and possibly her life, and that, if necessary, she would elect to undergo ECT again. However, people forget even important events ranging from salient changes in personal status to dietary behaviour (227). Thus, healthy air traffic controllers, 25 to 48 years of age, forgot a mean of 40 % of reported life change events after nine months. The variation was great across persons, and one fourth forgot 80% (228). Fink has suggested that the rare complaints of personal memory loss after successful ECT are best characterized as somatoform

disorders (229). This compares to attributing psychosomatic symptoms to dental amalgam fillings (230) or any somatic therapy in psychiatry (231).

The discrepancy between the objectively measured cognitive function and subjectively experienced impairment creates a need to take both perspectives into consideration (224). The complexity of cognitive function and cognitive side effects needs to be discussed with the patient on a number of occasions, and the clinician must be interested in the patient's experience (224). In the end, it is the value placed on memories versus the subjective experience of wellness that seems to determine the patient's view of the cognitive side effects (206).

#### *1.10.3.3. Prolonged seizures, tardive seizures and status epilepticus*

Prolonged seizures, i.e., seizures lasting more than 90-180 seconds in EEG, occur in 1-2% of treatments, mostly during the first treatment in young people (3, 26, 225). They should be stopped with, for example, midazolam or propofol. Tardive seizures (late return of seizure activity) during the recovery phase after a treatment, or non-convulsive status epilepticus, may be triggered by drugs (theophylline, lithium) (169, 232, 233) and pre-existing medical conditions that lower seizure threshold, such as electrolyte imbalance and previous brain damage (234). EEG is mandatory for diagnosis, and these very rare conditions must be treated as soon as possible.

#### *1.10.3.4. Mania*

The frequency of mania in bipolar disorder after treatment with ECT and antidepressants is in the same range as the natural risk of a switch from depression to mania during the recovery phase, 4-8% (225). The long-term risk of developing elevated mood in unipolar

depression is about 20%. Thus, there is also a small natural risk of mania after ECT in patients diagnosed with unipolar depression.

In the experience of Abrams (3), a maniform syndrome during ECT is favourable and an indication for observing the patient without further treatments. The majority will go on to enjoy full remission. The few who slip back into depression or remain manic can be treated with additional ECT or pharmacotherapy or both.

## 1.11 Contraindications

There are no absolute contraindications for ECT, but there are situations of increased risk that need special attention, such as patients with disorders of the central nervous system (CNS), cardiovascular and respiratory system (26), as well as pregnancy (158).

Recent myocardial infarction, unstable angina pectoris, decompensates congestive heart failure and other severe vascular diseases increase the risk of ECT treatment. Other conditions that elevate risk to ECT are increased intracranial pressure, recent cerebral infarction, severe pulmonary conditions or high anaesthesia risk in general (26). The ECT seizure itself does not seem to increase intracranial pressure, but the anaesthetic procedure may (235). Intracranial aneurysms are supposed to be a risk factor, but no complications have ever been reported (236), in spite of asymptomatic aneurysms occurring in 3-6 % of the population (237).

## 1.12 Clinical procedure of ECT

The modern practice of ECT requires up-to date equipment, high-level facilities, and highly trained medical staff including psychiatrist, anaesthetist and treatment nurse. The treatment is standardized through internationally accepted guidelines, and if modern methods are being used ECT is safe, with few side effects and good clinical outcome (3, 26, 225).

A general medical history and a physical examination including blood pressure are done for all patients before treatment (26). Symptoms should be evaluated regularly during treatment, for example by Montgomery and Åsberg Depression Rating Scale (MADRS) or three target symptoms and the Clinical Global Impression scale (CGI). Porter et al. have proposed cognitive tests for routine use during ECT, including reorientation time, which should always be measured (238). Otherwise, Weiner et al. (239) consider formal testing of memory as counterproductive because it does not catch the most bothersome memory problems. Instead, they recommend "bedside" testing of delayed recall of three items, different for each treatment, and of ability to recall life-relevant material, global self-rating, and rating by a significant other. Payne and Prudic highly recommend patients use a daily log or diary of visits and calls from family and results of meetings, and that they write down important passwords (206). As a result of cognitive side effects (memory-impairment) association with sine-wave current, it is now advised that brief-pulse wave be the standard treatment. The parameters of the stimulus can vary widely (pulse width from 0.3 to 1 ms, frequency from 20 to 120 Hz, duration of the stimulus 0.5-8 sec) and are adjusted for each patient, according to seizure threshold, clinical efficacy and side effects. Modern equipment delivers brief or ultrabrief pulse stimulation, a current of 0.8 to 0.9 Ampere (A), and has EEG, ECG and EMG. In addition, physiological monitoring during ECT, such as blood pressure and pulse oximetry, are included.

### 1.12.1 Consent

International guidelines recommend that patients consenting to ECT receive information about the treatment and that they may withdraw consent at any time. In some countries patients must give written consent before receiving ECT, whereas verbal consent is sufficient in other countries (240). The practice of consent differs between countries (240, 241).

### 1.12.2 Anesthesia

Anaesthetics are used together with succinylcholine as a muscle relaxant for ECT (modified ECT) (26). Some countries still practice unmodified ECT due to lack of equipment, lack of personnel, lack of anaesthesiologists, contraindication for anaesthesia, convenience, emergency, or for economic reasons (242, 243). Methohexital or propofol are most commonly used as anaesthetics (26).

### 1.12.3 Electrode placement

There are three main electrode placements; right unilateral (d'Èlia) (244), bilateral and bifrontal electrode placement.

The UK ECT review group found that bilateral ECT had stronger antidepressive effect than unilateral ECT, and a high stimulus dose is more efficacious than a low dose, but bilateral ECT is associated with greater temporary memory impairment than unilateral ECT (27). However, studies with low dose unilateral ECT, known to be ineffective, were included in this meta-analysis.

Right unilateral electrode placement (RUL) administered just above the seizure threshold is not as efficacious as bitemporal electrode placement (BL) ECT (77). When high-dose RUL is used, studies have found the treatment may be at least as effective as bitemporal electrode placement, but with less memory impairment (244-248). RUL is now the recommended electrode placement (26). Bilateral may sometimes be necessary when a maximum antidepressant effect is needed.

Bifrontal electrode placement has been less frequently used than the others, but is suggested to have fewer cognitive adverse effects than bitemporal (249, 250). Sienaert et al. found no significant differences between the patients given bifrontal ECT and those given unilateral ECT, although patients receiving unilateral ECT achieved response/remission-criteria after a smaller number of treatments (251). A recent review found that bifrontal ECT is not more effective than bitemporal or right unilateral ECT, but may have modest short-term benefits for specific memory domains. Bifrontal ECT has potential advantages, but given longer experience with bitemporal and right unilateral, bifrontal ECT requires better characterization (252).

### 1.12.4 Dose of electricity

The total dose of electricity is determined by amperage, pulse width, frequency of pulses and total stimulation time. There are different methods for determining the electrical charge required to induce an effective seizure. With the "stimulus titration method," one first determines seizure threshold by starting at a low level and increasing the electrical energy until the threshold is reached. Treatment is then provided with a charge well above the seizure threshold (77), generally 1.5-2.5 times the threshold in bilateral ECT, 4-8 times the threshold in right unilateral ECT (253, 254). McCall et al. (255) found in right unilateral ECT that doses 3-5 times the seizure threshold were more effective than 2.25 times, and 8-12

times more effective than 3-5 times. However, an increase in stimulus dose may also increase adverse effects.

Factors which can influence the seizure threshold are age, gender, medication and anaesthesia. Accordingly, another method of dose finding is based on the patient's age, to which the dose is adjusted (aged-based dosing). A third method is to use a fixed high dose, usually about 400 mC (256). The stimulus dose should be adjusted for gender, in that men may have up to double the seizure threshold of women (253). Moreover, the dose must sometimes be adjusted during the treatment series due to increasing threshold.

### 1.12.5 Seizure monitoring

A generalized cerebral seizure is necessary, but is not always sufficient to achieve antidepressant effect. Seizure duration of at least 25-30 seconds and a good EEG quality are usually necessary for effect, as is heart rate acceleration and a period of postictal disorientation. Therefore, seizure monitoring includes observation of motor activity, EEG, cardiovascular response and postictal disorientation time (3).

### 1.12.6 Number of treatments

The treatment is administered two to three times per week. A treatment series is usually between six and 12 treatment sessions. The CORE group (Consortium for Research in Electroconvulsive Therapy) found that an average of 7.3 sessions with ECT were necessary to obtain effect, which is consistent with the results from other studies (184, 244, 257). However, in some cases as many as 20 treatments may be necessary (26).

## 1.13 Attitudes

Despite documented efficacy, ECT still remains controversial, fiercely debated and stigma-bound. Reasons for negative attitudes among the general public, medical students, psychology students, other health workers, and even psychiatrists may be lack of knowledge, education and experience, as well as ideology (258-264). The negative impression of non-modified ECT, cognitive side effects and unfavourable descriptions in books and films (*One Flew Over the Cuckoo's Nest*) may have contributed to the negative attitudes as well. Reported experience of side effects such as memory impairment has been extensive (28). The attacks against ECT have led to stigmatization, and many psychiatric treatment facilities do not offer ECT.

# 2. The thesis

## 2.1 Aims of thesis

The aim of this dissertation is to study the practice of ECT and rates of use in Norway and worldwide.

This doctoral dissertation protocol on use of electric stimulation of the central nervous system in psychiatry covers these aspects:

1. ECT prescription rate, demographic distribution and diagnoses of the patients at a county hospital in Norway over a period of 11 years (Paper I).
2. The use of ECT, demographics and diagnoses in different psychiatric hospitals, as well as attitudes among psychiatrists in Norway (Paper II).
3. The practical use of ECT (Administration of ECT and ECT parameters), as well as side effects and outcomes in different psychiatric hospitals in Norway (Paper III).
4. The contemporary (1990 until 2011) worldwide (by continents, countries, regions, large city hospitals and/or country hospitals) use of ECT, ECT parameters (ex. electrode placement, dosage strategies) and practice, in psychiatric (both inpatient and outpatient) establishments (Paper IV).

# 3. Material and methods

## 3.1 Material

We studied patients who received ECT at a county hospital between 1993 and 2003, as well as patients in Norway receiving ECT in 2004 (Papers I-III). In paper IV a retrospective study of the scientific literature on the use of ECT worldwide was performed using databases or papers published between 1990 and November 2010.

Table1. Characteristics of papers I-IV

| Paper | I | II-III | IV |
|---|---|---|---|
| Design | Retrospective | Cross-section | Systematic review |
| Year | 1993-2003 | 2004 | 1990 to November 2010 |
| Geographical area | Ålesund, Norway | Norway | Worldwide |
| Selection | Data about ECT treatment extracted from patient journals and ECT journals | Questionnaire to psychiatric units, DPS and child and adolescent units about ECT practice and treatment | A systematic database search and data extracted from observational studies on ECT use, rates and practice |
| N | N= 210 patients<br>Women 65 % | N= 672 patients<br>Women 66 %<br>Response rate: 54 % | N= 70 included studies |

The study in Paper I was carried out at a psychiatric unit at a county hospital, Ålesund, located on the western coast of Norway, which provides health services for patients 18 years and above, with a catchment area of 122,000 inhabitants in 1993, increasing to 127,000 in 2003. Between 1993 and 2003 the mean number of annual admissions to the psychiatric unit was 491 (range, 299-822). Beginning in 1998, all acute patients from the region were admitted to the county hospital as the hospital built a new psychiatric unit (for involuntary patients). We wanted to study patients admitted to the psychiatric unit from 1993 to 2003 who received ECT as part of their hospitalization. We found 210 patients who had received ECT during this period. Of these 137 (65%) were women, and the patients had a mean age of 54 (range 20-94).

Papers II and III were based on responses from psychiatric departments that had received a questionnaire about electroconvulsive therapy. Data were collected between March and December 2005. A total of 67 (54 %) units finally responded, including 26 (67 %) of the 39 psychiatric hospitals, 32 (46 %) of the 69 district psychiatric centres (DPCs), and nine (53%) of the 17 child and adolescents units. Responses came from all health regions. ECT equipment was present and used in 19 (28 %) of the responding units. There were 672 patients who received ECT in 2004 in those 19 psychiatric units.

In Paper IV a systematic literature search was undertaken in the following databases: Medline, Embase, PsycINFO, SveMed and EBSCO/Cinahl, limited from 1990 to November 2010 (Appendix I, Table 1, Paper IV).

## 3.2 Methods

### 3.2.1 Design of studies

#### *3.2.1.1. Paper I*

Paper I is based on data collected retrospectively from dedicated ECT journals and patient medical records. These two sources of information were not independent, as the same physician recorded both, but they included different details. Medical records of six patients could not be retrieved, and for these patients information was obtained only from the ECT-journals. Information about total patients admitted to the psychiatric unit was obtained from the administration of the hospital. We chose a retrospective study design to be able to evaluate the stability of rate of use of ECT, age, gender and diagnoses of patients over a period of 11 years (Paper I).

#### *3.2.1.2. Papers II &III*

Papers II and III are based on data from a questionnaire (see appendix I). The questionnaire contained standardized, open and partly open questions regarding the use of ECT. These questions were evaluated by three psychiatrists (OML, PB, and BW). Reasons for the choice of a cross-sectional design were to examine prevalence rates, demographics, diagnoses and indications of ECT in Norway today. In addition, some supplementary questions regarding psychiatrists' attitudes regarding ECT made it possible to explore reasons for not prescribing ECT.

#### *3.2.1.3. Paper IV*

In paper IV the method for screening the literature and data extraction followed the guidelines of the "Cochrane Handbook for Systematic Reviews of Interventions", Chapter 13, concerning inclusion of non-randomized trials. Search terms intended for Medline were adapted as required for other databases. Terms used were 'electroconvulsive therapy,' 'electroshock,' 'electroconvulsive,' and 'ECT,' combined with any of the following: 'use,' 'utilization,' 'practice,' 'survey,' 'statistical data,' 'frequency,' and the search was limited to human use from 1990 until November 2010. Relevant references, known to authors of this review, published on governmental internet sites, or from published text books (Swartz 2009) or reference lists in retrieved included papers, were added by hand.

### 3.2.2 Method description

#### *3.2.2.1. Inclusion and exclusion criteria:*

**Paper I:**

*Inclusion criteria:*

All patients admitted to the psychiatric unit from 1993 to 2003 who received ECT as part of their hospitalisation were included in the analyses. All patients were 18 years or above. Some of the patients had more than one ECT series, but only the first ECT series in the period was included in the data analyses. All patients provided informed consent to ECT treatment. Six patients withdrew consent and treatment was terminated.

**Papers II and III:**

*Inclusion criteria:*

The questionnaire was sent to all Norwegian psychiatric hospitals, DPCs and child and adolescent psychiatric units (125 units in total), and concerned the use of ECT in 2004. A DPC provides specialized outpatient health service and inpatient treatment for the nearby population up to about 150,000 inhabitants, while psychiatric hospitals provide tertiary health services. The questionnaires were sent to the head of the psychiatric department of each unit. A new set of questionnaires was sent to those who had not answered within three months. Data about ECT equipment and their dispersion were based on answers to the questionnaire and from information from technical consultants with knowledge of the departments' equipment.

*Exclusion criteria:*

Departments treating patients with substance dependence, habilitation units, psychosomatic and pure psychiatric outpatient departments were not included.

**Paper IV:**

Screening of literature was done by two researches (KAL, BH) who independently checked the titles and, where available, the abstracts of the studies identified by the electronic database searches. All references appearing to meet inclusion criteria, including those with insufficient details, were requested in full text. All researchers (KAL, LJVS, BH) consisting of two pairs independently extracted data from the retrieved full text articles according to a pre-made data extraction scheme. All discrepancies were resolved by consensus meeting/discussion, and the final decision taken by the first author (KAL).

*Inclusion criteria:*

Data-based observational studies or surveys with reported ECT utilization, frequency, or prevalence rates, by data collected from 1990 and until November 2010, for patients in psychiatric establishments (inpatients or outpatients) in well-defined continents, countries, regions, cities, or local hospitals were included. Also included were relevant studies published near the date limits for this study (from 1990) for geographical areas that had few pertinent publications. English, Scandinavian (Norwegian, Swedish, Danish) and European (German, French, Spanish, Portuguese, Turkish) languages were included. In addition to the authors' European language fluency, the online Google translation tool (http://translate.google.com/) was used when needed (such as for Portuguese and Turkish).

*Exclusion criteria:*

Excluded were studies or surveys that were not data-based, had no or unclear report of ECT utilization, frequency, prevalence rate, practice, or had ill-defined populations. All reports of utilization frequency, prevalence rates of ECT in selected samples or subgroups (e.g., young/adolescent, elderly) or special populations (such as pregnancy, disability, mental retardation) and qualitative studies about clinicians' or physicians' subjective experience (views or opinions) on ECT were also excluded.

### 3.2.3 Instruments and variables

#### *3.2.3.1. Instruments*

In Papers II and III a questionnaire consisted of 40 items in three parts. Parts one and two of the questionnaire were to be filled out by all addressees and included questions about the institution, whether ECT was used or not and psychiatrists' attitudes towards ECT. The

questions about attitudes (seven items) were similar to the attitude questions from a questionnaire study about ECT in Germany (265). Part three of the questionnaire was to be filled in only by departments using ECT, and dealt with the implementation of ECT, such as practical routines, consent routines, demographics, diagnoses, side-effects and outcomes of ECT.

### *3.2.3.2. Description of variables*

**Paper I**

The following data was collected from the ECT journals and medical records: gender, age, diagnosis and number of treatments in the course. Age was later divided into groups: <25, 25-34, 35-44, 45-54, 55-65, >65 years. When analysing use of ECT per 100,000 population per year, age was divided into three age groups due to small number of patients in some groups: 20-49 years, 50-69 years and over 70 years. Diagnoses were based on ICD-10 and grouped into schizophrenia and paranoid psychosis (F20- F22), bipolar disorder (depressed, mania or mixed) (F31), major depressive disorder (F32-F34), anxiety disorder (F40-F43), puerperal mental disorder (F53) and personality disorder (F60-F61). Until 1998 patients were diagnosed using ICD 9, later with ICD 10. ICD 9 diagnoses were transformed into corresponding ICD 10 diagnoses by two psychiatrists.

**Papers II-III**

In Paper II information collected included questions about the institution, whether ECT was used or not, reasons for not prescribing ECT, referral to other facility, population base and number of inpatients. We also collected information about waiting lists, travelling distance, number of treated patients, gender, age distributions, diagnoses, indications, and attitudes. Age was divided into groups: < 18, 18-24, 25-44, 45-64, >64 years. Diagnosis information

consisted of ICD-10 categories and was grouped into schizophrenia (F20), polymorph psychosis (F23), schizoaffective disorder (F25), bipolar disorder (depression, mania, mixed episode) (F31), unipolar depression (F32-33), Parkinson's disease (G20), and other diagnosis. It was possible both to give the total number of patients in each diagnostic category and to isolate those diagnoses for which ECT was usually used. Of the 672 patients, we received diagnostic information from 319 patients in 16 of the 19 units. Indications were divided into lack of psychopharmacologic effect, patients` decision, psychotic features, refusing to eat and drink, suicide risk, catatonia, postpartum, side effects of drug treatment and other indications. It was possible both to give the total number of patients in each indication category and only indications usually used for ECT. We received information about indication in 163 patients in 10 units. Opinion and attitude questions to psychiatrists about ECT contained seven questions and could be answered with yes or no; ECT is redundant because of psychopharmacology, hospitals ought to offer ECT as a treatment option, there are clear indications for ECT, ECT is a last resort, ECT does not cause reversible memory impairment, ECT is underused, and ECT can cause brain damage.

In Paper III information collected included questions about the administration of ECT; staff (who decided whether ECT should be prescribed, who performed ECT, with or without supervision, who gave anaesthesia, and personnel present during treatment); ECT training program; and, treatment capacity per day. Information about consent routines was collected and divided into three non-exclusive categories; oral information, written information and written informed consent. Information about treatment characteristics included pre-treatment examination; anaesthetic agents used, use of hyperventilation, intubation, oropharyngial tube and tooth protection; electrode placements (right unilateral, bilateral or bifrontal), methods of deciding stimulus dose, monitoring (EEG, cuff method, observation of convulsive motor activity), number of treatments, and equipment and facilities. Information about

psychotropic drugs used during treatment was collected. This question was open and later divided into antidepressants, antipsychotics, lithium, anticonvulsants and benzodiazepines. The psychotropic drugs were divided into continued, reduced or discontinued. In addition, we collected information about the use of continuation/maintenance ECT and ambulatory ECT. Information about outcomes was divided into very much improved, much improved, minimally improved, no change and worse. We received information about outcomes in 246 patients from 10 units. Information about adverse effects was divided into memory impairment and headache. Memory impairment was divided into minimal, much, very much and long-lasting, whereas headache was divided into minimal, much and very much. We received information about adverse effects in 263 patients from 10 units about memory, and about 274 patients from 11 units regarding headache. It was possible to report deaths related to ECT. It was not possible to indicate no side effects. See appendix I for questionnaire details.

**Paper IV**

In Paper IV information collected included: number of persons treated with ECT, number of ECT administrations, the percentage of ECT-treated patients among the inpatients (psychiatric hospital admitted), and average number of ECTs administered per patient (in one course). Information about ECT parameters, such as use of modified or unmodified ECT, electrode placement, type of ECT device, as well as diagnoses and main indications were also collected. Gender and age were noted, as well as ethnicity, education, side effects, mortality, adverse events, use of written consent and involuntary conditions.

## 3.3 Ethical consideration

Ethics approval was not required by the Regional committees for medical and health research ethics, for data collection in Papers I-III. Paper I was considered to be a quality control of retrospective data and, as such, the committee stated that no further approval was needed. For Papers II and III it was not possible to identify patients on the data collection procedure. The psychiatrists responding in Papers II-III were anonymous and decided whether they wanted to answer or not.

## 3.4 Statistical analysis

In Paper I the frequencies per year were calculated as percentage of inpatients receiving ECT, number of ECT patients and treatment sessions per 100,000 population, and mean number of sessions per ECT series. These were analysed by Poisson regression, with year as independent variable, adjusting for number of inpatients and population. The yearly variation in use of ECT was analysed in mixed model Poisson regression, with year as random effect. The proportion of psychiatric patients given ECT per year was analysed in logistic regression, with gender, age group and year as covariates. Population development information for the years 1993-2003 was obtained from Statistics Norway (195).

In Paper II rate of ECT use per 10,000 population per year and number of inpatients receiving ECT in various health regions and for the whole country were calculated based on the answer to the question regarding the number of patients treated in 2004, and applying data from Statistics Norway (266). Descriptive analyses were made of demographics, diagnoses, indications, and attitudes. Rates of ECT use were compared between health

regions with Pearson's chi squared test. Some units failed to answer certain items, resulting in variations in N between the questions.

In Paper III descriptive data are presented with percentages. The following items were described: administration of ECT, consent routines, pre-treatment examinations, treatment courses, psychotropic drug use during treatment, continuation/maintenance ECT (CM-ECT), ambulatory (outpatient) ECT (A-ECT), training, side effects, and outcome. Some units did not answer all items, resulting in some variations in N in the results.

In Paper IV, where possible, utilization data have been presented either (1) as number of persons ECT treated per 10,000 resident population per year; that is, treated person rate (TPR), (2) number of ECT administrations per 10,000 resident population per year; that is, ECT administration rate (EAR), (3) the proportion in percent (%) of ECT-treated patients among the inpatient (psychiatric hospital admitted) population; that is, inpatient prevalence (iP%), and (4) average number of ECTs administered per patient (in a course); that is, average ECT number (AvE). Information about ECT parameters, diagnoses and main indications, gender and age are also presented. Other information such as ethnicity, education, side effects, mortality, adverse events, use of written consent, and involuntary conditions has also been noted.

The statistical analyses were carried out using SPSS version 19 (Paper I) and 15 (Paper II and III), and Stata Version 12 (Paper I).

# 4. Summary of papers

## 4.1 Paper I

Jarosch-von Schweder L., Lydersen S., Bergsholm P., Ottesen Kennair LE., Linaker OM.

**Electroconvulsive therapy at a county hospital: Rates of use, demographics and diagnoses.** Submitted.

**Objective:** This retrospective study of the clinical use of ECT in a county hospital, Norway, between 1993 and 2003, aimed to determine the rates of use, patient demographics and diagnoses, and to compare standards for ECT practice at this specific hospital, with similar studies conducted elsewhere.

**Method:** The study is based on data collected from specific ECT records and patient medical records. Frequency rates were calculated as number of ECT treatments per 100,000 per year, number of patients receiving ECT per 100,000 per year, and percentage of inpatient admissions who received ECT.

**Results:** Over the course of 11 years, 210 patients had received ECT, representing 4.2 % of all patients. Only the first ECT series was analysed. There was no trend in the proportion receiving ECT during that period. It varied between 1.8% in 2000 to 5.7% in 1997. There was a mean of 15.2 patients per 100,000 per year treated with ECT during that period. In total, 1,657 ECT treatments were administered to the 210 patients, giving a rate of 109 ECT treatments per 100,000 person per year. Of the patients, 137 (65%) were women, and 76 (36%) were 65 years old or older. ECT was used more in the older age groups, 50-69 years

and 70 years and above. Depressive disorders were the most common diagnostic indication (N=157), followed by bipolar disorder, (N=22) and other diagnoses (N=22).

**Conclusion:** We found the rate of use to be stable during the study period. Most patients who received ECT were women and elderly, and depression was the most common disorder.

## 4.2 Paper II

Schweder L.J., Lydersen S, Wahlund B., Bergsholm P. and Linaker O.M.

**Electroconvulsive therapy in Norway: rates of use, clinical characteristics, diagnoses and attitude.** J. ECT. 27,292-295. 2011a.

**Objectives:** The aim of the study was to describe the rate of use and geographic and demographic distribution of electroconvulsive therapy (ECT) in Norway in 2004, as well as attitudes among Norwegian psychiatrists about ECT.

**Methods:** A 40- item questionnaire on the practice of electroconvulsive therapy was sent to 125 Norwegian psychiatric hospitals, district psychiatric centres (DPC), and child and adolescent psychiatric units in 2004.

**Results:** A total of 67 (54 %) psychiatric units finally responded, including 26 (67 %) of the 39 psychiatric hospitals, 32 (46 %) of the 69 DPCs, and nine (53%) of the 17 child and adolescent units. ECT equipment was present and used in 19 (28 %) units. Lack of facilities (equipment and anaesthesia) was the main reason for not employing ECT. There were 672 patients who received ECT during 2004, which gives a yearly incidence of 2.4 / 10,000 inhabitants. In total, 5.3 % of all inpatients received ECT. The rate of ECT use varied significantly from 1.83 to 3.44 per 10,000 inhabitants per year between the different Health

Regions. Of the 672 patients, we got gender information on about 394 (59%), of which 135 were men and 259 were women. We got age information from 367 patients. Patients in the age group >64 (55 %) most commonly received ECT. The most common diagnoses were depressive episode or recurrent depressive disorder (70 %), followed by bipolar depression (19 %), and schizoaffective disorder (4 %). Lacking effect of psychopharmacologic treatment was the most common reason for ECT. The responders expressed generally positive attitudes towards ECT. Almost all considered ECT important, thought that hospitals should offer ECT, and that there are solid indications for such treatment. Most expressed concern about underuse of ECT.

**Conclusions:** ECT is widely available in Norway, but use is unevenly distributed between health regions. The attitudes toward ECT are generally positive among psychiatrists.

## 4.3 Paper III

Schweder L.J., Wahlund B., Bergsholm P. and Linaker O.M.

**Questionnaire study about the practice of electroconvulsive therapy in Norway.** J. ECT 27;296-299. 2011b.

**Objectives:** The aim of the study was to describe the contemporary practice of electroconvulsive therapy (ECT) in Norway.

**Methods:** A 40-item questionnaire on the practice of electroconvulsive therapy was sent to 125 Norwegian psychiatric hospitals, district psychiatric centres (DPC), and child and adolescent psychiatric units in 2004.

**Results:** A total of 67 (54 %) psychiatric units responded, including 26 (67 %) of 39 psychiatric hospitals, 32 (46 %) of 69 DPCs, and nine (53 %) of 17 child and adolescents units. Trainee psychiatrists most often administered ECT, with or without supervision, but underwent a training program before ECT. In one hospital the nurses administered ECT. Written informed consent was used in 50 % of institutions providing ECT. Oral information about ECT was always given. Psychiatrists were mostly satisfied with the facilities, and up-to-date equipment was used. Only modified ECT was administered and mostly anaesthetists gave anaesthesia. Right unilateral electrode placement was preferred, but with variations in dosage strategies. The practice in most of the departments was to discontinue some classes of psychotropics prior to ECT, mostly benzodiazepines and anticonvulsants. Antidepressants, lithium and antipsychotics were most often continued. Continuation/maintenance and ambulatory ECT were used in 88 % and 63 % of departments respectively. Most patients benefitted from ECT (78 %). Headache and memory impairment were frequent, but not reported as serious adverse effects.

**Conclusions:** The administration of ECT in Norway in 2004 was mostly in accordance with international guidelines. Compared with the last Norwegian survey in 1978, all institutions used modified ECT and brief pulse machines, and unilateral ECT was the preferred electrode placement. National guidelines should be developed, as there were considerable variations in practice among the hospitals.

## 4.4 Paper IV

Leiknes, K.A., Jarosch-von Schweder, L., Høie, B.

**Contemporary use and practice of electroconvulsive therapy worldwide.** Brain Behav. 2012 May;2(3):283-344.

**Objective:** To explore contemporary (1990 and after) utilization and practice of electroconvulsive therapy (ECT) worldwide.

**Methods:** Systematic search (limited to studies published 1990 to November 2010) was undertaken in the databases Medline, Embase, PsycINFO, SveMed, and EBSCO/Cinahl. Primary data-based studies which reported ECT utilization and practice in psychiatric institutions internationally, nationally, or regionally were included. Relevant references known to authors of this review, published on governmental internet sites, or from newly published text books or the reference lists in retrieved included papers were also found. Two researchers independently checked study titles and abstracts according to inclusion criteria. All researchers, consisting of two pairs, independently extracted data from the retrieved full-text articles according to a predetermined data extraction scheme.

**Results:** Seventy studies were included, seven from Australia and New Zealand, three from Africa, 12 from North and Latin America, 33 from Europe, and 15 from Asia. Worldwide ECT differences and trends were evident. Average number of ECT administered per patient was eight. Unmodified ECT (ECT without anaesthesia) was used in Asia, Africa, Latin America, Russia, Turkey and Spain. Worldwide preferred electrode placement was bilateral, although some places (Europe and Australia/New Zealand) preferred unilateral. Although brief-pulse wave was mainstream, sine-wave devices were still used. The majority of ECT treated patients were older women with depression in Western countries, versus younger men with schizophrenia in Asian countries. ECT under involuntary conditions (admissions), use of ambulatory-ECT, acute first line of treatment, as well as ECT administered by other professionals (geriatricians, nurses) were noted in some places. The general trends were that only some institutions within the same country provided ECT, training was inadequate, and

guidelines were not followed. Mandatory reporting and overall country ECT register data were sparse.

**Conclusion:** Many patients are still treated with outdated unmodified ECT today. There are widespread differences in ECT utilization, administration and practice worldwide. There is a need for sharing of knowledge about ECT, reflection and learning from each other's experiences.

# 5. Discussion

## 5.1 Main findings

We found that there were variations in use of ECT between regions in Norway and between countries worldwide. Among patients receiving ECT there was a preponderance of older women with depression in western countries including Norway, versus younger men with schizophrenia in Asian countries. Most Norwegian patients were reported to benefit from ECT, and side effects, such as memory impairment and headache, were reported to be minor problems. In Norway, antidepressants and antipsychotics are commonly used during ECT. There are still countries using unmodified ECT. Preferred electrode placement was bilateral, except in Europe and Australia/New Zealand, where unilateral electrode placement was preferred. Psychiatrists in Norway expressed generally positive attitudes towards ECT.

## 5.2 Empirical issues

### 5.2.1 Precription rates of ECT

Our results presented in this thesis confirm that there are large variations in clinical practice between countries and regions (34, 37, 242, 267, 268), despite international guidelines (26, 160, 161). Our studies present ECT utilization and practice from all continents, indicating a widespread use of ECT in the world today. Two continents, Africa and Latin America, have sparse ECT country data. This may indicate a trend away from ECT (269), which does not at all seem to be the case in the rest of the world. Although reports of ECT seem abundant in Europe, Asia, North America and Australia, the data does not cover all countries known to

have ECT practice. There are, for example, no “up to date” (1990 and after) ECT studies identified from either Iceland or Canada.

ECT in Norway during 2004 was given to 2.4 patients per 10,000 inhabitants, which was higher than the 0.98 patients per 10,000 inhabitants reported in the previous study in 1978 (20). The frequency was lower than in Belgium, 6.8 in 2003 (36); the Netherlands, 8.5 in 2007 (48); Denmark 3.0 in 1999 (33); and Sweden, 4.9 in 2008 (270). Most responding psychiatrists (Study II) from Norwegian hospitals expressed concern about underuse of ECT. This could have implications for patients not receiving necessary ECT. However, the rate of use in Norway was higher than in Germany, 0.08 in 1986 (265); Poland, 0.11 in 2005 (34); Spain, 0.61 in 2001 (242); Russia, 0.54 in 2003/2004 (35), and, Lithuania, 0.375 in 2010 (268). In Poland (34) anaesthetists are not available in many hospitals, and there is also a lack of training courses, both of which contribute to the low rate. In Russia (35) ECT depends more on individual enthusiasm than on regulatory standards. In Germany negative attitudes among patients and health personnel contribute to the low rate of use, despite positive attitudes among psychiatrists (265).

In our study of ECT at a county hospital, the use of ECT remained stable between 1993 and 2003, similar findings to a study in Hong Kong (271).

Our study of ECT in Norway shows that ECT is used in many hospitals and one or a few district psychiatric centres. Our data confirm that there are large variations in rates between the various health regions, although the number of hospitals providing ECT is spread among the health regions. The rate was lowest in the northern health region, and highest in the western health region. Such regional differences have been reported in other studies (36, 265). We have not found any data, such as availability of ECT or attitudes, which explain these geographical differences, except for a high, non-significant negative correlation

between use and distance to the ECT facilities. It is conceivable that long distances may contribute to lower ECT rate. Most hospitals that offer ECT use it frequently, 47 % treated more than 30 patients with ECT per year. However, the capacity of providing ECT was reported to be too low. Patients had to wait more than one month for treatment, which may result in longer episodes of illness. The main reasons for not using ECT were lack of equipment or unavailable anaesthesia, in line with an earlier Norwegian study, as well as other reports (20, 242, 272). Other potential reasons are lack of financial support, negative public attitudes towards ECT, and long distances to hospital, especially in the northern region of Norway. In our review of ECT worldwide (data from 1990), rates are computed in the data extraction to TPR (treated person rate) per 10,000 population to make it comparable, due to no internationally accepted uniform standards of ECT utilization reporting. The TPR per 10,000 (general population) varied from 0.11 (34) to 5.1 (273); likewise, the proportion of inpatient receiving ECT varied greatly with 21-28 % in Africa (274, 275) to 0.4-1.3 % in the USA (276, 277). Although the large worldwide differences in ECT utilization have been pointed out previously (34, 37, 242, 267), and the differences between countries on the basis of practice reports are not so easy to compare (due to large area and different languages) (278), overall variations in contemporary practice between the continents (Asia and Africa vs. USA, Australia and New Zealand, Europe) revealed by this review are large. Explanations of these variations are complex, encompassing not only the diversity in organization of psychiatric services, but probably also grounded in professional beliefs concerning the efficacy and safety of ECT (27).

### 5.2.2 Demographics and Diagnosis

ECT has long been held as a last-resort treatment for medication-resistant and very severe life-threatening clinical conditions (21, 279) as reported from the USA (29). However, a

change in ECT indication towards first line acute treatment (life-saving, catatonia, previous good response and patient preference) is apparent not only in Europe (152, 265, 280), but also Saudi Arabia (281) and Australia (282).

The most common indication for ECT use in Norway is depressive illness (89%), as in the Norwegian 1978-study (20), but it is sporadically used in psychotic disorders other than psychotic depression (4.7 %). The reason might be the availiability of antipsychotics and that ECT is generally not an accepted treatment for psychosis in Norway.

It is also rarely used in mania (0.9 %), although the response rate in mania is as high as in depression (91). In Europe, some sites (Brussels and Wallonia in Belgium) seem to regard ECT as a pure 'antidepressant,' using it exclusively for the treatment of depressive disorder (36). Interestingly, in Asia (ex. India, Thailand, Pacific Region, Japan) ECT seems to be regarded as an "antipsychotic" agent (31, 243, 278, 283-285). Discrepancies in indications could be due to differences in diagnostic practice, a lower recognition and under-treatment of depressive disorder, limited access to updated literature, and lower mental health care budgets (31). Another explanation might be the historical use of ECT in Europe and early spreading from Europe to the United States.

In our study of ECT at a county hospital we found that seven women (3%) with puerperal depression were treated with ECT. This treatment, with proper medical care, is effective in all trimesters of pregnancy, as well as in the postpartum period (156). However, consideration of risk and benefits of ECT must be taken into account, including the risk involved for the foetus/unborn child (158).

In Norway more women than men received ECT, and the majority of those patients were in the ≥65 (55 %) age group. Reasons for the increased usage in older adults might be higher

prevalence of severe depression among the elderly, higher rates of psychomotor changes and psychotic features in depressed elderly, somatic comorbidity making psycho pharmacological treatment contraindicated, as well as complications associated with polypharmacy. These results correspond to previous literature from Western countries (139, 141), also in Hong Kong (286), which indicates a predominance of patients receiving ECT to be elderly females with affective disorder (unipolar/bipolar depression) (139-141, 180). Except for younger patients, female gender and depression predominance was also found in Saudi Arabia (281) and Pakistan (287). Interestingly, study IV found that in the USA the typical ECT patient is said to be an elderly white female paying for treatment with insurance or private funds (277). Higher ECT treatment rates are found among Caucasians in Pennsylvania (277), England (288) and Western Australia (289), which might imply discriminatory factors in selection for treatment. There were no patients under 18 years of age who received ECT in Norway in our studies. Though, severe depression, mania and schizophrenia are also present in patients under 18 years, and for these patients ECT might be a treatment choice for achieving remission of symptoms (290). Current studies report equal clinical efficacy to adults (150, 291).

### 5.2.3 Effects and Adverse effects

The response rate to ECT in severe depressive disorders is high (26), and our results from Norway indicate that 78% of the patients were very much or much improved after ECT. Medication treatment failure has been suggested to predict the efficacy of ECT, whereas others report that antidepressant medication resistance does not influence short-term response to ECT (292). Our results indicate that patients benefit from ECT despite failing antidepressant medication trials.

There is an ongoing debate about the contribution of ECT to memory impairment after treatment. In our study, much or very much memory impairment was reported by 15 % of the patients after ECT. This was long-lasting, up to four months, in four patients (2%). However, we do not know whether these adverse effects were related to ECT or to other factors, such as continued low grade depression, anaesthesia, seizure length, old age, drugs and somatic illness. Cognitive adverse effects can be reduced without loss of efficacy by using high dose right unilateral ECT, which was generally employed in Norway, instead of bitemporal ECT (77, 293). Ultra brief electrical pulses and other electrode placements (bifrontal; left anterior right temporal) may possibly also reduce cognitive side effects (294, 295), but these methods are seldom used in Norway.

As in our study, mild transient headache after ECT is common (197). Prophylactic analgesic treatment may be warranted in those who experience marked post-ECT headache.

Worldwide, reports about side effects, adverse events, and mortality rates are sparse. Mortality rates were reported from Thailand (0.08%) (31) and Texas (14 deaths per 100,000 treatments within two weeks after ECT) (296). However, it is not clear if these deaths were caused by ECT or comorbid somatic illnesses, e.g., cardiac arrhythmia, anaesthetic complications or suicides. Side effects from unmodified ECT are typically fractures, dislocations and teeth injuries (243).

### 5.2.4 ECT and medication

Although the American Psychiatric Association Task Force on ECT discouraged combination treatment, due to minimal evidence for enhanced efficacy and concern about increased adverse effects (26), combination treatment with antidepressants and antipsychotics commonly are continued during ECT in Norway. There are few studies that

support the concomitant use of antidepressant during ECT. In one study, Sackeim et al. found that concomitant treatment with nortriptyline or venlafaxine during a course of ECT enhanced the efficacy in major depression relative to placebo (164), and nortriptyline reduced the cognitive side effects of ECT, whereas venlafaxine tended to worsen them. High dose venlafaxine together with ECT should therefore be avoided because of the adverse effects, including cardiac effects as asystoly (163, 297). A recent Cochrane review found that ECT, including CM-ECT, added to antipsychotics was superior to antipsychotics alone in schizophrenia (106), and adverse effects did not appear different from that seen with ECT alone (298, 299). In more than half of the responding institutions in Norway, lithium was continued during ECT. There are case reports and reviews that have found this combination to be safe (170, 171), but there is no consensus on the safety on this practice (159). Guidelines recommend lithium during ECT only after a risk/benefit analysis, and discontinuing lithium seems to be the appropriate practice (26, 159, 168). If lithium is continued during ECT, Sackeim has recommended not giving lithium the day before each ECT session (172). Benzodiazepines and anticonvulsants were mostly discontinued, probably because these might raise the seizure threshold and decrease efficacy. However, Sienaert et al. found that not all anticonvulsants have equivalent effects in this regard, with lamotrigine being less problematic than others (173). In patients who do not respond to ECT alone, the concomitant use of psychotropic medication during ECT might be useful. Since there is a high relapse rate after ECT and a delay in the onset of effect after starting with AD, use of concomitant medication should be re-evaluated (159).

### 5.2.5 Clinical Practice/ECT parameters

#### *5.2.5.1. Administration*

ECT worldwide is mainly administered by psychiatrists and trainee psychiatrists. However, our studies found that other professionals also administered ECT in Europe, such as geriatricians, and in Norway, nurses (48). This is not in accordance with international guidelines, which recommend a psychiatrist at least being present (26). In contrast to some other countries (35, 300, 301), almost all units in Norway, even four not providing ECT, had a training program for ECT, despite no national formal standard being available.

#### *5.2.5.2. Consent*

Written informed consent should include information about benefits and risks of ECT, alternatives to ECT and information about the patient's decision capacity (302). Despite oral consent to ECT being legally sufficient in Norway, written informed consent was used by 50% of institutions in our study. The departments not using written informed consent might have used oral consent together with oral and/or written information about ECT.

Written information is important for patients and close relatives, whereas written consent may not be appropriate. Thus, Ottosson and Fink (303) write: "It may be too much to insist on a signed, written consent. A nod of understanding and cooperation for the treatment as personnel meet no objection when preparing the patient should be acceptable. The insistence on a signed written consent encourages distrust and disturbs the delicate relationship between the patient and the psychiatrist. Yet, as the signed consent has become a standard of care in the United States and some other cultures, we accept this intervention as promoting better care."

Worldwide ECT is administered to a substantial number of patients under involuntary and guardian consent conditions, ranging from 1-3 % (139, 242, 296) to 20-29 % (265, 304, 305) in the USA and Europe. In Asia written informed consent is mainly obtained directly or counter signed by family members (31, 281, 284, 287). Consent given by legal bodies varies from 18 % in Scotland (under the Scottish Mental Health Act) (305) to 60 % in Sydney, Australia (by the Mental Health Review Tribunal) (282). Mandatory reporting of data for ECT usage is done only in a few places, i.e., Texas, USA, and Australia (139, 296, 306). Likewise, legislature regulation of practice is sparse, although found at some sites. Such regulations include obligatory anaesthesia (34, 263), obligatory written informed patient consent (34), ECT licensed facilities (306), exclusion of ECT for patients less than 16 years of age (139), and court or legal body allowance for involuntary ECT (282).

### *5.2.5.3. Modified/unmodified ECT*

Modified ECT is practiced in all institutions in Norway, which was not the case in the survey for 1968 to 1978 (20). In Norway ECT narcosis is given by an anaesthesiologist, mostly assisted by a nurse anaesthetist, which is recommended in guidelines (161). As in other countries, it is difficult to recruit trained anaesthesiologists to participate in ECT, and ambulatory anaesthesia teams are not common for ECT (36, 272). This has important implications for patients since this contributes to a low ECT capacity and long waiting periods for even severely ill patients in some institutions.

An important finding in this thesis is that some countries still practice unmodified ECT. On a worldwide scale, the number of patients receiving unmodified ECT is large. In Russia >80 % of patients receive unmodified ECT, whereas in Asia >55 % receive unmodified ECT (14 countries reported 129,906 unmodified ECT to 22,194 patients) and overall in Thailand estimated at 11.2 patients treated with unmodified ECT per 100,000 (307). The reasons for

this are diverse; Lack of equipment, lack of personnel, lack of anaesthesiologists, contraindication for anaesthesia, convenience, emergency and economic reasons (243). Whether these arguments are acceptable in light of knowledge about benefits and harms of modified ECT is another question. Despite attempts to ban it (308), argumentation defending unmodified ECT practice (309) is ongoing today (310). Our findings suggest that internationally acknowledged guidelines appear to have failed (311) in influencing important aspects of today's ECT practice worldwide. In Europe, the USA and Australia/New Zealand, modified ECT was almost exclusively used. In several countries, Chuvash Republic in Russia, Russia, Spain and Japan, the practice of reported modified ECT was sometimes without muscle relaxants, and with assistants used to restrain extreme motion from the convulsions in Japan (312). The alarming practice of muscle relaxants without anaesthesia is also undertaken in a few Asian institutions (283). How the latter practice has come about is not easy to decipher, but availability and recruitment of anaesthesiologists are pointed out both in Asia and Europe (313, 314).

#### *5.2.5.4. Electrode placement*

Preferred placement of electrodes worldwide (approx. 80%) is bilateral, as it was originally (12). Australia, New Zealand (315), Vienna (316), Munich (141) and Netherlands (48), though, adhere to unilateral as first choice, but use both types, which may indicate variation in practice of ECT. Right unilateral was the predominant electrode placement in Norway, in accordance with the recommendations of APA (26) and Scandinavian authorities such as d'Elia and Ottosson (51, 293), but bitemporal placement was also often used. Change from right unilateral to bitemporal placement is common practice if the response is insufficient, although two small studies suggest that continuous high-dose right unilateral stimulation may be at least equally effective with fewer side effects (245, 246). Fewer variations in ECT

practice between hospitals and countries and closer compliance to guidelines could be desirable even in Norway.

#### *5.2.5.5. Continuation electroconvulsive therapy (C-ECT)*

ECT is typically discontinued following response. Without continuation therapy, either with medication (antidepressants, lithium, anticonvulsants, and antipsychotics) and/or ECT, the risk of relapse is high within six months (183). The effect of C-ECT is well documented for depression (184). In Norway C- ECT for depression was available and used in 14 of 21 institutions.

### 5.2.6 Attitudes

Attitudes of psychiatrists toward ECT were generally favourable in Europe as found in study II (Norway) and IV (for example Spain, Germany and Russia) of this thesis.

In study II we found that the responding psychiatric hospitals in Norway generally had positive attitudes towards ECT. It is seen as an important treatment option, but probably still mostly considered for patients resistant to medication. In spite of lack of treatment guidelines for ECT in Norway, most clinics use the generally accepted indications and recommendations described by the American Psychiatric Association (26). Most express that ECT is underused and that it should be a treatment option in every hospital. Our attitude survey does not explain the relatively low use of ECT in Norway, or the unequal distribution of ECT use between health regions. The limited availability of ECT may be one cause for lower rates of use in some areas.

Reasons for not prescribing ECT in Europe were attributed to lack of equipment, economy and difficulties in recruiting anaesthetists, but no doubt also patient and health personnel

knowledge of and attitudes towards ECT, as well as economy, infrastructure, and policy were influential (38-40).

Negative attitudes may arise from ignorance, whereas positive attitudes come from experience and knowledge/information, as well as education and training resources in the psychiatric hospitals and medical schools.

## 5.3 Methodological issues

Methodological issues of this thesis will be considered from the two main forms of error; systematic error, referred to as bias, and random error (295).

### 5.3.1 Systematic error (bias)

#### *5.3.1.1. Selection bias*

Selection bias is the error arising from procedures used for finding and including patients in Paper I, respondents in Papers II- III, relevant studies in paper IV, and from other factors influencing study participation.

In Paper I, ECT patients were registered in ECT journals. Patients not registered here were not detected. It is possible that more patients have received ECT but were not found.

The samples in Papers II and III were psychiatrists responding to the questionnaire on behalf of psychiatric units, DPC and child and adolescent units in Norway. The overall response rate was 54 %; however, 67 % of the psychiatric hospitals performing ECT responded. One reason for the low response rate in DPCs and child and adolescent units may have been the rare use of ECT in these units. Another reason for non-response may have been that some

units did not receive the questionnaire because the units were not detected. All psychiatric units, DPCs and child and adolescent units were traced from the web sites of, and by telephone to, each health region in Norway, but it was difficult to identify all units. Attempts were made to avoid bias from self-selection by supplementing addresses from Medlex, Norwegian health information (email: info@lex.no). A third reason for non-response may have been the length of the questionnaire. Answering 40 items would take up to one hour if all information were available (which is mostly not the case). This may have been too time-consuming for clinicians. Fewer questions might have increased the response rate. Follow-up of postal questionnaire by email and/or telephone would probably have increased the response rate further. A fourth reason for non-response may have been that psychiatrists did not find the questionnaire relevant, or avoided response because they were against the treatment.

Study IV is a systematic review of literature and may as such include publication bias if essential grey literature was not found. Grey literature is defined as "information produced on all levels of government, academics, business and industry in electronic and print formats not controlled by commercial publishing i.e. where publishing is not the primary activity of the producing body" (ICGL Luxembourg definition, 1997 - Expanded in New York, 2004). Further characteristics are described as follows (317): “Grey literature publications are non-conventional, fugitive and often ephemeral. They may include but are not necessarily limited to the following types of materials: reports (pre-prints, preliminary progress and advanced reports, technical reports, statistical reports, memoranda, state-of-the art reports, market research reports, etc.), theses, conference proceedings, technical specifications and standards, non-commercial translations, bibliographies, technical and commercial documentation, and official documents not published commercially (primarily government reports and documents)." We are not sure that all relevant studies are found in study IV.

We might have overlooked works in other languages and works not indexed by major tools. This may have resulted in more positive results, as such are published more often than negative (studies which are not likely to receive a statistically significant difference and thus might have gone unpublished). This could result in both overestimation and underestimation of the estimated rates of use of ECT.

#### *5.3.1.2. Information bias*

Information bias is the error stemming from flawed information being collected about the study or from the study subjects.

Paper I: This was a retrospective study and information was obtained from medical and ECT records. Thus, information depended on the quality of documentation done by different psychiatrists. Diagnoses were not validated. Only one person worked with the information found, which can result in missing data.

Paper II-III: We were not able to control the answers from the psychiatrists who responded to questionnaire and the information given with regard to the number of ECT, patients (age, gender, diagnoses), and the practical use of ECT may have been inaccurate. We did not have information about observation methods or scales for evaluating memory impairment, headache or outcome from the participating institutions, which may result in underestimation or overestimation of these variables. The questionnaires were usually answered by one psychiatrist in each hospital, and this person's views may deviate from that of the other physicians. We do not know if other personnel than psychiatrists have answered. Furthermore, we do not know whether the attitudes of psychiatrists in the questionnaire study are representative of all psychiatrists in Norway. The clinicians most interested and

positive might have answered the questionnaire and therefore had positive attitudes toward ECT.

Paper IV: The sample includes patients with different diagnoses, lack of standardized diagnostics and clinical characteristics. Different ECT techniques and various concomitant drugs are used. There is a general lack of control groups, which makes it difficult to compare the results from various studies. Many studies consist of small samples, much use of administrative data, and few are prospective. Most studies do not quantify treatment outcomes. The studies were done in different time periods.

### 5.3.2 Study design

#### *5.3.2.1. Retrospective*

Paper I: The use of ECT is compared over a time period of 11 years in a single hospital. The strength of this method is that it excludes variables depending on differences between hospitals and health regions. The limitations are that it is a retrospective study and that information depended on the quality of medical records and ECT journals.

#### *5.3.2.2. Cross-sectional*

Papers II and III: The importance of these studies is the updating of information about the use of ECT in Norway. This may help in developing national guidelines, standardizing ECT, and securing the quality of the treatment. The responses contained specific information about rates of use, the practice of ECT and attitudes toward ECT. Its strength are that all health regions in Norway are represented and 67 % of all psychiatric hospitals responded.

A limitation of the cross-sectional or prevalence study design is its descriptive nature. Associations found in Papers II and III are therefore not explanatory. This is a postal survey,

not an audit, which is an official inspection, typically by an independent body, of an organization's accounts of actual practices, and results may deviate from the real practice. Another limitation is the lack of response from 23% of psychiatric hospitals. Nevertheless, we believe that the fact that a majority of the psychiatrists (80%) had the attitude that ECT is underused. This is in line with the finding of lacking capacity (63% of the responding psychiatrists) to give ECT to patients who need treatment, as well as the unacceptably long delay before treatment (median= six weeks). We had no information about reasons for not answering the questionnaire. In spite of methodological limitations, the results represent valuable new information about ECT administration and treatment in Norway, and provide a foundation for a discussion of quality guidelines. We believe that the study gives a reasonably good description of how ECT is practiced in Norway.

#### *5.3.2.3. Systematic review*

The strengths of this study are the extensive search strategy, high number of included studies, methodological transparency, and summary of findings in tables, providing an overview of contemporary world-wide use of ECT. This has not been undertaken in such detail previously.

Limitations of this review are the inclusion of non-randomized studies, questionnaire studies, and studies based on practitioner accounts of ECT use. This may influence the precision of the estimated rates depending on the accuracy of the sources. Seemingly more accurate are included reports from individual hospitals or national registers. The overall diversity in data sources, unclear representativeness of region or land, and large heterogeneity in reported ECT utilization rates, did not lend the data suitable for meta-analyses. National overviews of ECT data published by regulatory bodies or governmental agencies on the internet are not always easy to access, despite such internet sites being individually searched. National

government overviews do not usually appear in the databases where systematic literature search of published journal articles and studies are undertaken.

## 5.4 Conclusion and implications

Utilization rates and practice of ECT vary considerably between continents and countries as well as within countries. Among patients receiving ECT there was a preponderance of older women with depression in western countries including Norway, versus younger men with schizophrenia in Asian countries. Most patients in Norway were reported to benefit from ECT and adverse effects, such as memory impairment and headache, were reported to be minor problems. Unmodified ECT is still in use in Asia, Africa, and Latin America and even in Europe. In spite of existing guidelines, there is no uniform worldwide practice. Large global variation in ECT utilization, administration, and practice advocates a need for worldwide sharing of knowledge about ECT, reflection, and learning from each other's experiences.

There still exist some negative attitudes about ECT among the general public, patients and health personnel. Efforts to reduce negative attitudes toward ECT have to be coupled with continued research and will include improved training of residents and other physicians and dissemination of information to the general public. Training in ECT is important; Duffett and Lelliot (279) found that the better the training, the more likely that the quality of ECT will improve. Training should be organized as part of the psychiatric education program, with theory and practice, to better improve dissemination.

ECT will probably need further documentation, possibly gathered from as many national psychiatric units as possible, to gain an improved image and create an improved awareness of the effects of the method. Thus, including a national data gathering program in the

guideline- specified data records might generate more valid data and research that psychiatric practitioners in all countries will find convincing.

ECT should not to be a treatment of last resort in treatment algorithms. If patients are adequately informed about outcomes and adverse effects of ECT, and risks of not accepting treatment, fears and complaints might be reduced.

### 5.4.1 Future research

This thesis highlights the need for improvement of ECT utilization and practice not only in Norway, but also worldwide. An establishment of a National ECT health register reporting system in Norway, taking into account patient confidentiality, as well as the development of an international minimal dataset standard applied in all countries, would reduce our knowledge gaps. This would again contribute to more uniform worldwide ECT practice, to the benefit of the patient. A National survey by the Norwegian health authorities concerning the availability of ECT, waiting lists, training, administration of ECT, knowledge, etc. should be undertaken. There is also a need for Norwegian national ECT guidelines in order to be up to date and in line with other complicated interventions of our time. It is one of the most complex interventions in psychiatry, in need of a holistic medical team approach.

An important future research topic for ECT is to develop an understanding of the mechanisms of action, clarification of long-term effects and side effects, explore the specific effects of administering medication together with ECT, and strategies for relapse prevention after successful ECT, since mood disorders are often chronic relapsing illnesses.

# References


1. Kellaway P. The part played by electric fish in the early history of bioelectricity and electrotherapy. Bulletin of the history of medicine. 1946;20(2):112-37.
2. Bolwig TG, Fink M. Electrotherapy for melancholia: the pioneering contributions of Benjamin Franklin and Giovanni Aldini. The journal of ECT. 2009;25(1):15-8.
3. Abrams R. Electroconvulsive therapy. 4th ed. Oxford ; New York: Oxford University Press; 2002. ix, 328 p. p.
4. Pearce JM. Leopold Auenbrugger: camphor-induced epilepsy - remedy for manic psychosis. European neurology. 2008;59(1-2):105-7.
5. Kalinowsky LB. ECT: underused and misunderstood. Hospital & community psychiatry. 1982;33(6):425.
6. Shorter E. A History of Psychiatry:from the era of the asylyms to the age of Prozac. New York (NY): John Wiley & Sons, Inc; 1997.
7. Wagner-Jauregg J. The history of the malaria treatment of general paralysis. 1946. The American journal of psychiatry. 1994;151(6 Suppl):231-5.
8. Wagner-Jauregg J. The treatment of dementia paralytica by malaria inoculation. Nobel lecture, December 13, 1927. Nobel Lectures in Physiology or Medicine 1922-1941. Elsevier Publishing Company, Amsterdam. 1965.
9. Sakel M. The Origin and Nature of the Hypoglycemic Therapy of the Psychoses. Bulletin of the New York Academy of Medicine. 1937;13(3):97-109.
10. Mackay RP. Ladislas Joseph Meduna 1896-1964. Recent advances in biological psychiatry. 1965;8:357-8.
11. Fink M. Meduna and the origins of convulsive therapy. The American journal of psychiatry. 1984;141(9):1034-41.
12. Cerletti U, Bini L. Un nuovo metodo di shockterapie: 'l' elettroshock' (riassunto). Rome: Reale Accademia Medica 1938 (Communicazione alla seduta del 28 maggio 1938-XVI della Reale Accademia Medica di Roma). 1938.
13. Shorter E, Healy D. Shock therapy: A history of electroconvulsive treatment in mental illness. New Brunswick (NJ): Rutgers University Press; 2007.
14. Gralnick A. A three-year survey of electroshock therapy; report on 276 cases; comparative value of insulin-coma therapy. The American journal of psychiatry. 1946;102:583-93.
15. Kolb L, Vogel V. The use of shock therapy in 305 mental hospitals. The American journal of psychiatry. 1942;99:99-100.
16. Kringlen E. Norsk psykiatri gjennom tidene: N.W. Damm & Søn AS; 2007.
17. Straand T, Melle I, Gjerden P. User surveys in psychiatry in the 1950s. Tidsskrift for den Norske laegeforening : tidsskrift for praktisk medicin, ny raekke. 2012;132(5):543-6.
18. Eitinger L, Kringlen E. Universitetets psykiatriske klinikk 1926 - 1976. Oslo: Universitetets psykiatriske klinikk; 1976.
19. Hemphill KE WW. The treatment of mental disorders by electrically induced convulsions. Journal of Mental Science. 1941;87(367):256-75.
20. Volden O, Gotestam KG. [The use of electroconvulsive treatment in Norway during 1968-79]. Tidsskrift for den Norske laegeforening : tidsskrift for praktisk medicin, ny raekke. 1982;102(7):411-2.
21. McCall WV. Electroconvulsive therapy in the era of modern psychopharmacology. Int J Neuropsychopharmacol. 2001;4(3):315-24.

22. Weiner RD. Psychiatric Use of Electrically Induced Seizures. Am J Psychiat. 1979;136(12):1507-17.
23. Fink M. Impact of the antipsychiatry movement on the revival of electroconvulsive therapy in the United States. The Psychiatric clinics of North America. 1991;14(4):793-801.
24. Thompson JW, Weiner RD, Myers CP. Use of Ect in the United-States in 1975, 1980, and 1986. Am J Psychiat. 1994;151(11):1657-61.
25. Fink M. [History of electroconvulsive therapy in the United States in the last decades]. Nervenarzt. 1993;64(11):689-95.
26. American Psychiatric Association, Coffey EC, Weiner RD. The Practice of electroconvulsive therapy: recommendations for treatment, training, and privileging : a task force report of the American Psychiatric Association Washington, DC: The American Psychiatric Association 2001;VII, 355.
27. UK ECT Review Group. Efficacy and safety of electroconvulsive therapy in depressive disorders: a systematic review and meta-analysis. Lancet. 2003;361(9360):799-808.
28. Rose D, Fleischmann P, Wykes T, Leese M, Bindman J. Patients' perspectives on electroconvulsive therapy: systematic review. BMJ. 2003;326(7403):1363.
29. Prudic J, Olfson M, Sackeim HA. Electro-convulsive therapy practices in the community. Psychological medicine. 2001;31(5):929-34.
30. Moksnes KM, Vatnaland T, Eri B, Torvik NH. [Electroconvulsive therapy in the Ullevaal region of Oslo 1988-2002]. Tidsskrift for den Norske laegeforening : tidsskrift for praktisk medicin, ny raekke. 2006;126(13):1750-3.
31. Chanpattana W, Kramer BA. Electroconvulsive therapy practice in Thailand. The journal of ECT. 2004;20(2):94-8.
32. Gazdag G, Kocsis N, Lipcsey A. Rates of electroconvulsive therapy use in Hungary in 2002. The journal of ECT. 2004;20(1):42-4.
33. Andersson JE, Bolwig TG. [Electroconvulsive therapy in Denmark 1999. A nation-wide questionnaire study]. Ugeskrift for laeger. 2002;164(26):3449-52.
34. Gazdag G, Palinska D, Kloszewska I, Sobow T. Electroconvulsive therapy practice in Poland. The journal of ECT. 2009;25(1):34-8.
35. Nelson AI. A national survey of electroconvulsive therapy use in the Russian Federation. The journal of ECT. 2005;21(3):151-7.
36. Sienaert P, Dierick M, Degraeve G, Peuskens J. Electroconvulsive therapy in Belgium: a nationwide survey on the practice of electroconvulsive therapy. Journal of affective disorders. 2006;90(1):67-71.
37. Glen T, Scott AI. Variation in rates of electroconvulsive therapy use among consultant teams in Edinburgh (1993-1996). Journal of affective disorders. 2000;58(1):75-8.
38. Hermann RC, Ettner SL, Dorwart RA, Hoover CW, Yeung E. Characteristics of psychiatrists who perform ECT. The American journal of psychiatry. 1998;155(7):889-94.
39. Latey RH, Fahy TJ. Some influences on regional variation in frequency of prescription of electroconvulsive therapy. The British journal of psychiatry : the journal of mental science. 1988;152:196-200.
40. Gazdag G, Molnar E, Ungvari GS, Ivanyi Z. Knowledge of and attitude toward electroconvulsive therapy: a survey of Hungarian anesthesiology residents. The journal of ECT. 2009;25(2):113-6.
41. Swartz C. Electroconvulsive and neuromodulation therapies. Cambridge ; New York: Cambridge University Press; 2009. xxx, 609 p. p.
42. Magid M, Rohland BM. Electroconvulsive therapy availability in the United States. In: Swartz CM, editor. Electroconvulsive and neuromodulation therapies. New York: Cambridge University Press; 2009. p. 227-35.

43. Rosa MA, Rosa MO. Electroconvulsive therapy in Latin America. In: Swartz CM, editor. Electroconvulsive and neuromodulation therapies. New York: Cambridge University Press; 2009. p. 276-84.
44. Benbow SM, Bolwig TG. Electroconvulsive therapy in Scandinavia and the United Kingdom. In: Swartz CM, editor. Electroconvulsive and neuromodulation therapies. New York: Cambridge University Press; 2009. p. 236-45.
45. Sienaert P, van den Broek WW. Electroconvulsive therapy in continental Western Europe: A litterature review. In: Swartz CM, editor. Electroconvulsive and neuromodulation therapies. New York: Cambridge University Press 2009. p. 246-55.
46. Nelson AI, Giagou N. History of electroconvulsive therapy in the Russian Federation. In: Swartz CM, editor. Electroconvulsive and neuromodulation therapies. New York: Cambridge University Press; 2009. p. 266-75.
47. Chang SS. Electroconvulsive therapy in Asia. In: Swartz CM, editor. Electroconvulsive and neuromodulation therapies. New York: Cambridge University Press 2009. p. 256-65.
48. van Waarde JA, Verwey B, van den Broek WW, van der Mast RC. Electroconvulsive therapy in the Netherlands: a questionnaire survey on contemporary practice. The journal of ECT. 2009;25(3):190-4.
49. Stromgren LS. Electroconvulsive therapy in the Nordic countries, 1977-1987. Acta psychiatrica Scandinavica. 1991;84(5):428-34.
50. Flåtten Ø. Bør elektrosjokkbehandlingen evalueres? Tidskr Nor Lægeforen. 1975;95:1201-6.
51. d'Elia G, Ottosson JO, Stromgren LS. Present practice of electroconvulsive therapy in Scandinavia. Archives of general psychiatry. 1983;40(5):577-81.
52. Sobin C, Sackeim HA, Prudic J, Devanand DP, Moody BJ, McElhiney MC. Predictors of retrograde amnesia following ECT. The American journal of psychiatry. 1995;152(7):995-1001.
53. Scalia J, Lisanby SH, Dwork AJ, Johnson JE, Bernhardt ER, Arango V, et al. Neuropathologic examination after 91 ECT treatments in a 92-year-old woman with late-onset depression. The journal of ECT. 2007;23(2):96-8.
54. Devanand DP, Dwork AJ, Hutchinson ER, Bolwig TG, Sackeim HA. Does ECT alter brain structure? The American journal of psychiatry. 1994;151(7):957-70.
55. Ende G, Braus DF, Walter S, Weber-Fahr W, Henn FA. The hippocampus in patients treated with electroconvulsive therapy: a proton magnetic resonance spectroscopic imaging study. Archives of general psychiatry. 2000;57(10):937-43.
56. Dwork AJ, Christensen JR, Larsen KB, Scalia J, Underwood MD, Arango V, et al. Unaltered neuronal and glial counts in animal models of magnetic seizure therapy and electroconvulsive therapy. Neuroscience. 2009;164(4):1557-64.
57. Bolwig TG. How does electroconvulsive therapy work? Theories on its mechanism. Canadian journal of psychiatry Revue canadienne de psychiatrie. 2011;56(1):13-8.
58. Nutt DJ. The role of dopamine and norepinephrine in depression and antidepressant treatment. J Clin Psychiat. 2006;67:3-8.
59. Tsen P, El Mansari M, Blier P. Effects of repeated electroconvulsive shocks on catecholamine systems: Electrophysiological studies in the rat brain. Synapse. 2013;67(10):716-27.
60. Bolwig TG, Madsen TM. Electroconvulsive therapy in melancholia: the role of hippocampal neurogenesis. Acta psychiatrica Scandinavica. 2007;115:130-5.
61. Nordanskog P, Dahlstrand U, Larsson MR, Larsson EM, Knutsson L, Johanson A. Increase in Hippocampal Volume After Electroconvulsive Therapy in Patients With

Depression A Volumetric Magnetic Resonance Imaging Study. Journal of Ect. 2010;26(1):62-7.
62. Jansson L, Hellsten J, Tingstrom A. Region specific hypothalamic neuronal activation and endothelial cell proliferation in response to electroconvulsive seizures. Biological psychiatry. 2006;60(8):874-81.
63. Swartz CM. Hormonal effects of electroconvulsive therapy. In: Swartz CM. Electroconvulsive and neuromodulation therapies. New York: Cambridge University Press 2009.
64. Kunugi H, Ida I, Owashi T, Kimura M, Inoue Y, Nakagawa S, et al. Assessment of the dexamethasone/CRH test as a state-dependent marker for hypothalamic-pituitary-adrenal (HPA) axis abnormalities in major depressive episode: A multicenter study. Neuropsychopharmacology : official publication of the American College of Neuropsychopharmacology. 2006;31(1):212-20.
65. Yuuki N, Ida I, Oshima A, Kumano H, Takahashi K, Fukuda M, et al. HPA axis normalization, estimated by DEX/CRH test, but less alteration on cerebral glucose metabolism in depressed patients receiving ECT after medication treatment failures. Acta psychiatrica Scandinavica. 2005;112(4):257-65.
66. Hermann RC, Ettner SL, Dorwart RA, Langman-Dorwart N, Kleinman S. Diagnoses of patients treated with ECT: A comparison of evidence-based standards with reported use. Psychiatric Services. 1999;50(8):1059-65.
67. Sienaert P. What we have learned about electroconvulsive therapy and its relevance for the practising psychiatrist. Canadian journal of psychiatry Revue canadienne de psychiatrie. 2011;56(1):5-12.
68. Fink M, Kellner CH, McCall WV. The Role of ECT in Suicide Prevention. The journal of ECT. 2013.
69. Goodwin FK, Jamison KR, Ghaemi SN. Manic-depressive illness : bipolar disorders and recurrent depression. 2nd ed. New York, N.Y.: Oxford University Press; 2007. xxvi, 1262 p. p.
70. Kennedy SH, Lam RW, Parikh SV, Patten SB, Ravindran AV. Canadian Network for Mood and Anxiety Treatments (CANMAT) clinical guidelines for the management of major depressive disorder in adults. Introduction. Journal of affective disorders. 2009;117 Suppl 1:S1-2.
71. Petrides G, Fink M, Husain MM, Knapp RG, Rush AJ, Mueller M, et al. ECT remission rates in psychotic versus nonpsychotic depressed patients: a report from CORE. The journal of ECT. 2001;17(4):244-53.
72. Beale MD, Kellner CH. ECT in treatment algorithms: no need to save the best for last. The journal of ECT. 2000;16(1):1-2.
73. Husain MM, Rush AJ, Fink M, Knapp R, Petrides G, Rummans T, et al. Speed of response and remission in major depressive disorder with acute electroconvulsive therapy (ECT): a Consortium for Research in ECT (CORE) report. The Journal of clinical psychiatry. 2004;65(4):485-91.
74. Sienaert P, Vansteelandt K, Demyttenaere K, Peuskens J. Ultra-brief pulse ECT in bipolar and unipolar depressive disorder: differences in speed of response. Bipolar disorders. 2009;11(4):418-24.
75. Bailine S, Fink M, Knapp R, Petrides G, Husain MM, Rasmussen K, et al. Electroconvulsive therapy is equally effective in unipolar and bipolar depression. Acta psychiatrica Scandinavica. 2010;121(6):431-6.
76. Birkenhager TK, Pluijms EM, Lucius SA. ECT response in delusional versus non-delusional depressed inpatients. Journal of affective disorders. 2003;74(2):191-5.

77. Sackeim HA, Prudic J, Devanand DP, Nobler MS, Lisanby SH, Peyser S, et al. A prospective, randomized, double-blind comparison of bilateral and right unilateral electroconvulsive therapy at different stimulus intensities. Archives of general psychiatry. 2000;57(5):425-34.
78. Medda P, Perugi G, Zanello S, Ciuffa M, Rizzato S, Cassano GB. Comparative Response to Electroconvulsive Therapy in Medication-Resistant Bipolar I Patients With Depression and Mixed State. Journal of Ect. 2010;26(2):82-6.
79. Heijnen WT, Birkenhager TK, Wierdsma AI, van den Broek WW. Antidepressant pharmacotherapy failure and response to subsequent electroconvulsive therapy: a meta-analysis. Journal of clinical psychopharmacology. 2010;30(5):616-9.
80. Minichino A, Bersani FS, Capra E, Pannese R, Bonanno C, Salviati M, et al. ECT, rTMS, and deepTMS in pharmacoresistant drug-free patients with unipolar depression: a comparative review. Neuropsych Dis Treat. 2012;8:55-64.
81. Kho KH, van Vreeswijk MF, Simpson S, Zwinderman AH. A meta-analysis of electroconvulsive therapy efficacy in depression. The journal of ECT. 2003;19(3):139-47.
82. Daly JJ, Prudic J, Devanand DP, Nobler MS, Lisanby SH, Peyser S, et al. ECT in bipolar and unipolar depression: differences in speed of response. Bipolar disorders. 2001;3(2):95-104.
83. Dierckx B, Heijnen WT, van den Broek WW, Birkenhager TK. Efficacy of electroconvulsive therapy in bipolar versus unipolar major depression: a meta-analysis. Bipolar disorders. 2012;14(2):146-50.
84. Medda P, Perugi G, Zanello S, Ciuffa M, Cassano GB. Response to ECT in bipolar I, bipolar II and unipolar depression. Journal of affective disorders. 2009;118(1-3):55-9.
85. Gangadhar BN, Kapur RL, Kalyanasundaram S. Comparison of Electroconvulsive-Therapy with Imipramine in Endogenous-Depression - a Double-Blind-Study. Brit J Psychiat. 1982;141(Oct):367-71.
86. Dinan TG, Barry S. A Comparison of Electroconvulsive-Therapy with a Combined Lithium and Tricyclic Combination among Depressed Tricyclic Nonresponders. Acta psychiatrica Scandinavica. 1989;80(1):97-100.
87. Gazdag G, Bitter I, Ungvari GS, Baran B, Fink M. Laszlo Meduna's pilot studies with camphor inductions of seizures: the first 11 patients. The journal of ECT. 2009;25(1):3-11.
88. Fink M. Rediscovering catatonia: the biography of a treatable syndrome. Acta psychiatrica Scandinavica. 2013;127:1-47.
89. Cristancho P, Jewkes D, Mon T, Conway C. Successful Use of Right Unilateral ECT for Catatonia: A Case Series. The journal of ECT. 2013.
90. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Arlington, VA: American Psychiatric Association; 2013.
91. Mukherjee S, Sackeim HA, Schnur DB. Electroconvulsive therapy of acute manic episodes: a review of 50 years' experience. The American journal of psychiatry. 1994;151(2):169-76.
92. Malhi GS, Tanious M, Berk M. Mania: Diagnosis and Treatment Recommendations. Current psychiatry reports. 2012.
93. Sienaert P, Peuskens J. Electroconvulsive therapy: an effective therapy of medication-resistant bipolar disorder. Bipolar disorders. 2006;8(3):304-6.
94. Barekatain M, Jahangard L, Haghighi M, Ranjkesh F. Bifrontal versus bitemporal electroconvulsive therapy in severe manic patients. The journal of ECT. 2008;24(3):199-202.
95. Licht RW. Drug treatment of mania: a critical review. Acta psychiatrica Scandinavica. 1998;97(6):387-97.

96. Jacobowski NL, Heckers S, Bobo WV. Delirious mania: detection, diagnosis, and clinical management in the acute setting. Journal of psychiatric practice. 2013;19(1):15-28.
97. Volpe FM, Tavares A. Manic patients receiving ECT in a Brazilian sample. Journal of affective disorders. 2004;79(1-3):201-8.
98. Black DW, Winokur G, Nasrallah A. Treatment of mania: a naturalistic study of electroconvulsive therapy versus lithium in 438 patients. The Journal of clinical psychiatry. 1987;48(4):132-9.
99. Devanand DP, Polanco P, Cruz R, Shah S, Paykina N, Singh K, et al. The efficacy of ECT in mixed affective states. The journal of ECT. 2000;16(1):32-7.
100. McDonald WM, Thompson TR. Treatment of mania in dementia with electroconvulsive therapy. Psychopharmacol Bull. 2001;35(2):72-82.
101. Robinson LA, Penzner JB, Arkow S, Kahn DA, Berman JA. Electroconvulsive therapy for the treatment of refractory mania. Journal of psychiatric practice. 2011;17(1):61-6.
102. Mohan TS, Tharyan P, Alexander J, Raveendran NS. Effects of stimulus intensity on the efficacy and safety of twice-weekly, bilateral electroconvulsive therapy (ECT) combined with antipsychotics in acute mania: a randomised controlled trial. Bipolar disorders. 2009;11(2):126-34.
103. Suzuki K, Awata S, Matsuoka H. One-year outcome after response to ECT in middle-aged and elderly patients with intractable catatonic schizophrenia. The journal of ECT. 2004;20(2):99-106.
104. Zervas IM, Theleritis C, Soldatos CR. Using ECT in schizophrenia: a review from a clinical perspective. The world journal of biological psychiatry : the official journal of the World Federation of Societies of Biological Psychiatry. 2012;13(2):96-105.
105. Pompili M, Lester D, Dominici G, Longo L, Marconi G, Forte A, et al. Indications for electroconvulsive treatment in schizophrenia: A systematic review. Schizophrenia research. 2013.
106. Tharyan P. Electroconvulsive therapy for schizophrenia. Cochrane Database Syst Rev. 2000(2):CD000076.
107. Painuly N, Chakrabarti S. Combined use of electroconvulsive therapy and antipsychotics in schizophrenia: the Indian evidence. A review and a meta-analysis. The journal of ECT. 2006;22(1):59-66.
108. Chanpattana W, Andrade C. ECT for treatment-resistant schizophrenia: a response from the far East to the UK. NICE report. The journal of ECT. 2006;22(1):4-12.
109. Chanpattana W, Chakrabhand ML, Sackeim HA, Kitaroonchai W, Kongsakon R, Techakasem P, et al. Continuation ECT in treatment-resistant schizophrenia: a controlled study. The journal of ECT. 1999;15(3):178-92.
110. Kho KH, Blansjaar BA, de Vries S, Babuskova D, Zwinderman AH, Linszen DH. Electroconvulsive therapy for the treatment of clozapine nonresponders suffering from schizophrenia--an open label study. European archives of psychiatry and clinical neuroscience. 2004;254(6):372-9.
111. Berner P, Association WP. Diagnostic criteria for functional psychoses. 2 ed. Cambridge, New York: Cambridge University Press; 1992.
112. Ottosson JO. Psykiatri, Libris 1983-2010.
113. Little JD, Ungvari GS, McFarlane J. Successful ECT in a case of Leonhard's cycloid psychosis. The journal of ECT. 2000;16(1):62-7.
114. Varamballi S, Jagadisha, Velayudhan L, Gangadhar BN. Successful use of ECT as the sole modality of treatment in a case of motility psychosis. The journal of ECT. 2003;19(1):45-7; discussion 8-9.

115. Focht A, Kellner CH. Electroconvulsive therapy (ECT) in the treatment of postpartum psychosis. The journal of ECT. 2012;28(1):31-3.
116. Brauer H, Martinsen EW. [Confused woman shortly after childbirth]. Tidsskrift for den Norske laegeforening : tidsskrift for praktisk medicin, ny raekke. 2012;132(2):167-9.
117. Healy D. Mania : a short history of bipolar disorder. Baltimore: Johns Hopkins University Press; 2008. xxiii, 296 p. p.
118. Perugi G, Medda P, Reis J, Rizzato S, Giorgi Mariani M, Mauri M. Clinical subtypes of severe bipolar mixed states. Journal of affective disorders. 2013;151(3):1076-82.
119. Faber R, Trimble MR. Electroconvulsive therapy in Parkinson's disease and other movement disorders. Movement disorders : official journal of the Movement Disorder Society. 1991;6(4):293-303.
120. Moellentine C, Rummans T, Ahlskog JE, Harmsen WS, Suman VJ, O'Connor MK, et al. Effectiveness of ECT in patients with parkinsonism. The Journal of neuropsychiatry and clinical neurosciences. 1998;10(2):187-93.
121. Rasmussen K, Abrams R. Treatment of Parkinson's disease with electroconvulsive therapy. The Psychiatric clinics of North America. 1991;14(4):925-33.
122. Andersen K, Balldin J, Gottfries CG, Granerus AK, Modigh K, Svennerholm L, et al. A Double-Blind Evaluation of Electroconvulsive-Therapy in Parkinsons-Disease with on-Off Phenomena. Acta Neurol Scand. 1987;76(3):191-9.
123. Shulman RB. Maintenance ECT in the treatment of PD - Therapy improves psychotic symptoms, physical function. Geriatrics. 2003;58(11):43-5.
124. Popeo D, Kellner CH. ECT for Parkinson's disease. Medical hypotheses. 2009;73(4):468-9.
125. Faber R. Electroconvulsive therapy in parkinson's disease and other movement disorders. Convulsive therapy. 1996;12(1):65-.
126. Bhanushali MJ, Tuite PJ. The evaluation and management of patients with neuroleptic malignant syndrome. Neurologic clinics. 2004;22(2):389-411.
127. Tortella FC, Long JB. Endogenous anticonvulsant substance in rat cerebrospinal fluid after a generalized seizure. Science. 1985;228(4703):1106-8.
128. Lambrecq V, Villega F, Marchal C, Michel V, Guehl D, Rotge JY, et al. Refractory status epilepticus: Electroconvulsive therapy as a possible therapeutic strategy. Seizure-Eur J Epilep. 2012;21(9):661-4.
129. Kho KH, Blansjaar BA, Vothknecht S, Cornelissen NM, Koomen E, Zwinderman AH, et al. A study into predictors for the speed of response to electroconvulsive therapy. The journal of ECT. 2004;20(3):154-9.
130. Devanand DP, Sackeim HA, Prudic J. Electroconvulsive therapy in the treatment-resistant patient. The Psychiatric clinics of North America. 1991;14(4):905-23.
131. Rasmussen KG, Mueller M, Knapp RG, Husain MM, Rummans TA, Sampson SM, et al. Antidepressant medication treatment failure does not predict lower remission with ECT for major depressive disorder: a report from the consortium for research in electroconvulsive therapy. The Journal of clinical psychiatry. 2007;68(11):1701-6.
132. van den Broek WW, de Lely A, Mulder PG, Birkenhager TK, Bruijn JA. Effect of antidepressant medication resistance on short-term response to electroconvulsive therapy. Journal of clinical psychopharmacology. 2004;24(4):400-3.
133. Dombrovski AY, Mulsant BH, Haskett RF, Prudic J, Begley AE, Sackeim HA. Predictors of remission after electroconvulsive therapy in unipolar major depression. The Journal of clinical psychiatry. 2005;66(8):1043-9.
134. Prudic J, Olfson M, Marcus SC, Fuller RB, Sackeim HA. Effectiveness of electroconvulsive therapy in community settings. Biological psychiatry. 2004;55(3):301-12.

135. Feske U, Mulsant BH, Pilkonis PA, Soloff P, Dolata D, Sackeim HA, et al. Clinical outcome of ECT in patients with major depression and comorbid borderline personality disorder. The American journal of psychiatry. 2004;161(11):2073-80.
136. DeBattista C, Mueller K. Is electroconvulsive therapy effective for the depressed patient with comorbid borderline personality disorder? The journal of ECT. 2001;17(2):91-8.
137. Andrade C, Gangadhar BN, Vythilingam M, Channabasavanna SM, Pradhan N. Initial response to ect as a predictor of outcome in endogenous depression. Indian journal of psychiatry. 1989;31(4):293-5.
138. Kellner CH. Speed of response to ECT. Psychiatric Times. 2010 mai 27.
139. Reid WH, Keller S, Leatherman M, Mason M. ECT in Texas: 19 months of mandatory reporting. The Journal of clinical psychiatry. 1998;59(1):8-13.
140. Glen T, Scott AI. Rates of electroconvulsive therapy use in Edinburgh (1992-1997). Journal of affective disorders. 1999;54(1-2):81-5.
141. Baghai TC, Marcuse A, Moller HJ, Rupprecht R. [Electroconvulsive therapy at the Department of Psychiatry and Psychotherapy, University of Munich. Development during the years 1995-2002]. Nervenarzt. 2005;76(5):597-612.
142. Gormley N, Cullen C, Walters L, Philpot M, Lawlor B. The safety and efficacy of electroconvulsive therapy in patients over age 75. International journal of geriatric psychiatry. 1998;13(12):871-4.
143. Van der Wurff FB, Stek ML, Hoogendijk WL, Beekman AT. Electroconvulsive therapy for the depressed elderly. Cochrane Database Syst Rev. 2003(2):CD003593.
144. Mulsant BH, Rosen J, Thornton JE, Zubenko GS. A prospective naturalistic study of electroconvulsive therapy in late-life depression. Journal of geriatric psychiatry and neurology. 1991;4(1):3-13.
145. Damm J, Eser D, Schule C, Obermeier M, Moller HJ, Rupprecht R, et al. Influence of age on effectiveness and tolerability of electroconvulsive therapy. The journal of ECT. 2010;26(4):282-8.
146. Tew JD, Jr., Mulsant BH, Haskett RF, Prudic J, Thase ME, Crowe RR, et al. Acute efficacy of ECT in the treatment of major depression in the old-old. The American journal of psychiatry. 1999;156(12):1865-70.
147. O'Connor MK, Knapp R, Husain M, Rummans TA, Petrides G, Smith G, et al. The influence of age on the response of major depression to electroconvulsive therapy: a C.O.R.E. Report. The American journal of geriatric psychiatry : official journal of the American Association for Geriatric Psychiatry. 2001;9(4):382-90.
148. Riva-Posse P, Hermida AP, McDonald WM. The role of electroconvulsive and neuromodulation therapies in the treatment of geriatric depression. The Psychiatric clinics of North America. 2013;36(4):607-30.
149. Shoirah H, Hamoda HM. Electroconvulsive therapy in children and adolescents. Expert review of neurotherapeutics. 2011;11(1):127-37.
150. Cohen D, Paillere-Martinot ML, Basquin M. Use of electroconvulsive therapy in adolescents. Convulsive therapy. 1997;13(1):25-31.
151. Thorpe L, Whitney DK, Kutcher SP, Kennedy SH. Clinical guidelines for the treatment of depressive disorders. VI. Special populations. Canadian journal of psychiatry Revue canadienne de psychiatrie. 2001;46 Suppl 1:63S-76S.
152. Duffett R, Hill P, Lelliott P. Use of electroconvulsive therapy in young people. The British journal of psychiatry : the journal of mental science. 1999;175:228-30.
153. Consoli A, Cohen J, Bodeau N, Guinchat V, Wachtel L, Cohen D. Electroconvulsive therapy in adolescents with intellectual disability and severe self-injurious behavior and aggression: a retrospective study. Eur Child Adoles Psy. 2013;22(1):55-62.

154. Siegel M, Milligan B, Robbins D, Prentice G. Electroconvulsive Therapy in an Adolescent With Autism and Bipolar I Disorder. Journal of Ect. 2012;28(4):252-5.
155. Wachtel LE, Dhossche DM. Challenges of Electroconvulsive Therapy for Catatonia in Youth With Intellectual Disabilities Another Tomato Effect? Journal of Ect. 2012;28(3):151-3.
156. Saatcioglu O, Tomruk NB. The Use of Electroconvulsive Therapy in Pregnancy: A Review. Isr J Psychiatr Rel. 2011;48(1):6-11.
157. Anderson EL, Reti IM. ECT in pregnancy: a review of the literature from 1941 to 2007. Psychosomatic medicine. 2009;71(2):235-42.
158. Leiknes KA, Cooke MJ, Jarosch-von Schweder L, Harboe I, Hoie B. Electroconvulsive therapy during pregnancy: a systematic review of case studies. Archives of women's mental health. 2013.
159. Haskett RF, Loo C. Adjunctive psychotropic medications during electroconvulsive therapy in the treatment of depression, mania, and schizophrenia. The journal of ECT. 2010;26(3):196-201.
160. Ellis P, Royal A, New Zealand College of Psychiatrists Clinical Practice Guidelines Team for D. Australian and New Zealand clinical practice guidelines for the treatment of depression. The Australian and New Zealand journal of psychiatry. 2004;38(6):389-407.
161. Scott AIF. The ECT handbook. 2 ed. London, England: Royal College of Psychiatrists; 2005.
162. Lauritzen L, Odgaard K, Clemmesen L, Lunde M, Ohrstrom J, Black C, et al. Relapse prevention by means of paroxetine in ECT-treated patients with major depression: a comparison with imipramine and placebo in medium-term continuation therapy. Acta psychiatrica Scandinavica. 1996;94(4):241-51.
163. Baghai TC, Marcuse A, Brosch M, Schule C, Eser D, Nothdurfter C, et al. The influence of concomitant antidepressant medication on safety, tolerability and clinical effectiveness of electroconvulsive therapy. The world journal of biological psychiatry : the official journal of the World Federation of Societies of Biological Psychiatry. 2006;7(2):82-90.
164. Sackeim HA, Dillingham EM, Prudic J, Cooper T, McCall WV, Rosenquist P, et al. Effect of concomitant pharmacotherapy on electroconvulsive therapy outcomes: short-term efficacy and adverse effects. Archives of general psychiatry. 2009;66(7):729-37.
165. Mayur PM, Gangadhar BN, Subbakrishna DK, Janakiramaiah N. Discontinuation of antidepressant drugs during electroconvulsive therapy: a controlled study. Journal of affective disorders. 2000;58(1):37-41.
166. Nothdurfter C, Eser D, Schule C, Zwanzger P, Marcuse A, Noack I, et al. The influence of concomitant neuroleptic medication on safety, tolerability and clinical effectiveness of electroconvulsive therapy. The world journal of biological psychiatry : the official journal of the World Federation of Societies of Biological Psychiatry. 2006;7(3):162-70.
167. Kupchik M, Spivak B, Mester R, Reznik I, Gonen N, Weizman A, et al. Combined electroconvulsive-clozapine therapy. Clinical neuropharmacology. 2000;23(1):14-6.
168. Sartorius A, Wolf J, Henn FA. Lithium and ECT--concurrent use still demands attention: three case reports. The world journal of biological psychiatry : the official journal of the World Federation of Societies of Biological Psychiatry. 2005;6(2):121-4.
169. Weiner RD, Whanger AD, Erwin CW, Wilson WP. Prolonged confusional state and EEG seizure activity following concurrent ECT and lithium use. The American journal of psychiatry. 1980;137(11):1452-3.

170. Dolenc TJ, Rasmussen KG. The safety of electroconvulsive therapy and lithium in combination: a case series and review of the literature. The journal of ECT. 2005;21(3):165-70.
171. Jha AK, Stein GS, Fenwick P. Negative interaction between lithium and electroconvulsive therapy--a case-control study. The British journal of psychiatry : the journal of mental science. 1996;168(2):241-3.
172. Roose SP, Sackeim H. Late-life depression. New York: Oxford University Press; 2004.
173. Sienaert P, Peuskens J. Anticonvulsants during electroconvulsive therapy: review and recommendations. The journal of ECT. 2007;23(2):120-3.
174. Sienaert P, Roelens Y, Demunter H, Vansteelandt K, Peuskens J, Van Heeringen C. Concurrent use of lamotrigine and electroconvulsive therapy. The journal of ECT. 2011;27(2):148-52.
175. Pettinati HM, Stephens SM, Willis KM, Robin SE. Evidence for less improvement in depression in patients taking benzodiazepines during unilateral ECT. The American journal of psychiatry. 1990;147(8):1029-35.
176. Jha A, Stein G. Decreased efficacy of combined benzodiazepines and unilateral ECT in treatment of depression. Acta psychiatrica Scandinavica. 1996;94(2):101-4.
177. Greenberg RM, Pettinati HM. Benzodiazepines and Electroconvulsive Therapy. Convulsive therapy. 1993;9(4):262-73.
178. Stromgren LS, Dahl J, Fjeldborg N, Thomsen A. Factors influencing seizure duration and number of seizures applied in unilateral electroconvulsive therapy. Anaesthetics and benzodiazepines. Acta psychiatrica Scandinavica. 1980;62(2):158-65.
179. Olesen AC, Lolk A, Christensen P. Effect of a Single Nighttime Dose of Oxazepam on Seizure Duration in Electroconvulsive Therapy. Convulsive therapy. 1989;5(1):3-7.
180. Moksnes KM. Relapse following electroconvulsive therapy. Tidsskrift for den Norske laegeforening : tidsskrift for praktisk medicin, ny raekke. 2011;131(20):1991-3.
181. Sackeim HA, Prudic J, Devanand DP, Decina P, Kerr B, Malitz S. The impact of medication resistance and continuation pharmacotherapy on relapse following response to electroconvulsive therapy in major depression. Journal of clinical psychopharmacology. 1990;10(2):96-104.
182. NIMH/NIH Consensus Development Conference statement. Mood disorders: pharmacologic prevention of recurrences. Consensus Development Panel. The American journal of psychiatry. 1985;142(4):469-76.
183. Sackeim HA, Haskett RF, Mulsant BH, Thase ME, Mann JJ, Pettinati HM, et al. Continuation pharmacotherapy in the prevention of relapse following electroconvulsive therapy: a randomized controlled trial. JAMA : the journal of the American Medical Association. 2001;285(10):1299-307.
184. Kellner CH, Knapp RG, Petrides G, Rummans TA, Husain MM, Rasmussen K, et al. Continuation electroconvulsive therapy vs pharmacotherapy for relapse prevention in major depression: a multisite study from the Consortium for Research in Electroconvulsive Therapy (CORE). Archives of general psychiatry. 2006;63(12):1337-44.
185. Kellner CH, Knapp R, Husain MM, Rasmussen K, Sampson S, Cullum M, et al. Bifrontal, bitemporal and right unilateral electrode placement in ECT: randomised trial. The British journal of psychiatry : the journal of mental science. 2010;196(3):226-34.
186. Seager CP, Bird RL. Imipramine with Electrical Treatment in Depression - a Controlled Trial. Journal of Mental Science. 1962;108(456):704-&.
187. Kay DW, Fahy T, Garside RF. A seven-month double-blind trial of amitriptyline and diazepam in ECT-treated depressed patients. The British journal of psychiatry : the journal of mental science. 1970;117(541):667-71.

188. Nordenskjold A, von Knorring L, Engstrom I. Predictors of time to relapse/recurrence after electroconvulsive therapy in patients with major depressive disorder: a population-based cohort study. Depression research and treatment. 2011;2011:470985.
189. Tew JD, Jr., Mulsant BH, Haskett RF, Joan P, Begley AE, Sackeim HA. Relapse during continuation pharmacotherapy after acute response to ECT: a comparison of usual care versus protocolized treatment. Annals of clinical psychiatry : official journal of the American Academy of Clinical Psychiatrists. 2007;19(1):1-4.
190. Petrides G, Tobias KG, Kellner CH, Rudorfer MV. Continuation and maintenance electroconvulsive therapy for mood disorders: review of the literature. Neuropsychobiology. 2011;64(3):129-40.
191. Navarro V, Gasto C, Torres X, Masana G, Penades R, Guarch J, et al. Continuation/maintenance treatment with nortriptyline versus combined nortriptyline and ECT in late-life psychotic depression: a two-year randomized study. The American journal of geriatric psychiatry : official journal of the American Association for Geriatric Psychiatry. 2008;16(6):498-505.
192. Gagne GG, Jr., Furman MJ, Carpenter LL, Price LH. Efficacy of continuation ECT and antidepressant drugs compared to long-term antidepressants alone in depressed patients. The American journal of psychiatry. 2000;157(12):1960-5.
193. Odeberg H, Rodriguez-Silva B, Salander P, Martensson B. Individualized continuation electroconvulsive therapy and medication as a bridge to relapse prevention after an index course of electroconvulsive therapy in severe mood disorders: a naturalistic 3-year cohort study. The journal of ECT. 2008;24(3):183-90.
194. Vaidya NA, Mahableshwarkar AR, Shahid R. Continuation and maintenance ECT in treatment-resistant bipolar disorder. The journal of ECT. 2003;19(1):10-6.
195. Shiwach RS, Reid WH, Carmody TJ. An analysis of reported deaths following electroconvulsive therapy in Texas, 1993-1998. Psychiatr Serv. 2001;52(8):1095-7.
196. Nuttall GA, Bowersox MR, Douglass SB, McDonald J, Rasmussen LJ, Decker PA, et al. Morbidity and mortality in the use of electroconvulsive therapy. The journal of ECT. 2004;20(4):237-41.
197. Weiner SJ, Ward TN, Ravaris CL. Headache and electroconvulsive therapy. Headache. 1994;34(3):155-9.
198. Leung M, Hollander Y, Brown GR. Pretreatment with ibuprofen to prevent electroconvulsive therapy-induced headache. The Journal of clinical psychiatry. 2003;64(5):551-3.
199. Calev A, Cohen R, Tubi N, Nigal D, Shapira B, Kugelmass S, et al. Disorientation and Bilateral Moderately Suprathreshold Titrated ECT. Convulsive therapy. 1991;7(2):99-110.
200. Daniel WF, Crovitz HF, Weiner RD. Neuropsychological aspects of disorientation. Cortex; a journal devoted to the study of the nervous system and behavior. 1987;23(2):169-87.
201. Prudic J. Strategies to minimize cognitive side effects with ECT: aspects of ECT technique. The journal of ECT. 2008;24(1):46-51.
202. Fraser LM, O'Carroll RE, Ebmeier KP. The effect of electroconvulsive therapy on autobiographical memory: a systematic review. The journal of ECT. 2008;24(1):10-7.
203. Semkovska M, Keane D, Babalola O, McLoughlin DM. Unilateral brief-pulse electroconvulsive therapy and cognition: effects of electrode placement, stimulus dosage and time. Journal of psychiatric research. 2011;45(6):770-80.
204. Ingram A, Saling MM, Schweitzer I. Cognitive side effects of brief pulse electroconvulsive therapy: a review. The journal of ECT. 2008;24(1):3-9.

205. Kellner CH, Tobias KG, Wiegand J. Electrode placement in electroconvulsive therapy (ECT): A review of the literature. The journal of ECT. 2010;26(3):175-80.
206. Payne NA, Prudic J. Electroconvulsive therapy: Part I. A perspective on the evolution and current practice of ECT. Journal of psychiatric practice. 2009;15(5):346-68.
207. Shapira B, Tubi N, Lerer B. Balancing speed of response to ECT in major depression and adverse cognitive effects: role of treatment schedule. The journal of ECT. 2000;16(2):97-109.
208. Loo CK, Katalinic N, Martin D, Schweitzer I. A review of ultrabrief pulse width electroconvulsive therapy. Therapeutic advances in chronic disease. 2012;3(2):69-85.
209. Gardner BK, O'Connor DW. A review of the cognitive effects of electroconvulsive therapy in older adults. The journal of ECT. 2008;24(1):68-80.
210. Sackeim HA, Prudic J, Fuller R, Keilp J, Lavori PW, Olfson M. The cognitive effects of electroconvulsive therapy in community settings. Neuropsychopharmacology : official publication of the American College of Neuropsychopharmacology. 2007;32(1):244-54.
211. Semkovska M, McLoughlin DM. Objective cognitive performance associated with electroconvulsive therapy for depression: a systematic review and meta-analysis. Biological psychiatry. 2010;68(6):568-77.
212. Lisanby SH, Maddox JH, Prudic J, Devanand DP, Sackeim HA. The effects of electroconvulsive therapy on memory of autobiographical and public events. Archives of general psychiatry. 2000;57(6):581-90.
213. Semkovska M, McLoughlin DM. Measuring retrograde autobiographical amnesia following electroconvulsive therapy: historical perspective and current issues. The journal of ECT. 2013;29(2):127-33.
214. Administration USFaD. Meeting to Discuss the Classification of Electroconvulsive Therapy Devices (ECT), FDA Executive Summar 2011 [cited 2014 June 12, 2014].
215. Sienaert P, Vansteelandt K, Demyttenaere K, Peuskens J. Randomized comparison of ultra-brief bifrontal and unilateral electroconvulsive therapy for major depression: cognitive side-effects. Journal of affective disorders. 2010;122(1-2):60-7.
216. Stoppe A, Louza M, Rosa M, Gil G, Rigonatti S. Fixed high-dose electroconvulsive therapy in the elderly with depression: a double-blind, randomized comparison of efficacy and tolerability between unilateral and bilateral electrode placement. The journal of ECT. 2006;22(2):92-9.
217. Weiner RD, Rogers HJ, Davidson JR, Squire LR. Effects of stimulus parameters on cognitive side effects. Annals of the New York Academy of Sciences. 1986;462:315-25.
218. Prudic J, Peyser S, Sackeim HA. Subjective memory complaints: a review of patient self-assessment of memory after electroconvulsive therapy. The journal of ECT. 2000;16(2):121-32.
219. Squire LR, Chace PM. Memory functions six to nine months after electroconvulsive therapy. Archives of general psychiatry. 1975;32(12):1557-64.
220. Reid M, Parkinson L, Gibson R, Schofield P, D'Este C, Attia J, et al. Memory complaint questionnaire performed poorly as screening tool: validation against psychometric tests and affective measures. Journal of clinical epidemiology. 2012;65(2):199-205.
221. Bergsholm P. Patients' perspectives on electroconvulsive therapy: a reevaluation of the review by Rose et al on memory loss after electroconvulsive therapy. The journal of ECT. 2012;28(1):27-30.
222. Chakrabarti S, Grover S, Rajagopal R. Electroconvulsive therapy: a review of knowledge, experience and attitudes of patients concerning the treatment. The world journal of biological psychiatry : the official journal of the World Federation of Societies of Biological Psychiatry. 2010;11(3):525-37.
223. Dukakis K, Tye L. 'I feel good, I feel alive'. Newsweek. 2006;148(12):62-3.

224. Vamos M. The cognitive side effects of modern ECT: patient experience or objective measurement? The journal of ECT. 2008;24(1):18-24.
225. Freeman CP. Cognitive adverse effects of ECT. In: Waite J, Easton A, editors. The ECT Handbook. 3 ed. RCPsych Publications: The Royal College of Psychiatrists, College Report CR 176; 2013.
226. Donahue AB. Electroconvulsive therapy and memory loss: a personal journey. The journal of ECT. 2000;16(2):133-43.
227. Dudai Y. How big is human memory, or on being just useful enough. Learning & memory. 1997;3(5):341-65.
228. Jenkins CD, Hurst MW, Rose RM. Life changes. Do people really remember? Archives of general psychiatry. 1979;36(4):379-84.
229. Fink M. Complaints of loss of personal memories after electroconvulsive therapy: evidence of a somatoform disorder? Psychosomatics. 2007;48(4):290-3.
230. Bailer J, Rist F, Rudolf A, Staehle HJ, Eickholz P, Triebig G, et al. Adverse health effects related to mercury exposure from dental amalgam fillings: toxicological or psychological causes? Psychological medicine. 2001;31(2):255-63.
231. Reisner AD. The electroconvulsive therapy controversy: evidence and ethics. Neuropsychology review. 2003;13(4):199-219.
232. Peters SG, Wochos DN, Peterson GC. Status epilepticus as a complication of concurrent electroconvulsive and theophylline therapy. Mayo Clinic proceedings. 1984;59(8):568-70.
233. Devanand DP, Decina P, Sackeim HA, Prudic J. Status epilepticus following ECT in a patient receiving theophylline. Journal of clinical psychopharmacology. 1988;8(2):153.
234. Finlayson AJ, Vieweg WV, Wilkey WD, Cooper AJ. Hyponatremic seizure following ECT. Canadian journal of psychiatry Revue canadienne de psychiatrie. 1989;34(5):463-4.
235. Derikx RLE, van Waarde JA, Verwey B, van der Mast RC. Effects on Intracranial Pressure of Electroconvulsive Therapy. Journal of Ect. 2012;28(2):E23-E4.
236. van Herck E, Sienaert P, Hagon A. [Electroconvulsive therapy for patients with intracranial aneurysms: a case study and literature review]. Tijdschrift voor psychiatrie. 2009;51(1):43-51.
237. Mehan WA, Jr., Romero JM, Hirsch JA, Sabbag DJ, Gonzalez RG, Heit JJ, et al. Unruptured intracranial aneurysms conservatively followed with serial CT angiography: could morphology and growth predict rupture? Journal of neurointerventional surgery. 2013.
238. Porter RJ, Douglas K, Knight RG. Monitoring of cognitive effects during a course of electroconvulsive therapy: recommendations for clinical practice. The journal of ECT. 2008;24(1):25-34.
239. Weiner R, Lisanby SH, Husain MM, Morales OG, Maixner DF, Hall SE, et al. Electroconvulsive therapy device classification: response to FDA advisory panel hearing and recommendations. The Journal of clinical psychiatry. 2013;74(1):38-42.
240. Gazdag G, Takacs R, Ungvari GS, Sienaert P. The practice of consenting to electroconvulsive therapy in the European Union. The journal of ECT. 2012;28(1):4-6.
241. Harris V. Electroconvulsive therapy: administrative codes, legislation, and professional recommendations. The journal of the American Academy of Psychiatry and the Law. 2006;34(3):406-11.
242. Bertolin-Guillen JM, Peiro-Moreno S, Hernandez-de-Pablo ME. Patterns of electroconvulsive therapy use in Spain. European psychiatry : the journal of the Association of European Psychiatrists. 2006;21(7):463-70.

243. Chanpattana W, Kunigiri G, Kramer BA, Gangadhar BN. Survey of the practice of electroconvulsive therapy in teaching hospitals in India. The journal of ECT. 2005;21(2):100-4.
244. d'Elia G. Unilateral electroconvulsive therapy. Acta psychiatrica Scandinavica Supplementum. 1970;215:1-98.
245. Tew JD, Jr., Mulsant BH, Haskett RF, Dolata D, Hixson L, Mann JJ. A randomized comparison of high-charge right unilateral electroconvulsive therapy and bilateral electroconvulsive therapy in older depressed patients who failed to respond to 5 to 8 moderate-charge right unilateral treatments. The Journal of clinical psychiatry. 2002;63(12):1102-5.
246. Stromgren LS. Is bilateral ECT ever indicated? Acta psychiatrica Scandinavica. 1984;69(6):484-90.
247. Bergsholm P. Electroconvulsive therapy : issues related to narcosis, physiology, radiological anatomy, electrode placement, endocrinology. Department of psychiatry: Bergen; 1995.
248. Sand Strömgren L. Unilateral og bilateral ECT: Depression og hukommelse: Aarhus 1978.
249. Bakewell CJ, Russo J, Tanner C, Avery DH, Neumaier JF. Comparison of clinical efficacy and side effects for bitemporal and bifrontal electrode placement in electroconvulsive therapy. The journal of ECT. 2004;20(3):145-53.
250. Bailine SH, Rifkin A, Kayne E, Selzer JA, Vital-Herne J, Blieka M, et al. Comparison of bifrontal and bitemporal ECT for major depression. The American journal of psychiatry. 2000;157(1):121-3.
251. Sienaert P, Vansteelandt K, Demyttenaere K, Peuskens J. Randomized comparison of ultra-brief bifrontal and unilateral electroconvulsive therapy for major depression: clinical efficacy. Journal of affective disorders. 2009;116(1-2):106-12.
252. Dunne RA, McLoughlin DM. Systematic review and meta-analysis of bifrontal electroconvulsive therapy versus bilateral and unilateral electroconvulsive therapy in depression. The world journal of biological psychiatry : the official journal of the World Federation of Societies of Biological Psychiatry. 2012;13(4):248-58.
253. Sackeim HA, Decina P, Portnoy S, Neeley P, Malitz S. Studies of dosage, seizure threshold, and seizure duration in ECT. Biological psychiatry. 1987;22(3):249-68.
254. Tiller JW, Ingram N. Seizure threshold determination for electroconvulsive therapy: stimulus dose titration versus age-based estimations. The Australian and New Zealand journal of psychiatry. 2006;40(2):188-92.
255. McCall WV, Reboussin DM, Weiner RD, Sackeim HA. Titrated moderately suprathreshold vs fixed high-dose right unilateral electroconvulsive therapy: acute antidepressant and cognitive effects. Archives of general psychiatry. 2000;57(5):438-44.
256. Petrides G, Fink M. The "half-age" stimulation strategy for ECT dosing. Convulsive therapy. 1996;12(3):138-46.
257. Ottosson JO. Experimental studies of the mode of action of electroconvulsive therapy: Introduction. Acta psychiatrica Scandinavica Supplementum. 1960;35(145):5-6.
258. Dowman J, Patel A, Rajput K. Electroconvulsive therapy: attitudes and misconceptions. The journal of ECT. 2005;21(2):84-7.
259. Aki OE, Ak S, Sonmez YE, Demir B. Knowledge of and attitudes toward electroconvulsive therapy among medical students, psychology students, and the general public. The journal of ECT. 2013;29(1):45-50.
260. Gazdag G, Kocsis-Ficzere N, Tolna J. Hungarian medical students' knowledge about and attitudes toward electroconvulsive therapy. The journal of ECT. 2005;21(2):96-9.

261. Papakosta VM, Zervas IM, Pehlivanidis A, Papadimitriou GN, Papakostas YG. A survey of the attitudes of Greek medical students toward electroconvulsive therapy. The journal of ECT. 2005;21(3):162-4.
262. Gazdag G, Zsargo E, Kerti KM, Grecu IG. Attitudes toward electroconvulsive therapy in Romanian psychiatrists. The journal of ECT. 2011;27(3):e55-6.
263. Golenkov A, Ungvari GS, Gazdag G. ECT practice and psychiatrists' attitudes towards ECT in the Chuvash Republic of the Russian Federation. European psychiatry : the journal of the Association of European Psychiatrists. 2010;25(2):126-8.
264. McDonald A, Walter G. ECT and stigma. In: Ghaziuddinn N, Walter G, editors. Electroconvulsive therapy in children and adolescents. Oxford: Oxford University Press; 2012.
265. Muller U, Klimke A, Janner M, Gaebel W. [Electroconvulsive therapy in psychiatric clinics in Germany in 1995]. Nervenarzt. 1998;69(1):15-26.
266. Norway S. Vital statistic and migration, 1951-2006 [Statistics Norway Website] Available at: http://www@ssb.no2009.
267. Hermann RC, Dorwart RA, Hoover CW, Brody J. Variation in ECT use in the United States. The American journal of psychiatry. 1995;152(6):869-75.
268. Lookene M, Kisuro A, Maciulis V, Banaitis V, Ungvari GS, Gazdag G. Use of electroconvulsive therapy in the Baltic states. The world journal of biological psychiatry : the official journal of the World Federation of Societies of Biological Psychiatry. 2013.
269. Levav I, Gonzalez UR. The use of electroconvulsive therapy in Latin America and the Caribbean [Spanish]. Acta Psiquiatr Psicol Am Lat. 1996;42:137-41.
270. The national board of health and welfare. Socialstyrelsen kartlägger ECT-behandling inom vården [Socialstyrelsen Web site] Sweden: The national board of health and welfare; 2009. Available from: http://www.socialstyrelsen.se/pressrum/nyhetsarkiv/etc.
271. Chung KF. Electroconvulsive therapy in Hong Kong: rates of use, indications, and outcome. The journal of ECT. 2003;19(2):98-102.
272. Kaliora SC, Braga RJ, Petrides G, Chatzimanolis J, Papadimitriou GN, Zervas IM. The practice of electroconvulsive therapy in Greece. The journal of ECT. 2013;29(3):219-24.
273. Rosenbach ML, Hermann RC, Dorwart RA. Use of electroconvulsive therapy in the Medicare population between 1987 and 1992. Psychiatr Serv. 1997;48(12):1537-42.
274. Mugisha RX, Ovuga EB. The use of electroconvulsive therapy in the treatment of psychiatric illness at Umzimkulu Hospital in Transkei. A retrospective study. South African medical journal = Suid-Afrikaanse tydskrif vir geneeskunde. 1991;79(7):391-3.
275. Selis MA, Kauye F, Leentjens AF. The practice of electroconvulsive therapy in Malawi. The journal of ECT. 2008;24(2):137-40.
276. McCall WV, Weiner RD, Shelp FE, Austin S. ECT in a State Hospital Setting. Convulsive therapy. 1992;8(1):12-8.
277. Sylvester AP, Mulsant BH, Chengappa KN, Sandman AR, Haskett RF. Use of electroconvulsive therapy in a state hospital: a 10-year review. The Journal of clinical psychiatry. 2000;61(7):534-9; quiz 40.
278. Little JD. ECT in the Asia Pacific region: what do we know? The journal of ECT. 2003;19(2):93-7.
279. Eranti SV, McLoughlin DM. Electroconvulsive therapy - state of the art. The British journal of psychiatry : the journal of mental science. 2003;182:8-9.
280. Zeren T TL, Evlice YE Electroconvulsive Therapy: Assesment of Practice of 12 Years' Period [Turkish] Yeni Symposium: psikiyatri, noroloji ve davranis bilimleri dergisi 2003;;41(2):54-63.

281. Alhamad AM, al-Haidar F. A retrospective audit of electroconvulsive therapy at King Khalid University Hospital, Saudi Arabia. Eastern Mediterranean health journal = La revue de sante de la Mediterranee orientale = al-Majallah al-sihhiyah li-sharq al-mutawassit. 1999;5(2):255-61.
282. Lamont S, Brunero S, Barclay C, Wijeratne C. Evaluation of an electroconvulsive therapy service in a general hospital. International journal of mental health nursing. 2011;20(3):223-9.
283. Chanpattana W, Kramer BA, Kunigiri G, Gangadhar BN, Kitphati R, Andrade C. A survey of the practice of electroconvulsive therapy in Asia. The journal of ECT. 2010;26(1):5-10.
284. Chanpattana W, Kojima K, Kramer BA, Intakorn A, Sasaki S, Kitphati R. ECT practice in Japan. The journal of ECT. 2005;21(3):139-44.
285. Ahikari SR, Pradhan SN, Sharma SC, Shrestha BR, Shrestha S, Tabedar S. Diagnostic variability and therapeutic efficacy of ECT in Nepalese sample. Kathmandu Univ Med J (KUMJ). 2008;6(1):41-8.
286. Chung J, Yim P, Dunn E. Clinical and treatment characteristics of Chinese patients undergoing electroconvulsive therapy in an acute psychiatric unit in Hong Kong. Hong Kong J Psychiatr 2009(4):150-4.
287. Naqvi H, Khan MM. Use of electroconvulsive therapy at a university hospital in Karachi, Pakistan: a 13-year naturalistic review. The journal of ECT. 2005;21(3):158-61.
288. Department of Health. Electro Convulsive Therapy: Survey covering the period from January 2002 to March 2002 England: Department of Health; 2003 [cited 2011 January 6]. Available from: http://www.dh.gov.uk/en/Publicationsandstatistics/Statistics/StatisticalWorkAreas/Statistical healthcare/DH_4000216.
289. Teh SP, Xiao AJ, Helmes E, Drake DG. Electroconvulsive therapy practice in Western Australia. The journal of ECT. 2005;21(3):145-50.
290. Lima NN, Nascimento VB, Peixoto JA, Moreira MM, Neto ML, Almeida JC, et al. Electroconvulsive therapy use in adolescents: a systematic review. Annals of general psychiatry. 2013;12(1):17.
291. Ghaziuddin N, Kutcher SP, Knapp P, Bernet W, Arnold V, Beitchman J, et al. Practice parameter for use of electroconvulsive therapy with adolescents. Journal of the American Academy of Child and Adolescent Psychiatry. 2004;43(12):1521-39.
292. Prudic J, Haskett RF, Mulsant B, Malone KM, Pettinati HM, Stephens S, et al. Resistance to antidepressant medications and short-term clinical response to ECT. The American journal of psychiatry. 1996;153(8):985-92.
293. Ottosson JO. Is Unilateral Nondominant ECT as Efficient as Bilateral ECT? A New Look at the Evidence. Convulsive therapy. 1991;7(3):190-200.
294. Sackeim HA, Prudic J, Nobler MS, Fitzsimons L, Lisanby SH, Payne N, et al. Effects of pulse width and electrode placement on the efficacy and cognitive effects of electroconvulsive therapy. Brain stimulation. 2008;1(2):71-83.
295. Eschweiler GW, Vonthein R, Bode R, Huell M, Conca A, Peters O, et al. Clinical efficacy and cognitive side effects of bifrontal versus right unilateral electroconvulsive therapy (ECT): a short-term randomised controlled trial in pharmaco-resistant major depression. Journal of affective disorders. 2007;101(1-3):149-57.
296. Scarano VR, Felthous AR, Early TS. The state of electroconvulsive therapy in Texas. Part I: reported data on 41,660 ECT treatments in 5971 patients. Journal of forensic sciences. 2000;45(6):1197-202.

297. Gonzalez-Pinto A, Gutierrez M, Gonzalez N, Elizagarate E, Perez de Heredia JL, Mico JA. Efficacy and safety of venlafaxine-ECT combination in treatment-resistant depression. The Journal of neuropsychiatry and clinical neurosciences. 2002;14(2):206-9.
298. Tang WK, Ungvari GS. Efficacy of electroconvulsive therapy in treatment-resistant schizophrenia: a prospective open trial. Progress in neuro-psychopharmacology & biological psychiatry. 2003;27(3):373-9.
299. Hustig H, Onilov R. ECT rekindles pharmacological response in schizophrenia. European psychiatry : the journal of the Association of European Psychiatrists. 2009;24(8):521-5.
300. Duffett R, Lelliott P. Junior doctors' training in the theory and the practice of electroconvulsive therapy. The journal of ECT. 1998;14(2):127-30.
301. Yuzda E, Parker K, Parker V, Geagea J, Goldbloom D. Electroconvulsive therapy training in Canada: a call for greater regulation. Canadian journal of psychiatry Revue canadienne de psychiatrie. 2002;47(10):938-44.
302. Mankad MV BJ, Weiner RD et al. Clinical manual of electroconvulsive therapy. Washington (DC): American Psychiatric Publishing; 2010.
303. Ottosson J-O, Fink M. Ethics in electroconvulsive therapy. New York: Brunner-Routledge; 2004. x, 157 p. p.
304. Huuhka MJ KL, Leinonen EVJ. Historical perspective on electroconvulsive therapy in Pitkaniemi Hospital: a comparison of practice in 1940s, 1960s and 1990s. Psychiatria Fennica. 2000;31:55-64.
305. Fergusson GM, Cullen LA, Freeman CP, Hendry JD. Electroconvulsive therapy in Scottish clinical practice: a national audit of demographics, standards, and outcome. The journal of ECT. 2004;20(3):166-73.
306. Wood DA, Burgess PM. Epidemiological analysis of electroconvulsive therapy in Victoria, Australia. The Australian and New Zealand journal of psychiatry. 2003;37(3):307-11.
307. Chanpattana W. One hundred twenty years of mental health care in Thailand and the development of electroconvulsive therapy. The journal of ECT. 2010;26(1):11-3.
308. Mudur G. Indian group seeks ban on use of electroconvulsive therapy without anaesthesia. BMJ. 2002;324(7341):806.
309. Andrade C, Chanpattana W, Kramer BA, Kunigiri G, Gangadhar BN, Kitphati R. The Practice of Electroconvulsive Therapy in Asia Variations and Deviations From the Guidelines-A Response to Dr Grunhaus. Journal of Ect. 2010;26(1):34-6.
310. Grunhaus L. A Call for Action-My Own Personal Views. Journal of Ect. 2010;26(1):32-3.
311. Strachan J. Electroconvulsive therapy-attitudes and practice in New Zealand. Psychiatr Bull. 2001;25:467-70.
312. Ishimoto Y, Imakura A, Nakayama H. Practice of electroconvulsive therapy at University Hospital, the University of Tokushima School of Medicine from 1975 to 1997. The journal of medical investigation : JMI. 2000;47(3-4):123-7.
313. Duffett R, Lelliott P. Auditing electroconvulsive therapy. The third cycle. The British journal of psychiatry : the journal of mental science. 1998;172:401-5.
314. Motohashi N, Awata S, Higuchi T. A questionnaire survey of ECT practice in university hospitals and national hospitals in Japan. The journal of ECT. 2004;20(1):21-3.
315. O'Dea JF, Mitchell PB, Hickie IB. Unilateral or bilateral electroconvulsive therapy for depression? A survey of practice and attitudes in Australia and New Zealand. The Medical journal of Australia. 1991;155(1):9-11.
316. Tauscher J, Neumeister A, Fischer P, Frey R, Kasper S. [Electroconvulsive therapy in clinical practice]. Nervenarzt. 1997;68(5):410-6.

317. Alberani V, De Castro Pietrangeli P, Mazza AM. The use of grey literature in health sciences: a preliminary survey. Bulletin of the Medical Library Association. 1990;78(4):358-63.

# Appendix 1

**NTNU**
**Noregs teknisk-naturvitskaplege universitet**

**Det medisinske fakultet**
**Institutt for nevromedisin**

Vår dato: 10.03.05

**SPØRRESKJEMA FOR UNDERSØKELSE AV ELEKTROKONVULSIV BEHANDLING (ECT) I NORGE OG SVERIGE**

I forbindelse med etableringen av Nordisk Selskap for Konvulsiv Terapi (Nordic Association of Convulsive Therapy: NACT) ser man behovet for en oversikt over virksomheten av ECT ved psykiatriske enheter i Norden.
Vi har utarbeidet et skjema for å kartlegge bruken av ECT i Norge. Dette skjemaet sendes til alle psykiatriske enheter i Norge med ønske om at det blir besvart innen 1.desember 2005.

Spørsmålene etterlyser opplysninger om ECT- virksomheten fra året 2004. De som ikke utfører ECT ved enheten bes besvare spørsmål 1-4.
Vennligst svar så fullstendig som mulig.

På forhånd takk.
Med hilsen

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**A. Spørsmål om institusjonen**

1. Utføres ECT ved Deres enhet? Ja_____ Nei_____

   Hvis Nei, hvorfor _____

   Hva gjør Dere da dersom det er behov for ECT?_____

   Hvis Nei, dersom Dere hadde pasienter som fikk ECT i 2004 ved annen enhet enn Deres, angi om mulig hvor mange og hvor ECT ble utført

   _____
   ____

   Hvis Ja, fikk likevel noen av Deres pasienter ECT ved annen enhet?_____ Angi om mulig hvor mange og hvor ECT da ble utført

   _____
   _____

2. Hva er det totale befolkningsgrunnlaget (antall pasienter per avdeling/sektor)?
   Oppgi evt. enhets andel av sektors totale dersom befolkningsgrunnlaget ikke betjenes alene. _____

3. Hvor mange pasienter var innlagt ved Deres psykiatriske avdeling i 2004?_____

**B. Spørsmål om holdninger**

4. Spørsmål om holdninger til ECT:
   - Pga innføringen av psykofarmaka er ECT blitt overflødig? Ja___ Nei___
   - Hvert sykehus som vil tilby et omfattende behandlingstilbud, må også ha mulighet til å tilby ECT? Ja____ Nei____
   - Det finnes i dag klare indikasjoner for ECT? Ja___ Nei____
   - ECT brukes som siste utvei? Ja____ Nei_____
   - ECT er forbundet med ikke reversible hukommelsesproblemer? Ja____ Nei____
   - ECT blir i dag sjeldnere anvendt enn det som er nødvendig? Ja____ Nei_____
   - ECT kan gi hjerneskade? Ja____ Nei ____

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**C. Spørsmål tilknyttet bruken av ECT**

5. Gjøres ECT på den psykiatriske enheten? _____
   Hvis ikke, hvor lang distanse er det til der ECT utføres?_____

6. Er det kapasitet til å gi ECT til alle som trenger det uten ventetid? _____
   Hvis ikke, hvor lenge må man vente?_____

7. Hvem bestemmer at ECT skal gis? _____

8. Hvem gir ECT? (overlege, assistentlege, sykepleier) _____

9. Har Dere noen formell opplæring av bruken av ECT?_____

10. Informeres pasienten muntlig? ____ Skriftlig?____ Anvendes skriftlig samtykkeskjema?____

11. Brukes eget ECT-skjema eller ECT-journal? _____

12. Brukes anestesijournal? _____

13. Hvor mange sykepleiere deltar ved behandlingen? _____

14. Minstekrav til undersøkelser før ECT?_____

15. Hvilke rutiner har Dere for samtidig bruk av psykofarmaka (blir litium, benzodiazepiner, antikonvulsiva eller andre medikamenter seponert før ECT)?

_____

_____

_____

16. Gi en kort beskrivelse og vurdering av lokalene (hensiktsmessige?)

_____

17. Hvem utfører narkosen? _____

18. Hvilke narkosemidler brukes, og i hvilken dose (mg/kg)?_____

19. Får pasientene oksygentilførsel? _____Blir oksygenmetningen målt? _____
    Blir pasientene eller noen av dem intubert? _____
    Blir pasientene ventilert under hele behandlingen? _____Blir de hyperventilert? ____
    Brukes svelgtube? _____Brukes tannbeskyttelse? _____

20. Hvilket ECT- apparat brukes (MECTA, Thymatron m.fl.)?_____

21. Anvendes EEG- monitorering? _____

22. Hvilke elektrodeplasseringer ble brukt? (antall dersom mulig):
Unilateral (d`Elia): _____ Bitemporal: _____ Bifrontal: _____
Andre: _____
Har Dere hos noen pasienter pga dårlig effekt skiftet fra unilateral til bilateral plassering? ___
Hvis Ja, hvor mange pasienter? ____

23. På hvilken måte bestemmes strømmengde (mC)?
Ved titrering: _____ Evt hvor høyt over anfallsterskelen?_____
Ut fra alder: _____ Hvordan?
_____
Tas kjønn med ved bestemmelsen? _____ Hvordan?
_____

24. Hvilke verdier foretrekkes for? (svar evt "kortest mulig" eller "lengst mulig")
Pulsvidde_____ Pulsfrekvens _____
Stimuleringstid (pulstogets varighet) _____

25. Hvordan måles krampeanfallets lengde?
EEG: _____
Mansjettmetoden:_____
Observasjon av ekstremiteter, øyelokk og/eller øyne:_____

26. Hvilke ukedager gis ECT? _____
Hvor mange pasienter er det kapasitet til per dag? _____
Kan ECT om nødvendig gis andre dager? _____

27. Hvor mange pasienter fikk ECT i 2004? _____ Antall kvinner_____ Antall menn_____

28. Hvor mange elektrokonvulsive behandlingsserier (uavbrutt serie) ble gitt i 2004?_____

29. Hvor mange pasienter fikk 2 ECT- serier? ___ 3 ECT- serier? ___
4 ECT- serier? _____ >4 ECT- serier? _____

30. Hvor mange pasienter fikk vedlikeholds- ECT? _____

31. Hvor mange pasienter fikk ECT poliklinisk? _____

32. Hvilke diagnostiske grupper var pasientene i? (antall dersom mulig)

a. Unipolar depresjon _____

b. Bipolar depresjon _____
c. Mani _____
d. Blandingstilstand _____
e. Polymorf psykose _____
f. Schizoaffektiv lidelse _____
g. Schizofreni _____
h. Parkinsons sykdom _____
i. Andre, hvilke diagnoser _____

33. Hvilke indikasjoner for ECT? (antall dersom mulig)

a. Dårlig effekt av psykofarmaka _____
b. Bivirkninger av psykofarmaka _____
c. For alvorlig til å vente på effekt av psykofarmaka
- Psykotisk _____
- Sterk hemming/katatoni _____
- Spise-drikkevegring _____
- Suicidalfare _____
- Postpartum _____
- Pasienten ønsker helst ECT _____
- Annet, oppgi hva _____

34. Antall behandlinger per pasient?
1-3 _____
4-6 _____
7-9 _____
10-12 _____
>12 _____

35. Angi om mulig hvor mange pasienter som kom i hver aldersgruppe:

<18 _____
18-24 _____
25-44 _____
45-64 _____
>64 _____

36. Angi om mulig hvor mange pasienter som kom i hver CGI endringsgruppe nedenfor:
veldig mye bedre _____
mye bedre _____
litt bedre _____
ingen endring _____
verre _____

37. Angi om mulig hvor mange pasienter som etter behandlingen lenge klaget over:
veldig mye amnesi _____
mye amnesi _____
litt amnesi _____

langvarig amnesi, hvor lenge _____

38. Angi om mulig hvor mange pasienter som etter behandlingen lenge klaget over:
    veldig mye hodepine _____
    mye hodepine _____
    litt hodepine _____

39. Angi om mulig hvor mange pasienter som etter behandlingen lenge klaget over andre bivirkninger, hvilke bivirkninger _____
    Har Dere notert årsak f.eks. litium, langvarige krampeanfall osv.?_____

40. Opplevde Dere noen dødsfall relatert til behandlingen?_____

Kommentarer og synspunkter på spørreskjemaet:

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**Takk for Deres medvirkning!**

**Hvis Dere har spørsmål i forbindelse med spørreskjemaet er Dere velkommen til å ta kontakt med Lindy Jarosch-von Schweder.**
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## Original papers I-IV

# Paper I

# Electroconvulsive therapy at a county hospital in Norway: Rates of use, demographics and diagnoses

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Authors have no disclosure of interest.

**Abstract**

**Objectives**

This is a retrospective study of the clinical use of ECT in a county hospital in Norway between 1993 and 2003. The study aimed to determine the rates of use, demographics and diagnoses, and to compare standards for ECT practice at this specific hospital with similar studies conducted elsewhere.

**Methods**

The study is based on data collected from specific ECT records and the patients' medical records. To compare our results with others, the frequency rates were calculated as number of ECT treatments per 100,000 per year, number of patients receiving ECT per 100,000 per year, and percent of in-patients who received ECT.

**Results**

During 11 years, 210 patients had received ECT, representing 4.2 % of in-patients. There was no trend in the proportion receiving ECT in the period. It varied between 1.8% in 2000 and 5.7% in 1997. Totally, 1,657 ECT treatments were administered to the 210 patients, giving a rate of 109 ECT treatments per 100,000 person years. Of the patients, 137 (65%) were women, and 76 (36%) were 65 years or more. Unipolar or bipolar depressive disorders were the most common diagnostic indications (85%), followed by puerperal mental disorder (3.4%) and personality disorders (3%).

**Conclusions**

We found no trend in proportion of patients given ECT, as opposed to other studies. Most patients who received ECT were women and elderly, and depression was the most common disorder. ECT is an important treatment in psychiatry, especially for the treatment of severe depression.

**Keywords**

Electroconvulsive therapy, county hospital, demographics, indications

## Introduction

Electroconvulsive therapy (ECT) has become widely available on all continents within psychiatric practice, and worldwide it is estimated that about one million patients per year receive ECT (1-8). However, there are variations in rates of use between countries, between regions within a country, and within individual centres over time (1, 8-11). Many factors contribute to these variations, such as patients' and health personnel's knowledge about ECT and their attitudes towards ECT, lack of training courses, economy, availability of psychiatrists or equipment, and some countries' legislative requirements (1, 5, 8, 12-15).

There are no Norwegian guidelines for the use of ECT, though psychiatrists are required to have knowledge about the treatment. The ECT rate of use in Norway was 2.4 per 10,000 population per year in 2004, but varied from 1.83 to 3.44 between the different health region authorities (8). In line with other western countries the patients receiving ECT in Norway most often are elderly women with severe depression (3, 10, 12, 16). However, ECT is reported to be safe and effective also for other psychiatric disorders such as mania, bipolar mixed states, polymorphic (cycloid) psychosis and schizophrenia (17-20).

This study focuses on the clinical use of ECT in the psychiatric unit at a general psychiatric department in the central health region of Norway. We aimed to determine the rate of use over time, demographics and diagnoses of patients who

received ECT, and to compare our results with that of similar studies conducted elsewhere.

## Material and Methods

### *Setting*

The study was carried out at a county Hospital in Ålesund, located on the western coast of Norway, which provided health services for the catchment area of 122,000 inhabitants in 1993, increasing to 127,000 in 2003. Between 1993 and 2003 the mean annual number of adults (≥ 18 years) admitted to the inpatient psychiatric unit was 491 (range 282 to 822). However, all patients receiving ECT were 20 years or above. The mean annual number of patients 20 years or above admitted to the inpatient psychiatric unit was 459 (range 282 to 776) in the study period. All ECT treatments in the region were done in this unit.

### *Data collection*

All patients who were admitted to the psychiatric unit from 1993 to 2003 and received ECT as part of their hospitalisation, were included in the analyses. All patients provided informed consent for ECT. Six patients withdrew consent and treatment was terminated. The study is based on data collected from dedicated ECT records and the patients' medical records. These two sources of information were not independent, as the same physician recorded both, but they included different information. Age, gender, diagnosis and number of treatments per course were recorded. Medical records of 6 patients could not be retrieved, and for these patients information was obtained only from the ECT journals.

We found 210 patients who had received ECT during this period. All patients were 20 years or above. For patients who had more than one ECT series, only the first series was included.

Indications and appropriateness for ECT were evaluated by the ward psychiatrist. Patients were diagnosed according to ICD-9 until it was replaced with ICD-10 criteria in 1998. ICD-9 diagnoses were converted into corresponding ICD-10 diagnoses.

### *Statistical analysis*

SPSS Version 19 and Stata Version 12 were used for statistical analyses. The frequencies per year were calculated as percentage of inpatients receiving ECT, number of ECT patients and treatment sessions per 100,000 population, and mean number of sessions per ECT series. These were analysed by Poisson regression, with year as independent variable, adjusting for number of inpatients and population. The yearly variation in use of ECT was analysed in mixed model Poisson regression, with year as random effect. The proportion of psychiatric patients given ECT per year was analysed in logistic regression, with gender, age group and year as covariates. Two-sided P-values $<0.05$ were considered significant, and 95% confidence intervals (CI) are reported when relevant. The population development in the years 1993-2003 was obtained from Statistics Norway (21).

## Results

### *Rates of use*

From 1993 to 2003 a total of 210 patients received ECT, representing 4.2 % of all the 5045 psychiatric inpatients at this psychiatric unit (≥ 20 years). Table 1 shows the use of ECT in the hospital from 1993 to 2003. The use of ECT per 100,000 population per year increased totally with 7.5% (CI 2.9% to 12.3%, p=0.001). The total admission of patients also increased, resulting in a non-significant reduction in the proportion of inpatients given ECT (yearly change -2.9%, CI -6.8% to 1.3%, p=0.18). However, there were variations from year to year (Table 1), close to statistical significance (mixed model Poisson regression, p=0.052). The lowest percentage of ECT patients was in 2000 with 1.8% of admissions, the highest in 1997 with 5.7% ECT of admissions.

There was a mean of 15.2 patients per 100,000 per year treated with ECT in the period (range 6 to 26). Totally, 1,657 ECT treatments were administered to 210 patients, giving a rate of 109 ECT treatments per 100,000 persons per year (range 57 to 199). The mean number of ECT sessions per series was 7.9 ± 3.5 (range 1 to 20), with no time trend (p=0.98) during the study period.

***Demographics and diagnoses***

Of the patients receiving ECT 137 (65%) were women and 76 (36%) patients were 65 years or older (Table 2). Mean age was 54 ± 18.2 (range 20-94). Mean age for women was 54.3 ± 18, 0 (range 20-94), mean age for men was 53.4 ± 18.7 (range 23-88). Table 3 summarizes the use of ECT within gender and age groups in the periods 1993-1995, 1996-1999, and 2000-2003. Logistic regression analyses with gender, age group and period as categorical covariates showed a trend towards more frequent use in women (OR 1.32, CI 0.99 to 1.78, p=0.061), significantly more use in the older age groups 50-69 years (OR 2.64, CI 1.93 to 3.62, p<0.001) and 70+ years

(OR 4.27. CI 2.94 to 6.20, p<0.001), and no time trend (OR per year 0.992, CI 0.94 to 1.05, p=0.77). There were no significant interactions between any of the covariates. Depressive disorders were the most common diagnostic indications for ECT (N=157), followed by bipolar disorder (N=22) and other diagnoses (N=22) (Table 2).

## Discussion

### *Rates of use*

The 4.2 % proportion of in-patient receiving ECT is in agreement with other European reports (22-25). The proportion remained fairly stable between 1993 and 2003, similar to findings in a study in Hong Kong (23), but in contrast to other studies that found increased or decreased rates of use (3, 16, 22).

However, in our study fluctuations (from 1.8 to 5.7 %) from year to year were close to statistical significance. Such differences within a hospital have been reported earlier among consultant teams in Edinburgh; there was an 18-fold difference (from 0.8 to 15.0%) in use of ECT between 11 general psychiatric teams (9).

Variations within or between hospitals may be due to health personnel's knowledge about and attitudes towards ECT. Lack of national guidelines may also contribute to these variations. Other factors might be differences in budgets and equipment, hospitals' policies and other non-medical factors. The patient population and the number of anaesthesiologists or psychiatrists may also influence this (7, 26-28).

The ECT rate of 15.2 per 100,000 populations per year in our study is comparable to the Netherlands (18 in 1999) (29) and western Australia (14 in 2001) (30). The rate is lower than in Belgium (68 in 2003)(31), Edinburgh (39 in 1996/1997) (16) and Norway as a whole (24 in 2004)(8) , but higher than in Hungary

(3.1 in 2002) (32), Poland (1.1 in 2005) (33), Spain (6.1 in 2001) (1) and Ireland (9.6 in 2008) (34).

***Gender and age***

The higher percentage of women and higher age of patients receiving ECT was in agreement with earlier western reports, although not in agreement with some reports from Asia (9, 12, 24, 35-37).

It may be possible to explain these gender differences by the higher rates of depression among women also reflected in the admittance rates to hospitals and (38), although these rates are not unchallenged (39).

In our study we could confirm the high rate of ECT among elderly. The high frequency of medical co-morbidity may be one reason for the higher age groups being more likely to receive ECT. Also, the lower response rate to medication in this group may be a contributory factor (40-42).

***Diagnoses***

The most frequent indication for ECT in our study was depression (unipolar and bipolar depression, 85%). This is similar to what is described in earlier studies (3, 12, 22). Only a few patients with bipolar disorder with manic symptoms were treated with ECT, although the response rate in mania is reported to be as high as in depression (17). The reasons for the low ECT use in mania may be that these patients are rarely offered ECT, that compliance is difficult to achieve, or that the treatment with psychopharmacology is satisfactory. In our study only one patient with schizophrenia received ECT, which is in line with other studies from western countries (30, 31, 34, 43), but contrasting Asian findings (35, 37, 44). The reasons for this may be the

availability of antipsychotic drugs (8). We found that seven women (3%) with puerperal depression were treated with ECT. This treatment, with proper medical care, is effective in all trimesters of pregnancy, as well as in the postpartum period (45). However, consideration of risk and benefits of ECT must be taken into account including the risk involved for the foetus/unborn child (46).

There is little evidence and no general acceptance for treating anxiety and personality disorders with ECT, but 5.4% of our patients with these diagnoses received ECT.

## Conclusions

We found that the total ECT utilization remained fairly stable in the study period. Patients who received ECT were most women and elderly, and depression was the most common diagnosis.

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## References

1. Bertolin-Guillen JM, Peiro-Moreno S, Hernandez-de-Pablo ME. Patterns of electroconvulsive therapy use in Spain. Eur Psychiatry. 2006;21(7):463-70.

2. Chanpattana W, Kojima K, Kramer BA, Intakorn A, Sasaki S, Kitphati R. ECT practice in Japan. The journal of ECT. 2005;21(3):139-44.

3. Fergusson GM, Cullen LA, Freeman CP, Hendry JD. Electroconvulsive therapy in Scottish clinical practice: a national audit of demographics, standards, and outcome. The journal of ECT. 2004;20(3):166-73.

4. Hermann RC, Dorwart RA, Hoover CW, Brody J. Variation in ECT use in the United States. The American journal of psychiatry. 1995;152(6):869-75.

5. Nelson AI. A national survey of electroconvulsive therapy use in the Russian Federation. J ECT. 2005;21(3):151-7.

6. Odejide AO, Ohaeri JU, Ikuesan BA. Electroconvulsive Therapy in Nigeria. Convuls Ther. 1987;3(1):31-9.

7. Prudic J, Olfson M, Sackeim HA. Electro-convulsive therapy practices in the community. Psychol Med. 2001;31(5):929-34.

8. Schweder LJ, Lydersen S, Wahlund B, Bergsholm P, Linaker OM. Electroconvulsive therapy in Norway: rates of use, clinical characteristics, diagnoses, and attitude. The journal of ECT. 2011;27(4):292-5.

9. Glen T, Scott AI. Variation in rates of electroconvulsive therapy use among consultant teams in Edinburgh (1993-1996). J Affect Disord. 2000;58(1):75-8.

10. Chanpattana W. A questionnaire survey of ECT practice in Australia. The journal of ECT. 2007;23(2):89-92.

11. Leiknes KA, Jarosh-von Schweder L, Hoie B. Contemporary use and practice of electroconvulsive therapy worldwide. Brain and behavior. 2012;2(3):283-344.

12. Reid WH, Keller S, Leatherman M, Mason M. ECT in Texas: 19 months of mandatory reporting. J Clin Psychiatry. 1998;59(1):8-13.

13. Wood DA, Burgess PM. Epidemiological analysis of electroconvulsive therapy in Victoria, Australia. The Australian and New Zealand journal of psychiatry. 2003;37(3):307-11.

14. Muller U, Klimke A, Janner M, Gaebel W. [Electroconvulsive therapy in psychiatric clinics in Germany in 1995]. Nervenarzt. 1998;69(1):15-26.

15. Sienaert P, Filip B, Willy M, Joseph P. Electroconvulsive therapy in Belgium: a questionnaire study on the practice of electroconvulsive therapy in Flanders and the Brussels Capital region. J ECT. 2005;21(1):3-6.

16. Glen T, Scott AI. Rates of electroconvulsive therapy use in Edinburgh (1992-1997). J Affect Disord. 1999;54(1-2):81-5.

17. Mukherjee S, Sackeim HA, Schnur DB. Electroconvulsive therapy of acute manic episodes: a review of 50 years' experience. The American journal of psychiatry. 1994;151(2):169-76.

18. Tharyan P, Adams CE. Electroconvulsive therapy for schizophrenia. Cochrane Database Syst Rev. 2005(2):CD000076.

19. Taylor MA, Fink M. Commentary on "successful use of ECT as the sole modality of treatment in a case of motility psychosis": The classification of catatonia. Journal of Ect. 2003;19(1):48-9.

20. Varamballi S, Jagadisha, Velayudhan L, Gangadhar BN. Successful use of ECT as the sole modality of treatment in a case of motility psychosis. The journal of ECT. 2003;19(1):45-7; discussion 8-9.

21. Norway S. Vital statistic and migration, 1951-2006 [Statistics Norway Website] Availiable at: http://www@ssb.no. Accessed June, 2011.

22. Andersson JE, Bolwig TG. [Electroconvulsive therapy in Denmark 1999. A nation-wide questionnaire study]. Ugeskrift for laeger. 2002;164(26):3449-52.

23. Chung KF. Electroconvulsive therapy in Hong Kong: rates of use, indications, and outcome. The journal of ECT. 2003;19(2):98-102.

24. Moksnes KM. Use of electroconvulsive therapy in an university hospital from 1988 to 2002 in Oslo. Increasing use among the elderly. International Psychogeriatrics. 2005;17:98-98.

25. Baghai TC, Marcuse A, Moller HJ, Rupprecht R. [Electroconvulsive therapy at the Department of Psychiatry and Psychotherapy, University of Munich. Development during the years 1995-2002]. Nervenarzt. 2005;76(5):597-612.

26. Hermann RC, Ettner SL, Dorwart RA, Hoover CW, Yeung E. Characteristics of psychiatrists who perform ECT. The American journal of psychiatry. 1998;155(7):889-94.

27. Latey RH, Fahy TJ. Some influences on regional variation in frequency of prescription of electroconvulsive therapy. The British journal of psychiatry : the journal of mental science. 1988;152:196-200.

28. Philpot M, Treloar A, Gormley N, Gustafson L. Barriers to the use of electroconvulsive therapy in the elderly: a European survey. Eur Psychiatry. 2002;17(1):41-5.

29. van Waarde JA, Verwey B, van den Broek WW, van der Mast RC. Electroconvulsive therapy in the Netherlands: a questionnaire survey on contemporary practice. The journal of ECT. 2009;25(3):190-4.

30. Teh SP, Xiao AJ, Helmes E, Drake DG. Electroconvulsive therapy practice in Western Australia. The journal of ECT. 2005;21(3):145-50.

31. Sienaert P, Dierick M, Degraeve G, Peuskens J. Electroconvulsive therapy in Belgium: a nationwide survey on the practice of electroconvulsive therapy. J Affect Disord. 2006;90(1):67-71.

32. Gazdag G, Kocsis N, Lipcsey A. Rates of electroconvulsive therapy use in Hungary in 2002. J ECT. 2004;20(1):42-4.

33. Gazdag G, Palinska D, Kloszewska I, Sobow T. Electroconvulsive therapy practice in Poland. J ECT. 2009;25(1):34-8.

34. Enriquez S TS, Fitzgibbon N,. Five years of ECT: the relationship between consent status and treatment experiences. I. R J PSYCHOL MED. 2010;27(3):117-22.

35. Chanpattana W, Kramer BA. Electroconvulsive therapy practice in Thailand. J ECT. 2004;20(2):94-8.

36. Chanpattana W, Kramer BA, Kunigiri G, Gangadhar BN, Kitphati R, Andrade C. A survey of the practice of electroconvulsive therapy in Asia. J ECT. 2010;26(1):5-10.

37. Chanpattana W, Kunigiri G, Kramer BA, Gangadhar BN. Survey of the practice of electroconvulsive therapy in teaching hospitals in India. The journal of ECT. 2005;21(2):100-4.

38. Practice guideline for the treatment of patients with major depressive disorder (revision). American Psychiatric Association. Am J Psychiatry. 2000;157(4 Suppl):1-45.

39. Stordal E, Bjartveit Kruger M, Dahl NH, Kruger O, Mykletun A, Dahl AA. Depression in relation to age and gender in the general population: the Nord-Trondelag Health Study (HUNT). Acta Psychiatr Scand. 2001;104(3):210-6.

40. Tew JD, Jr., Mulsant BH, Haskett RF, Dolata D, Hixson L, Mann JJ. A randomized comparison of high-charge right unilateral electroconvulsive therapy and bilateral electroconvulsive therapy in older depressed patients who failed to respond to 5 to 8 moderate-charge right unilateral treatments. J Clin Psychiatry. 2002;63(12):1102-5.

41. Stek ML, Beekman AT, Verwey B. [Electroconvulsive therapy in late life depression: a review]. Tijdschr Gerontol Geriatr. 1997;28(3):106-12.

42. Gibbons RD, Hur K, Brown CH, Davis JM, Mann JJ. Benefits from antidepressants: synthesis of 6-week patient-level outcomes from double-blind

placebo-controlled randomized trials of fluoxetine and venlafaxine. Archives of general psychiatry. 2012;69(6):572-9.

43. Scarano VR, Felthous AR, Early TS. The state of electroconvulsive therapy in Texas. Part I: reported data on 41,660 ECT treatments in 5971 patients. J Forensic Sci. 2000;45(6):1197-202.

44. Little JD. ECT in the Asia Pacific region: what do we know? The journal of ECT. 2003;19(2):93-7.

45. Saatcioglu O, Tomruk NB. The Use of Electroconvulsive Therapy in Pregnancy: A Review. Isr J Psychiatr Rel. 2011;48(1):6-11.

46. Leiknes KA, Cooke MJ, Jarosch-von Schweder L, Harboe I, Hoie B. Electroconvulsive therapy during pregnancy: a systematic review of case studies. Archives of women's mental health. 2013.

*Table 1*. The use of ECT at a county hospital in Norway from 1993 to 2003.

| | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of ECT patients (N=210) | 13 | 19 | 16 | 8 | 17 | 19 | 24 | 11 | 23 | 33 | 27 | 19 |
| Total number of admitted patients *(N= 5045) | 318 | 341 | 334 | 302 | 282 | 347 | 403 | 548 | 660 | 735 | 776 | 459 |
| % of patients given ECT | 3.86 | 5.41 | 4.56 | 2.52 | 5.69 | 5.41 | 5.38 | 1.76 | 3.08 | 4.36 | 3.60 | 3.94 |
| Average number of treatments per ECT course | 6.3 | 8.4 | 7.8 | 8.9 | 6.9 | 8.9 | 10.5 | 9.7 | 6.0 | 7.6 | 6.9 | 8.0 |

*Patients 20 years and above

*Table 2*. Demographics and diagnoses of the 210 patients who received ECT from 1993 to 2003.

| **Variables** | **N= Total sample (%)** |
|---|---|
| **Age (yrs)** | |
| <25 | 9 (4.3) |
| 25-34 | 34 (16.2) |
| 35-44 | 34 (16.2) |
| 45-54 | 27 (12.9) |
| 55-65 | 30 (14.3) |
| >65 | 76 (36.2) |
| Mean (SD, Range) | 54 (18.2, 20 to 94) |
| **Gender** | |
| Men | 73 (35) |
| Women | 137 (65) |
| **Primary Diagnosis ICD10** | |
| Major depressive disorder | 157 (74.9) |
| Bipolar disorder, depressed | 21 (10.1) |
| Puerperal mental disorder | 7 (3.4) |
| Personality Disorder | 6 (3.0) |
| Anxiety disorder | 5 (2.4) |
| Paranoid psychosis | 3 (1.4) |
| Schizophrenia | 1 (0.5) |
| Bipolar disorder, mania or mixed | 1 (0.5) |
| Missing diagnostic information | 9 ( 4.3) |

*Table 3*. Percent of admitted patients given ECT by gender and age groups in three time periods

| Period | 1993-1996 | 1997-1999 | 2000-2003 |
|---|---|---|---|
| **Women** | | | |
| **20-49 years** | 3.6 | 3.4 | 2.7 |
| **50-69 years** | 7.3 | 11.2 | 5.3 |
| **>70 years** | 5.7 | 12.5 | 12.4 |
| | | | |
| **Men** | | | |
| **20-49 years** | 1.5 | 1.4 | 1.9 |
| **50-69 years** | 5.1 | 12.8 | 5.8 |
| **>70 years** | 12.2 | 20.0 | 11.0 |

# Paper II

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# Paper III

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# Paper IV

Brain and Behavior

Open Access

# Contemporary use and practice of electroconvulsive therapy worldwide

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**Keywords**
Electroconvulsive therapy, epidemiology, health care surveys, mental disorders, review, systematic.

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## Abstract

To explore contemporary (from 1990) utilization and practice of electroconvulsive therapy (ECT) worldwide. Systematic search (limited to studies published 1990 and after) was undertaken in the databases Medline, Embase, PsycINFO, SveMed, and EBSCO/Cinahl. Primary data-based studies/surveys with reported ECT utilization and practice in psychiatric institutions internationally, nationally, and regionally; city were included. Two reviewers independently checked study titles and abstracts according to inclusion criteria, and extracted ECT utilization and practice data from those retrieved in full text. Seventy studies were included, seven from Australia and New Zealand, three Africa, 12 North and Latin America, 33 Europe, and 15 Asia. Worldwide ECT differences and trends were evident, average number ECTs administered per patient were eight; unmodified (without anesthesia) was used in Asia (over 90%), Africa, Latin America, Russia, Turkey, Spain. Worldwide preferred electrode placement was bilateral, except unilateral at some places (Europe and Australia/New Zealand). Although mainstream was brief-pulse wave, sine-wave devices were still used. Majority ECT treated were older women with depression in Western countries, versus younger men with schizophrenia in Asian countries. ECT under involuntary conditions (admissions), use of ambulatory-ECT, acute first line of treatment, as well as administered by other professions (geriatricians, nurses) were noted by some sites. General trends were only some institutions within the same country providing ECT, training inadequate, and guidelines not followed. Mandatory reporting and overall country ECT register data were sparse. Many patients are still treated with unmodified ECT today. Large global variation in ECT utilization, administration, and practice advocates a need for worldwide sharing of knowledge about ECT, reflection, and learning from each other's experiences.

## Introduction

Convulsive interventions have been used to treat mental disorders since the 16th century and even today in the form of electroconvulsive therapy (ECT). Ugo Cerletti and Luigi Bini demonstrated ECT in Rome for the first time in 1938 (Cerletti and Bini 1938). The ECT intervention per se, that is, the application of electrical current to the scalp in order to provoke a generalized epileptic seizure, for the purpose of alleviating psychotic and depressive symptoms, is still much the same today as it was in the beginning. Modifications of Cerletti and Bini's original bitemporal placement of electrodes to the scalp, administering 120 V sine-wave electrical current to the head (Cerletti and Bini 1938), include the development of newer brief-pulse electrical current wave devices and unilateral (UL) placement of electrodes.

ECT was originally used in the treatment of schizophrenia. ECTs effectiveness for patients with depression was established in 1941 (Hemphill and Walter 1941). The use of ECT declined in the 1970s and 1980s after the introduction of

pharmacotherapy for severe mental disorders (McCall 2001). The main indication for ECT also transformed from first-line to last-resort treatment for medication-resistant and very severe life-threatening clinical conditions (McCall 2001; Eranti and McLoughlin 2003). However, in 2001, guidelines developed by the American Psychiatric Association (APA) advised that ECT should not only be used as a last resort (American Psychiatric Association 2001). Situations of increased risk that need special attention are mentioned by international guidelines, such as patients with disorders of the central nervous system, cardiovascular and respiratory system (American Psychiatric Association 2001; Royal College of Psychiatrists 2005; Enns et al. 2010). As a result of cognitive side effects (memory impairment) association with sine-wave current (The UK ECT Review Group 2003), it is now advised that brief-pulse wave be the standard treatment (American Psychiatric Association 2001; Royal College of Psychiatrists 2005; Enns et al. 2010). The use of sine-wave constant voltage and constant energy devices is currently not considered justified (APA guidelines) (American Psychiatric Association 2001).

ECT spread rapidly from Europe to other continents and to the United States, due to the Second World War's displacement of psychiatrists (Shorter 2009). In the beginning, ECT was administered without anesthesia (termed unmodified ECT) and later, under anesthesia together with muscle relaxant succinylcholine medication (termed modified ECT), in order to reduce side effects from the convulsions, such as bone fractures, teeth, tendon, and muscular damage. In the last decade, modified ECT has been recommended as the standard routine according to internationally established guidelines (American Psychiatric Association 2001; Royal College of Psychiatrists 2005; Enns et al. 2010).

ECT's mode of action has still not been clarified (Fink 2001). Despite documented efficacy for alleviating symptoms of depression (The UK ECT Review Group 2003), ECT still remains controversial and stigma-bound. Reported side effects, such as memory impairment (Rose et al. 2003), and whether ECT induces long-term permanent cognitive impairment remains yet obscure.

Worldwide, it has been estimated that about one million patients receive ECT annually (Prudic et al. 2001). ECT appears to have become a widely available treatment for mental disorders on all continents (Swartz 2009), in USA/Canada and Latin America (Magid and Rohland 2009; Rosa and Rosa 2009), Western Europe (Benbow and Bolwig 2009; Sienaert and van den Broek 2009) and Russia (Nelson and Giagou 2009), Africa and Asia (Chang 2009). Despite international guidelines (American Psychiatric Association 2001; Royal College of Psychiatrists 2005; Enns et al. 2010), large variations in clinical practice between countries and regions have been reported (Hermann et al. 1995; Glen and Scott 2000; Bertolin-Guillen et al. 2006; Gazdag et al. 2009a). Reports on ECT utilization also largely vary. There have been some international studies. A study by Van Waarde et al. (van Waarde et al. 2009) included data from nine other countries and another by Gazdag et al. (Gazdag et al. 2009a) presented an overview of 13 surveys undertaken on the use of ECT in the past 10 years. In the United States, the nationwide number of persons ECT treated per 10,000 resident population per year, was estimated to be 4.9 in 1995 (Hermann et al. 1995). On the whole, there seems to be a paucity of updated ECT utilization surveys, reviews, and data. There is, therefore, an imminent need for a systematic international review concerning contemporary use of ECT. Against this background, the main objective of this article is to give a systematic contemporary overview (from 1990) of the extent to which ECT is used worldwide.

Briefly the following aspects were considered. ECT utilization: ECT rates according to population, administration frequency, and inpatient prevalence rates; ECT parameters: the manner in which ECT is applied (modified or unmodified, brief-pulse or sine-wave current, device type, electrode placement bilateral [BL] or unilateral [UL]); and ECT practice: diagnoses, indications, gender, age, conditions (consent or involuntary), settings (ambulatory), under which ECT is applied.

## Material and Methods

### Data sources and search strategy

A systematic literature search was undertaken in the following databases. Medline, Embase, PsycINFO, SveMed and EBSCO/Cinahl, limited from 1990 to November 2010 (Appendix A, Table 1). Search terms intended for Medline were adapted as required for other databases. Terms used were "electroconvulsive therapy," "electroshock," "electroconvulsive," "ECT," combined with any of the following "use," "utilization," "practice," "survey," "statistical data," "frequency," limited to human studies and dating from 1990 to today. Relevant references, known to authors of this review published on governmental internet sites or from newly published text books (Swartz 2009) or reference lists in retrieved included papers, were also hand found.

### Inclusion and exclusion criteria

Inclusion criteria: Data-based observational studies or surveys with reported ECT utilization, frequency, or prevalence rates, by data collected from 1990 and above, for patients in psychiatric establishments (inpatients or outpatients) in well-defined continents, countries, regions, cities, or local hospitals. Also included were relevant studies published near the date limits for this study (from 1990), for geographical areas that had few pertinent publications.

**Table 1.** Overview of included studies ($N = 70$) according to continent, country, region, city, or local hospital level.

| Country | Land (L)/Region (R)/ City (C)/Hospital (H) | Publication year | First author (reference) |
|---|---|---|---|
| Australia and New Zealand ($N = 7$) | | | |
| Australia | L | 2007 | Chanpattana W (Chanpattana 2007) |
| New Zealand | L | 2006 | Ministry of Health (Ministry of Health 2006) |
| New Zealand | L | 2005 | Ministry of Health (Ministry of Health 2005) |
| Australia and New Zealand | L | 1991 | O'Dea JF (O'Dea et al. 1991) |
| Victoria, Australia | R | 2003 | Wood DA (Wood and Burgess 2003) |
| Western Australia | R | 2005 | Teh SPC (Teh et al. 2005) |
| Sydney, New South Wales Australia | C | 2011 | Lamont S (Lamont et al. 2011) |
| Africa ($N = 3$) | | | |
| Malawi | L | 2008 | Selis MA (Selis et al. 2008) |
| South Africa | H | 1991 | Mugisha RX (Mugisha and Ovuga 1991) |
| Nigeria | H | 1985 | Sijuwola OA (Sijuwola 1985) |
| North and Latin America ($N = 12$) | | | |
| USA | L | 1995 | Hermann RC (Hermann et al. 1995) |
| USA, tri-state New York City Metropolitan region | L | 2001 | Prudic J (Prudic et al. 2001) |
| Latin America and the Caribbean | L | 1996 | Levav I (Levav and Gonzalez 1996) |
| California, USA | R | 1999 | Kramer BA (Kramer 1999) |
| Texas, USA | R | 2000 | Scarano VR (Scarano et al. 2000) |
| Texas, USA | R | 1998 | Reid WH (Reid et al. 1998) |
| USA (Medicare) | R | 1997 | Rosenbach ML (Rosenbach et al. 1997) |
| North Carolina, USA | R | 1995 | Creed P (Creed et al. 1995) |
| Louisiana, USA (Medicare) | C | 1997 | Westphal JR (Westphalet al. 1997) |
| North Carolina, USA | H | 1992 | McCall WV (McCall et al. 1992) |
| South West Pennsylvania, State Hospital, USA | H | 2000 | Sylvester AP (Sylvester et al. 2000) |
| Rio de Janeiro, Brazil | H | 2008 | Pastore DL (Pastore et al. 2008) |
| Europe ($N = 33$) | | | |
| Belgium | L | 2006 | Sienaert P (Sienaert et al. 2006) |
| England | L | 2007 | Department of Health (www.dh.gov.uk) (Department of Health 2007) |
| Hungary | L | 2004 | Gazdag G (Gazdag et al. 2004a) |
| Poland | L | 2009 | Gazdag G (Gazdag et al. 2009a) |
| Germany | L | 1998 | Muller U (Muller et al. 1998) |
| Spain | L | 2006 | Bertolin-Guillen JM (Bertolin-Guillenet al. 2006) |
| Russia | L | 2005 | Nelson AI (Nelson 2005) |
| Netherlands | L | 2009 | van Waarde JA (van Waarde et al. 2009) |
| France | L | 2001 | Benadhira R (Benadhira and Teles 2001) |
| Denmark | L | 2002 | Andersson JE (Andersson and Bolwig 2002) |
| Denmark | L | 2010 | Sundhedsstyrelsen (Sundhedsstyrelsen 2011) |
| Norway | L | 2011 | Schweder LJ (Schweder et al. 2011a) |
| Norway | L | 2011 | Schweder LJ (Schweder et al. 2011b) |
| Sweden | L | 2010 | Socialstyrelsen (www.socialstyrelse.se) (Socialstyrelsen 2010) |
| Belgium | R | 2005 | Sienaert P (Sienaert et al. 2005a) |
| Wales | R | 1999 | Duffett R (Duffett et al. 1999) |
| England | R | 1998 | Duffett R (Duffett and Lelliott 1998) |
| England | R | 1992 | Pippard J (Pippard 1992) |
| Ireland | R | 2010 | Enriquez S (Enriquez et al. 2010) |
| Chuvash republic, Russia | R | 2010 | Golenkov A (Golenkov et al. 2010) |
| Vienna, Austria | C | 1997 | Tauscher J (Tauscher et al. 1997) |
| Barcelona, Spain | C | 1996 | Bernardo M (Bernardo et al. 1996) |
| London (UK) and Bengaluru, India | C | 2011 | Eranti SV (Eranti et al. 2011) |
| Edinburgh, Scotland | C | 1999 | Glen T (Glen and Scott 1999) |
| Edinburgh, Scotland | C | 2008 | Okagbue N (Okagbue et al. 2008) |
| Munich, Germany | C | 2005 | Baghai TC (Baghai et al. 2005) |
| Dikemark Hospital, Oslo, Norway | H | 2010 | Moksnes KM (Moksnes and Ilner 2010) |

(*Continued*)

**Table 1.** *Continued*

| Country | Land (L)/Region (R)/ City (C)/Hospital (H) | Publication year | First author (reference) |
|---|---|---|---|
| Ullevaal University Hospital, Oslo, Norway | H | 2006 | Moksnes KM (Moksnes et al. 2006) |
| Hospital Innland, Norway | H | 2010 | Eiring O (Eiring 2010) |
| Pitkaniemi Hospital, Finland | H | 2000 | Huuhka MJ (Huuhka et al. 2000) |
| Hospital, Turkey | H | 2008 | Saatcioglu O (Saatcioglu and Tomruk 2008) |
| Scotland | H | 2004 | Fergusson GM (Fergusson et al. 2004) |
| Cukurova University Psychiatry Service, Turkey | H | 2003 | Zeren T (Zeren et al. 2003) |
| Asia ($N = 15$) | | | |
| Japan | L | 2004 | Motohashi N (Motohashi et al. 2004) |
| Japan | L | 2005 | Chanpattana W (Chanpattana et al. 2005a) |
| Thailand | L | 2004 | Chanpattana W (Chanpattana and Kramer 2004) |
| Asia | L | 2003 | Little JD (Little 2003) |
| Asia | L | 2010 | Chanpattana W (Chanpattana et al. 2010) |
| Katmandu, Nepal | C | 2008 | Ahikari SR (Ahikari et al. 2008) |
| Hong Kong | C | 2003 | Chung KF (Chung 2003) |
| Hong Kong | C | 2003 | Chung KF (Chung et al. 2003) |
| India | H | 2005 | Chanpattana W (Chanpattana et al. 2005b) |
| Chulalongkorn Memorial Hospital, Thailand | H | 2005 | Lalitanatpong D (Lalitanatpong 2005) |
| Local psychiatric unit, Hong Kong | H | 2009 | Chung JPY (Chung et al. 2009) |
| Tokushima, University Hospital, Japan | H | 2000 | Ishimoto Y (Ishimoto et al. 2000) |
| Hospital, Saudi Arabia | H | 1999 | Alhamad AM (Alhamad 1999) |
| Hospital, Karachi, Pakistan | H | 2005 | Naqvi H (Naqvi and Khan 2005) |
| Al Ain, United Arab Emirates | H | 1998 | Tewfik KD (Tewfik et al. 1998) |

Studies in the following languages were included: English, Scandinavian (Norwegian, Swedish, Danish), and European (German, French, Spanish, Portuguese, Turkish). In addition to authors' European language fluency, the online Google translation tool (http://translate.google.com/) was used when needed (e.g., for Portuguese and Turkish).

Following exclusion criteria were included. Not data-based study or survey, no or unclear report of ECT utilization, frequency, prevalence rate, practice, in unclearly defined populations. All report of utilization frequency, prevalence rates of ECT in selected samples or subgroups (e.g., young/adolescent, elderly) or special populations (such as pregnancy, disability, mental retardation), and qualitative studies about clinician or physician subjective experience (views or opinions) on ECT.

### Screening of literature

Two reviewers (KAL, BH) independently checked the titles, and where available, the abstracts of the studies identified by the electronic database searches. All references appearing to meet inclusion criteria, including those with insufficient details, were requested in full text. All reviewers (KAL, LJVS, BH) consisting of two pairs independently extracted data from the retrieved full-text articles according to a premade data extraction scheme. All discrepancies were resolved by consensus meeting/discussion, and the final decision was made by the first author (KAL).

### Data extraction and data analyses

Where possible, utilization data have been presented as either (1) number of persons ECT treated per 10,000 resident population per year, that is, treated person rate (TPR), (2) number of ECT administrations per 10,000 resident population per year, that is, ECT administration rate (EAR), (3) the proportion in percent (%) of ECT-treated patients among the inpatient (psychiatric ward, hospital admitted) population, that is, inpatient prevalence (iP%), and (4) average number of ECTs administered per patient (in a series or course), that is, average ECT number (AvE). Information about ECT parameters, diagnoses and main indications, gender and age is also presented. Other information such as ethnicity, education, side effects, mortality, adverse events, use of written consent, involuntary conditions has also been noted.

## Results

### Study selection

The study selection process, databases searched and total numbers of references identified ($N = 1403$), title and abstract screened ($N = 851$), full-text screened ($N = 101$), included for data extraction ($N = 70$) and full text excluded ($N = 31$) references are given in Figure 1.

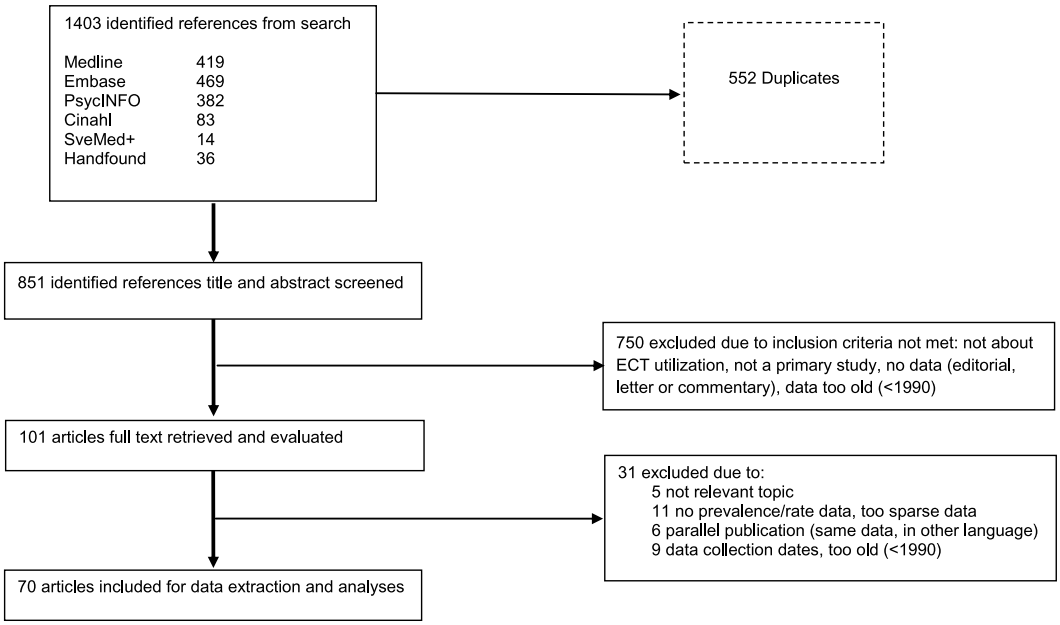


**Figure 1.** Flow chart of study-selection process.

## Description of studies

Overview of included studies ($N = 70$) and data extracted is given in Table 1, sorted according to the continents: Australia and New Zealand ($N = 7$), Africa ($N = 3$), North and Latin America ($N = 12$), Europe ($N = 33$), and Asia ($N = 15$). Each reference was categorized according to the data presented, whether it represented the Land ($n = 27$), Region ($n = 13$), City ($n = 11$), or Hospital ($n = 19$).

Overview of full text excluded references ($N = 31$) and reasons for exclusion are given in Appendix B. Five references were found not relevant in topic, 10 had no rate or prevalence data or insufficient/too sparse data, six were parallelly published in other languages than English or not possible to find/full-text retrieve, and the data in nine were evaluated too old, collected before 1990.

Detailed summery of findings tables of included full-text studies are presented in Appendix C, Tables C1–C5 according to the five continents: (1) Australia and New Zealand, (2) Africa, (3) North and Latin America, (4) Europe and (5) Asia.

Seven studies were included from Australia and New Zealand, including a recent one from Sydney (Lamont et al. 2011). Only three of six studies from Africa were included, representing Malawi, Nigeria, and South Africa. The three excluded (Appendix B) were two from Nigeria and one from Egypt, due to data being too old (before 1990), insufficient, and sparse. One of the two included studies from Latin America, claimed representation of 17 Latin American and four Caribbean countries, but with unstated names except for Haiti being excluded (Levav and Gonzalez 1996). Two of the 10 studies from North America represented Medicare populations (Rosenbach et al. 1997; Westphal et al. 1997) leaving many of all USA's 50 States not represented. A study by the National Institute of Mental Health (NIMH) was found too old (Thompson et al. 1994). Altogether, 33 studies were included from Europe and nine were from the Nordic countries. Twelve identified European studies, including one study from Italy (Lucca et al. 2010), did not meet inclusion criteria (Appendix B). Surveys including a number of countries were identified from Asia (Little 2003; Chanpattana and Kramer 2004; Chanpattana et al. 2010) and 15 studies from this continent were included. ECT practice was verified from 27 Asian countries: Bangladesh, China, Hong Kong, India, Indonesia, Iran, Iraq, Israel, Japan, Jordan, South Korea, Malaysia, Myanmar, Nepal, Oman, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Turkey, United Arab Emirates, Vietnam (Chanpattana et al. 2010), Fiji, Kiribati, Solomon Islands (Little 2003), and Saudi Arabia (Alhamad 1999). ECT was reported not available in all countries, such as Bhutan, Brunei, Cambodia, Georgia, Laos, and Lebanon

 

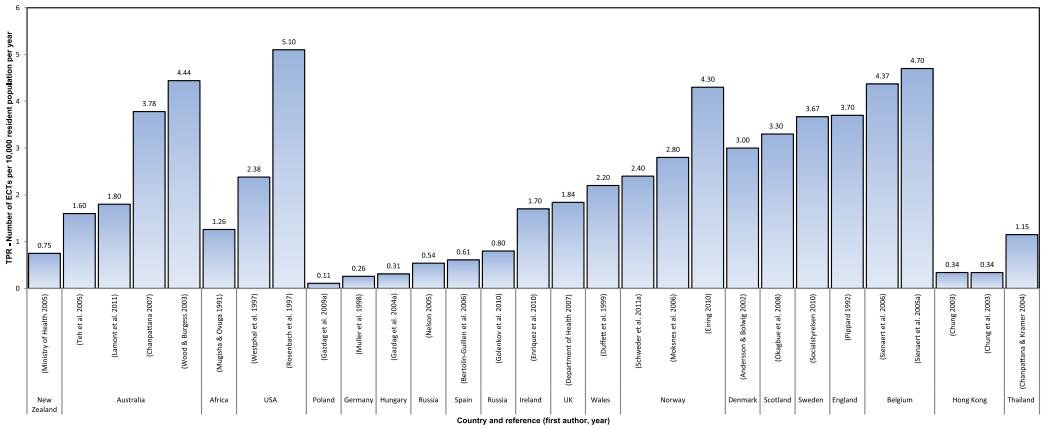


**Figure 2.** Worldwide Treated Person Rates (TPR)—number of ECTs per 10,000 resident population per year. [Correction added after first online publication on 20 March 2012: The TPR column for UK (Department of Health 2007) has been changed to 1.84.]

(Chanpattana et al. 2010), Micronesia and Palau (Little 2003). The countries Cyprus, Macoa, Qatar, and Maldives had also been excluded by a survey (Chanpattana et al. 2010).

Overall, the included studies displayed a large heterogeneity in the presentation of rate and prevalence data and practice of ECT worldwide. On a global basis, a crude estimate (from numbers given in Appendix C, Tables C1–C5) of worldwide contemporary TPR (SD) (age < 65 years) was 2.34 (1.56); EAR (SD), 11.2 (9.0); iP (SD) 6.1 (6.9); and AvE (SD) 8 (1.4). Globally, under half of all psychiatric institutions within the same country provided ECT. Main findings of ECT utilization, parameters, and practice from the five continents are presented below.

## ECT Utilization

### Treated person rate

Overview of TPR from all countries providing such data is illustrated in Figure 2.

TPR (Fig. 2) varied from 0.75 in New Zealand (Ministry of Health 2005) to 4.4 in Victoria, Australia (Teh et al. 2005). TPR in the USA Medicare population was 5.1 (5.7 women; 3.6 men) (Rosenbach et al. 1997). TPR by age groups (and therefore not included in Fig. 2) ranged from 0.0001 (<18 years) to 3.8 (>65 years) in California (Kramer 1999). TPR for the elderly (>65 years) in the Medicare population was from 2.4 to 4.2, (Rosenbach et al. 1997; Westphal et al. 1997) and varied from 3.8 West USA to 6.1 in the Northeast, as well as between rural (TPR 3.2) to large urban areas (TPR 6.0) (Rosenbach et al. 1997). TPR variations within the same State were reported from Louisiana, TPR (>65 years): 2.8 urban parishes versus 1.9 rural parishes (Westphal et al. 1997).

TPR in Europe varied between countries and regions and between individual centers (Fig. 2), with the lowest TPR 0.11 in Poland (Gazdag et al. 2009a). The within-country regional variation in Belgium (TPR 2.6–10.6) was reported as significant (Sienaert et al. 2006), which was also the case for Norway (TPR 1.83–3.44) (Schweder et al. 2011a). In South Africa, TPR was 1.26 (Mugisha and Ovuga 1991). In Asia, TPR was only reported from Thailand 1.15 (Chanpattana and Kramer 2004) and Hong Kong ranging 0.27–0.34 (Chung 2003; Chung et al. 2003; Chanpattana et al. 2010).

### Inpatient prevalence

Overview of iP from all countries providing such data is illustrated in Figure 3.

The iP was highest in Africa 21–28% (Mugisha and Ovuga 1991; Selis et al. 2008), Nepal 22%, (Ahikari et al. 2008), and overall in Asia estimated between <9% and 26% (Little 2003). In the United States, iP was lowest, from 0.4% to 1.3% (McCall et al. 1992; Sylvester et al. 2000), similar to Hong Kong was 0.6–1.8% (Chung 2003; Chung et al. 2009). In Australia, iP ranged from 1% to 8% (Wood and Burgess 2003; Teh et al. 2005), and in Europe from 0.6% (Hungary) (Gazdag et al. 2004a) to 14% (Turkey) (Zeren et al. 2003).

### Average ECT number

The AvE in New Zealand and Australia ranged from seven to 12 (O'Dea et al. 1991; Ministry of Health 2006; Chanpattana 2007), in Africa from one to 10, (Sijuwola 1985; Selis et al. 2008), in USA from five (Reid et al. 1998; Kramer 1999) to 12

 

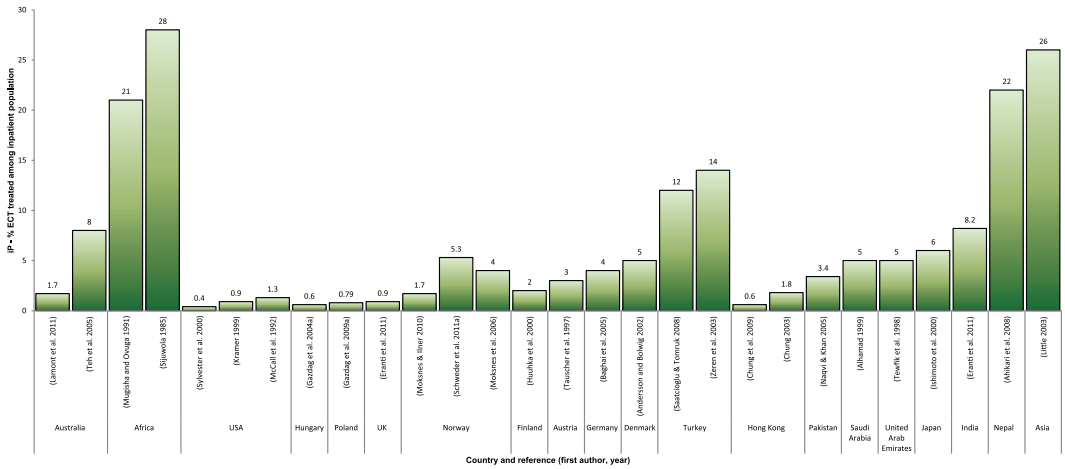


**Figure 3.** Inpatient prevalence rate (iP%)—percent of ECT-treated patients among inpatient population.

(Sylvester et al. 2000), USA overall seven to eight (Rosenbach et al. 1997; Scarano et al. 2000; Prudic et al. 2001), and in Brazil eight (Pastore et al. 2008) (Appendix C, Tables C1–C5). AvE in Europe ranged from five (Glen and Scott 1999) to 11 (Sundhedsstyrelsen 2011a), except Sweden where it was one to 22 (Socialstyrelsen 2010). AvE in Pakistan was one to 20 (Naqvi and Khan 2005), in Nepal two to 16 (Ahikari et al. 2008), and generally in Asia between six and eight.

## ECT Parameters

### Unmodified and modified

All parameter report in Australia and New Zealand indicated modified ECT (O'Dea et al. 1991; Ministry of Health 2005; Chanpattana 2007; Lamont et al. 2011), similarly in the United States (Reid et al. 1998; Scarano et al. 2000; Prudic et al. 2001). ECT in Africa was generally administered unmodified and in Malawi modified after 2007 (Mugisha and Ovuga 1991; Selis et al. 2008). A study excluded from Nigeria reported modified ECT administered in 1979, but found too expensive (Odejide et al. 1987).

In Europe, all parameter report indicated modified ECT, except for Russia (in contrast to Hungary [Gazdag et al. 2004a], with obligatory anesthesia) where >80% was unmodified (Nelson 2005). In the Chuvash Republic, ECT was modified, but 40% without use of muscle relaxants (and administered mainly to women with schizophrenia) (Golenkov et al. 2010). In Spain, 0.6% received unmodified ECT, and 2.3% without muscle relaxants (Bertolin-Guillen et al. 2006).

A large survey in Asia with 23 countries investigated reported 129,906 unmodified ECTs administered to 22,194 patients (55.7%) at 141 (54.9%) institutions in 14 countries (61%) (Chanpattana et al. 2010). Two-thirds of patients were treated unmodified in Japan (1997–1999) (Motohashi et al. 2004), and 20% of all institutions administered only unmodified, with only sine-wave approved devices. In a later survey from Japan (2001–2003), unmodified comprised 57% of all administered ECTs (Chanpattana et al. 2005a). Patients selected for modified (with anesthesia) in Japan were mainly elderly or with medical conditions (Motohashi et al. 2004). In Thailand, almost all (94%) ECT administration was unmodified (Chanpattana and Kramer 2004). In India, both modified and unmodified ECT was administered (Chanpattana et al. 2005b), 52% of patients received unmodified at 50% of all institutions, and 30% of institutions administered only unmodified.

Overall in Asia, only 45% of facilities used modified ECT exclusively (Chanpattana et al. 2010), in Hong Kong 87% modified (Chung et al. 2003), and the Asian Pacific Region (Little 2003) and Katmandu, Nepal, used only modified (Ahikari et al. 2008). Eight facilities in Asia reported succinylcholine muscle relaxant used routinely without anesthesia (Chanpattana et al. 2010). Anesthesia was also used without muscle relaxants in Japan, and extreme motion from the convulsions held down with aid of assistants restraining patient's shoulders, arms, and thighs (Ishimoto et al. 2000).

Overall, 26% Latin American countries used unmodified ECT (Levav and Gonzalez 1996), except for all modified in Rio de Janeiro, Brazil and one country in the Caribbean (Levav and Gonzalez 1996; Pastore et al. 2008).

### Placement and devices

On a worldwide scale, BL placement was the preferred electrode placement. However, UL placement was the first main choice in Australia and New Zealand (O'Dea et al. 1991; Ministry of Health 2005; Chanpattana 2007; Lamont et al. 2011), likewise to several European countries such as Vienna (Tauscher et al. 1997), Munich (Baghai et al. 2005), Netherlands (van Waarde et al. 2009), and Norway (Schweder et al. 2011b).

In the United States, there was some sine wave (2%) (Prudic et al. 2001) and some UL (16–21%) (Reid et al. 1998; Scarano et al. 2000; Prudic et al. 2001) report, but BL placement (73–79%) and brief-pulse wave current (Reid et al. 1998; Scarano et al. 2000; Prudic et al. 2001) was mainstream. Similarly, brief-pulse wave current devices were dominant in Europe, except sine-wave current still used in Spain 14% (Bertolin-Guillen et al. 2006), Russia 26% (Nelson 2005), Belgium 34% (Sienaert et al. 2006), Poland 30% (Gazdag et al. 2009a), Germany 39% (Muller et al. 1998), and Hungary 52% (Gazdag et al. 2004a).

Overall electrode placement in Asia was BL (77%) (Chanpattana et al. 2010). Thailand (Chanpattana and Kramer 2004) and Japan (Motohashi et al. 2004) reported only the use of BL and India always reported the use of BL in 82% (Chanpattana et al. 2005b). In Asia, 58% of institutions used brief-pulse devices and 42% sine wave (Chanpattana et al. 2010). In Japan, the device type was often Japanese-produced Sakai C1, but also some had Thymatron® DGx devices (Somatics, Inc., www.thymatron.com) (Chanpattana et al. 2005a). In India, a diversity of devices was in use, including locally made (Chanpattana et al. 2005b). In Katmandu, Nepal, device type was only brief pulse (Ahikari et al. 2008).

## ECT Practice

### Provision of ECT and training

In Australia, ECT was provided by 66% institutions and ECT training by 73% (Chanpattana 2007).

In the tri-state New York City metropolitan region, 55% of institutions provided ECT (Prudic et al. 2001), 33% in Texas (Reid et al. 1998), and 44% of all psychiatric hospitals in North Carolina (Creed et al. 1995). A decrease from 1990 to 1994 in provision of ECT was reported in California and ECT provided by public institutions to be very low, <6% (Kramer 1999).

In Europe, ECT provision in the Netherlands was 23% (van Waarde et al. 2009), Belgium nationwide 22% (Sienaert et al. 2006), Flanders and Brussels capital region 26% (Sienaert et al. 2005a), Poland 34% (Gazdag et al. 2009a), Spain and Russia 46% (Nelson 2005; Bertolin-Guillen et al. 2006), France 51% (Benadhira and Teles 2001), Hungary 57% (Gazdag et al. 2004a), Germany 59% (Muller et al. 1998), Norway 72% (Schweder et al. 2011a), and in Denmark 100% (Andersson and Bolwig 2002). In Norway, patients had to wait up to eight weeks for treatment due to a low capacity in administrating ECT (Schweder et al. 2011b).

ECT was mainly performed by junior doctors in Denmark (Andersson and Bolwig 2002), England (Duffett and Lelliott 1998), and Norway (Schweder et al. 2011b). In Norway, 6% of ECTs were administered by nurses (Schweder et al. 2011b) and in the Netherlands sometimes by geriatricians or physicians (van Waarde et al. 2009). About one-third of clinics in England had developed clear policies to help guide junior doctors in administering ECT effectively (Duffett and Lelliott 1998). ECT teaching programs were found at 59% of institutions in India (Chanpattana et al. 2005b), and 78% in Japan, but rated in 10% as fair to poor (Chanpattana et al. 2005a). Acceptable ECT training in Thailand was only found for five hospitals (Chanpattana and Kramer 2004). In Saudi Arabia, a two-lecture course on ECT was given every year for junior doctors, as well as practical demonstration and training (Alhamad 1999).

### Diagnoses and diagnostic indication

Main diagnoses, diagnostic indication for ECT in Australia, New Zealand, USA, South America, and Africa, are illustrated in Figure 4.

Affective disorder (unipolar/bipolar depression) was the main diagnoses in Australia and New Zealand (O'Dea et al. 1991; Wood and Burgess 2003; Teh et al. 2005; Chanpattana 2007; Lamont et al. 2011), but other main indications for administering ECT were also noted (Lamont et al. 2011), such as being too distressed to await drug response, patient preference, previous response, life saving, and medication resistance. Affective disorders (unipolar/bipolar depression) were also the main diagnoses in USA (72–92%), and schizophrenia and/or schizoaffective disorders were much less (8–29%) (McCall et al. 1992; Hermann et al. 1995; Rosenbach et al. 1997; Reid et al. 1998; Scarano et al. 2000; Sylvester et al. 2000; Prudic et al. 2001). However in Africa, the main diagnoses were schizophrenia and psychotic conditions (60–83%) (Sijuwola 1985; Mugisha and Ovuga 1991; Selis et al. 2008), and in Brazil 49% of cases reported same conditions (Pastore et al. 2008).

Main diagnoses, diagnostic indication for ECT in Europe, are illustrated in Figure 5.

Although affective disorders (unipolar and/or bipolar depression with or without psychosis) were the most prominent in Europe (Fig. 5), schizophrenia and/or schizoaffective disorder were major in Hungary 64%, Chuvash Republic 88%, and Turkey 37% (Gazdag et al. 2004a; Saatcioglu and Tomruk 2008; Golenkov et al. 2010).

Schizophrenia and/or schizoaffective disorder were much less common in Belgium 5% (Sienaert et al. 2006), Nor-

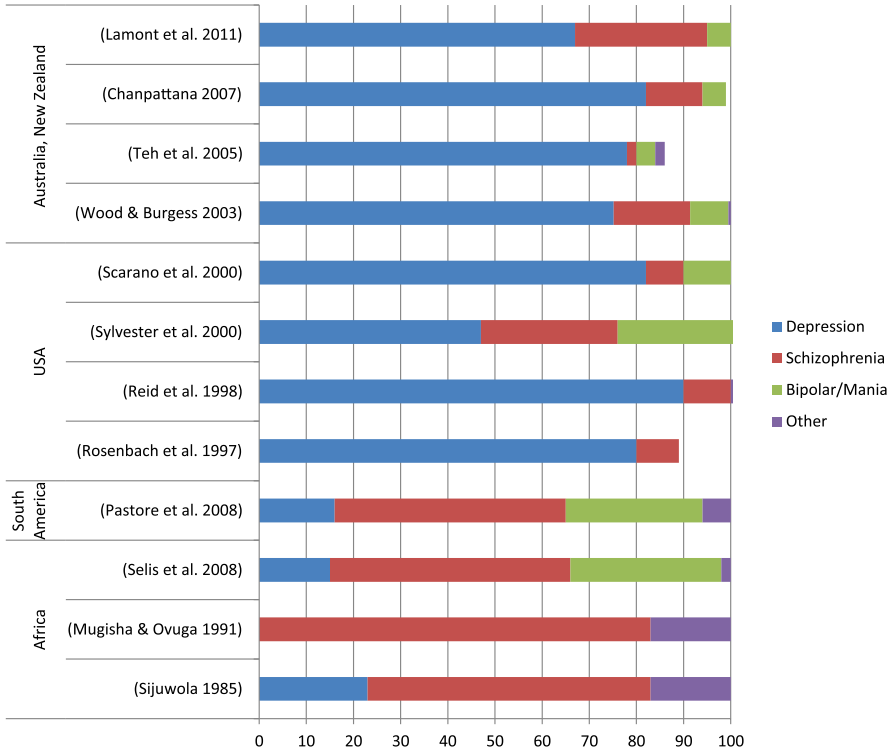


**Figure 4.** Diagnoses and ECT in Australia, New Zealand, USA, South America, Africa.

way 5% (Schweder et al. 2011a), Ireland 4% (Enriquez et al. 2010), and Scotland 5% (Fergusson et al. 2004). ECT for mania varied from 0.2% (Munich) (Baghai et al. 2005) to 12% (Spain) (Bertolin-Guillen et al. 2006). The main indication for ECT was medication resistance, but also life saving, catatonia, previous good response, and patient preference (Muller et al. 1998; Duffett et al. 1999; Zeren et al. 2003; Schweder et al. 2011a). ECT administered under pregnancy was noted at 10 Polish sites (Gazdag et al. 2009a) and in Spain (Bertolin-Guillen et al. 2006).

Main diagnoses, diagnostic indication for ECT in Asia, are illustrated in Figure 6.

Main diagnostic indication in Asia overall (Little 2003; Chanpattana and Kramer 2004; Chanpattana et al. 2005b, 2010) was schizophrenia (Ishimoto et al. 2000; Motohashi et al. 2004; Chanpattana et al. 2005a). However, in Saudi Arabia (Alhamad 1999), Pakistan (Naqvi and Khan 2005), and Hong Kong (Chung et al. 2009), depressive illness was the main indication (over 60%). Reasons for giving ECT to patients with schizophrenia (74%) in Thailand was small budget for mental health care and no antipsychotics included in the essential drug list from the Ministry of Health (Chanpattana and Kramer 2004). In India, ECT was prescribed to other diagnoses, including drug abuse (Chanpattana et al. 2005b). Indication for ECT in Asia was also severe violence, suicide and refractory treatment (Lalitanatpong 2005), need of rapid improvement (Ishimoto et al. 2000), drug resistance, or life-threatening situation (Naqvi and Khan 2005), and in Saudi Arabia 35% as first-choice emergency treatment (Alhamad 1999).

## Gender, age, and ethnicity

An overview of studies presenting gender and age data is given in Table 2.

ECT-treated patients in Australia and New Zealand were mainly women (63–71%) (O'Dea et al. 1991; Wood and Burgess 2003; Teh et al. 2005; Ministry of Health 2006; Chanpattana 2007; Lamont et al. 2011), and one-third of patients were above 65 years (O'Dea et al. 1991; Wood and Burgess 2003; Teh et al. 2005; Ministry of Health 2006; Chanpattana

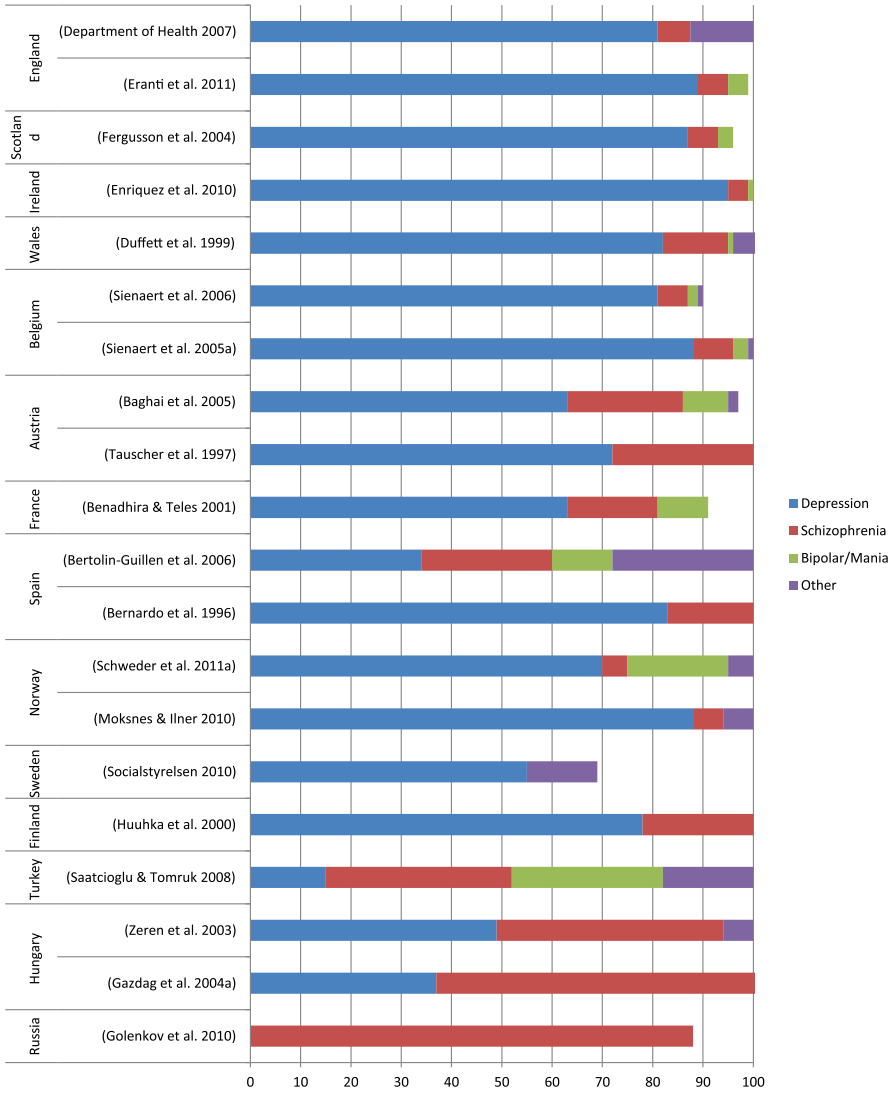


**Figure 5.** Diagnoses and ECT in Europe.

2007; Lamont et al. 2011). Similarly in the United States, 66–79% of patients were women (Rosenbach et al. 1997; Westphal et al. 1997; Reid et al. 1998; Kramer 1999; Scarano et al. 2000; Sylvester et al. 2000), and 48–59% were elderly (over 60 years) (Reid et al. 1998; Sylvester et al. 2000; Prudic et al. 2001). In New Zealand, >80% were of European ethnicity (Ministry of Health 2006) and in USA Caucasian white ethnicity was dominant (87% to >90%) (Rosenbach et al. 1997; Westphal et al. 1997; Reid et al. 1998; Kramer 1999; Scarano et al. 2000). A typical ECT patient in the United States was said to be an elderly white female paying for treatment with insurance or private funds (Kramer 1999).

In Europe, not all studies reported gender and age, such as Russia (Nelson 2005) and Denmark (Andersson and Bolwig 2002). The percent of ECT-treated European women ranged from 44% to 81%. Mean age for ECT in Europe was overall

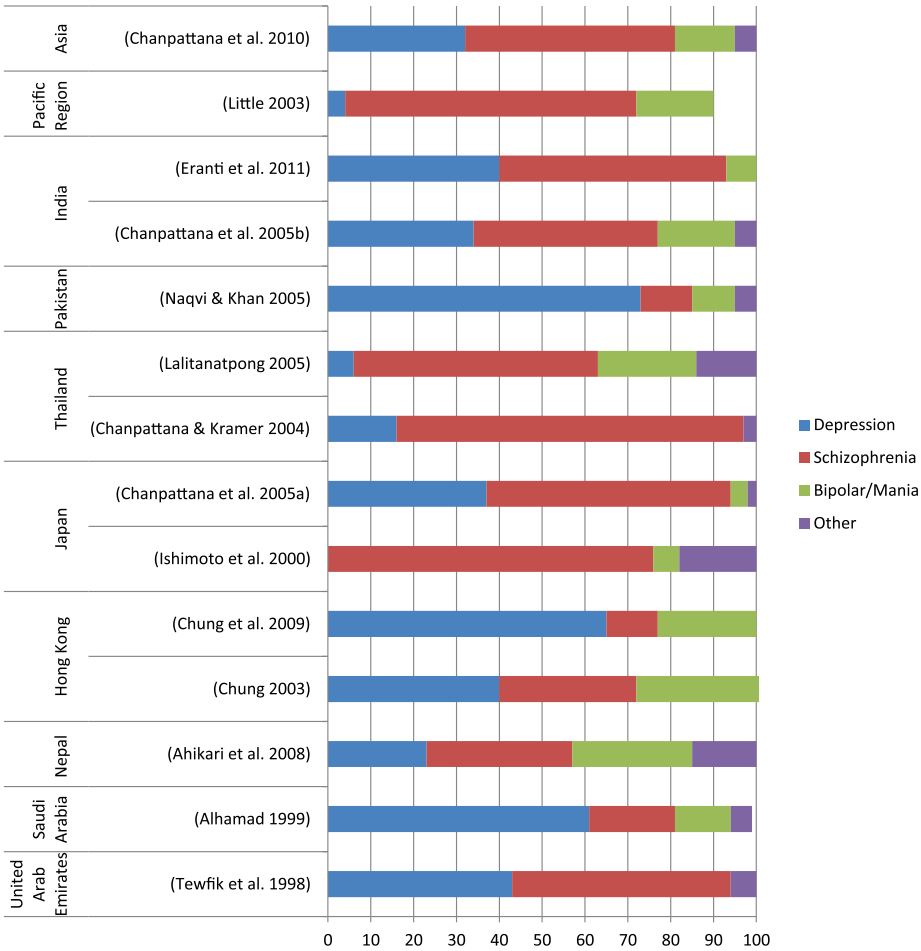


**Figure 6.** Diagnoses and ECT in Asia.

high (49–66 years) (Tauscher et al. 1997; Duffett et al. 1999; Huuhka et al. 2000; Baghai et al. 2005; Moksnes et al. 2006; Moksnes and Ilner 2010; Socialstyrelsen 2010; Eranti et al. 2011), except 33.1–35.1 years in Turkey (Zeren et al. 2003; Saatcioglu and Tomruk 2008) and 34.4 years in the Chuvash Republic (Golenkov et al. 2010). Patients above 64 years seldom received ECT in Turkey (1–3%) (Zeren et al. 2003; Saatcioglu and Tomruk 2008), in the Chuvash Republic none (Golenkov et al. 2010). UK's National Health Service data revealed 0.2% ECT-given young patients (16–18, but none <16 years) in 2007 (Department of Health 2007). The highest treatment rates in the United Kingdom were found among those with Caucasian white ethnicity (Department of Health 2007).

In Africa, men were treated with ECT more often than women (29% women), and mean age was young (30.7 [Mugisha and Ovuga 1991], range 17–37 years [Selis et al. 2008]). Similarly, percent of ECT-treated female patients in Asia was generally low, for example, 28% Katmandu (Ahikari et al. 2008) 33% Emirates (Tewfik et al. 1998), 39% India (Chanpattana et al. 2005b), 28–63% Thailand (Chanpattana and Kramer 2004; Lalitanatpong 2005), and overall estimated to be 38% (Chanpattana et al. 2010). In some places, the female proportion was higher, for example, 51%

Japan (Ishimoto et al. 2000), 56% Pakistan (Naqvi and Khan 2005), 60% Saudi Arabia (Alhamad 1999), and 68–88% Hong Kong (Chung et al. 2003, 2009). In Saudi Arabia, the typical ECT patient was described to be a Saudi married woman, with medium level of education, living in the City, not employed outside the home, and with affective disorder (Alhamad 1999). Proportion of young (<18 years) ECT-treated patients in Asia was overall 6% (Chanpattana et al. 2010), 5% Hong Kong (Chung 2003), 1% India (Chanpattana et al. 2005b), and 11% (<19 years) Katmandu (Ahikari et al. 2008). In Thailand, ECT-treated patients with schizophrenia were younger than those with depression (Lalitanatpong 2005).

## Other data—conditions, adverse events, side effects, training, guidelines, legal regulations conditions

In Australia and New Zealand, consent by Mental Health Review Tribunal varied from 21% to 60% (Teh et al. 2005; Lamont et al. 2011). In the United States, use of informed consent was noted as 37% always and 26% never (Levav and Gonzalez 1996), involuntary conditions and use of guardian consent ranged from 1–2% in Texas (Reid et al. 1998; Scarano et al. 2000), 3% California (Kramer 1999) to 29% North Carolina (McCall et al. 1992). From 1993, mandatory report of ECT use to health authorities was initiated in Texas and ECT use was prohibited for patients <16 years of age (Reid et al. 1998).

Report of involuntary ECT conditions varied in Europe from 1% in Spain (Bertolin-Guillen et al. 2006), 3.2% Denmark (2009) (Sundhedsstyrelsen 2011a), to 20% Germany (Muller et al. 1998), 24% Scotland (Fergusson et al. 2004), and 26% in Finland (Huuhka et al. 2000). In Scotland, 18% of patients received ECT under the safeguards of the Scottish Mental Health Act of 1984 (Fergusson et al. 2004), and in England 60%, of those formally detained, did not consent to ECT treatment (Department of Health 2007).

The use of written informed consent documents was obligatory in Poland (Gazdag et al. 2009a), and reported as 15% in Germany (Muller et al. 1998), 44% in Belgium (Sienaert et al. 2006), and 50% in Norway (Schweder et al. 2011b). Written informed consent was mainly obtained from family members in Japan (Motohashi et al. 2004; Chanpattana et al. 2005a), Thailand (Chanpattana and Kramer 2004), and Pakistan (Naqvi and Khan 2005), and countersigning by a near relative practiced in Saudi Arabia (Alhamad 1999). In Hong Kong, 13% were judged incapable of giving informed consent (Chung 2003).

## Adverse events and side effects

Adverse events (within two weeks after ECT) in Texas, in 1998 (Reid et al. 1998), were eight deaths (two were noted as possibly anesthesia-related complications) and in 2000, 25 deaths (Scarano et al. 2000), with mortality rate (within two weeks after ECT) estimated at 14 deaths per 100,000 treatments (Scarano et al. 2000). Side effects were noted in 37% in Japan, including one case of compression fractures of vertebrae (Ishimoto et al. 2000). Side effects from unmodified ECT in India were fractures, dislocations, teeth injury, and one death in the one-year study period (Chanpattana et al. 2005b). Mortality rate was estimated 0.08% in Thailand (Chanpattana and Kramer 2004), although there were no ECT-related deaths in the survey period.

## Maintenance, continuation, and ambulatory ECT

Maintenance ECT was practiced in Texas (Reid et al. 1998), and continuation ECT (C-ECT) in Australia (Chanpattana 2007). Ambulatory ECT (A-ECT) was lacking in the Chuvash Republic (Golenkov et al. 2010), rarely used in Belgium (Sienaert et al. 2006), and not performed in Polish outpatients clinics (Gazdag et al. 2009a). A-ECT was reported available in 2% of Russian institutions (Nelson 2005) and 63% of Norwegian (Schweder et al. 2011b). Proportion of A-ECT-treated patients was 15% in Norway (Schweder et al. 2011b), 16% Wales (Duffett et al. 1999), 18% Ireland (Enriquez et al. 2010), and 19% UK (Department of Health 2007). A-ECT was also practiced in Thailand (Lalitanatpong 2005) but A-ECT and C-ECT rarely were used in Hong Kong (Chung 2003). In India, C-ECT report varied from given to 1–10% to 60% of patients (Chanpattana et al. 2005b).

## Legislation and guidelines

In Victoria, Australia legislation requires mandatory monthly reports (Teh et al. 2005). In Poland (Gazdag et al. 2009a) and the Chuvash Republic (Golenkov et al. 2010), the presence of an anesthetist under ECT was mandatory.

Locally developed guidelines were described in Norway (Moksnes et al. 2006; Schweder et al. 2011b) and Vienna (Tauscher et al. 1997), and in Belgium less than 44% of departments did not follow guidelines (Sienaert et al. 2005a). Guidelines were used only by 28% of Japanese institutions (Motohashi et al. 2004). In Hong Kong, a hospital policy of patient assessment every one to two treatments during an ECT course was practiced only sometimes (Chung et al. 2003).

## Other—funding and attitudes

Over half (57%) funding of ECT in the United States was financed by public third party payment source (including Medicare) (Reid et al. 1998). Attitudes of psychiatrists toward ECT were generally favorable in Europe, for example, in Spain (Bertolin-Guillen et al. 2006), Germany (Muller et al. 1998), Russia (Nelson 2005), and Norway (Schweder et al. 2011a).

**Table 2.** Overview of ECT treatment worldwide by gender and age.

| Country | First author (reference) | Percent of ECT-treated women | Age in years | | |
|---|---|---|---|---|---|
| | | | %*N* >65 (%) | Mean | Range |
| Australia and New Zealand | | | | | |
| Sydney, Australia | Lamont (Lamont et al. 2011) | 71 | 28 | | |
| New Zealand | Ministry of Health (Ministry of Health 2006) | 69 | 40 (2004/2005) | | |
| Western Australia | Teh (Teh et al. 2005) | 65 | | | |
| Australia | Chanpattana (Chanpattana 2007) | 63 | 38 | | |
| Victoria, Australia | Wood (Wood and Burgess 2003) | 63 | 33 | | |
| Africa | | | | | |
| Malawi | Selis (Selis et al. 2008) | 49 | | | 17–35 |
| South Africa | Mugisha (Mugisha and Ovuga 1991) | 29 | | 30.7 | |
| North America | | | | | |
| Louisiana | Westphal (Westphal et al. 1997) | 79 | 100 | | |
| Pennsylvania | Sylvester (Sylvester et al. 2000) | 71 | 59 (>60) | | |
| Texas | Reid (Reid et al. 1998) | 70 | 48 | | |
| Texas | Scarano (Scarano et al. 2000) | 69 | | | |
| California | Kramer (Kramer 1999) | 69 | | | |
| USA | Rosenbach (Rosenbach et al. 1997) | 66 | | | |
| USA | Prudic (Prudic et al. 2001) | | 55 (>60) | | |
| North Carolina | McCall (McCall et al. 1992) | | | 44.3 | 19–75 |
| South America | | | | | |
| Brazil | Pastore (Pastore et al. 2008) | 71 | | 41.3 | |
| Europe | | | | | |
| Austria | Tauscher (Tauscher et al. 1997) | 81 | | 49 | 23–69 |
| Finland | Huuhka (Huuhka et al. 2000) | 76 | | 58.9 | 18–83 |
| Norway | Moksnes (Moksnes and Ilner 2010) | 74 | | 64 | 29–87 |
| UK | Department of Health (Department of Health 2007) | 71 | 46 | | |
| Wales | Duffett (Duffett et al. 1999) | 71 | | 56.9 (women)<br>55.5 (men) | |
| Scotland | Glen (Glen and Scott 1999) | 71 | | | |
| London, UK | Eranti (Eranti et al. 2011) | 70 | | 62.8 | |
| Scotland | Fergusson (Fergusson et al. 2004) | 70 | 26 | | |
| Norway | Moksnes (Moksnes et al. 2006) | 69 | | 67 (women)<br>65 (men) | 23–91 |
| Ireland | Enriquez (Enriquez et al. 2010) | 66 | | 50.6 | 18–87 |
| Munich | Baghai (Baghai et al. 2005) | 66 | | 51.2 | |
| Poland | Gazdag (Gazdag et al. 2009a) | 65 | | | |
| Norway | Schweder (Schweder et al. 2011a) | 65 | 55 | | |
| UK | Duffett (Duffett and Lelliott 1998) | 64 | | | |
| Sweden | Socialstyrelsen (Socialstyrelsen 2010) | 59 | | 54.5 | 15–92 |
| Hungary | Gazdag (Gazdag et al. 2004a) | 59 | | | |
| Russia | Golenkov (Golenkov et al. 2010) | 56 | | 34.4 | 15–64 |
| Turkey | Zeren (Zeren et al. 2003) | 52 | 3(>64) | 33.1 | |
| Turkey | Saatcioglu (Saatcioglu and Tomruk 2008) | 44 | 1(>64) | 35.1 | |
| Asia | | | | | |
| Hong Kong | Chung (Chung et al. 2009) | 88 | 60 | 62 | 21–87 |
| Hong Kong | Chung (Chung 2003) | 68 | 15 | | |
| Thailand | Lalitanatpong (Lalitanatpong 2005) | 63 | | | |
| Saudi Arabia | Alhamad (Alhamad 1999) | 60 | | 27.9 | 15–60 |
| Pakistan | Naqvi (Naqvi and Khan 2005) | 56 | 7 (>60) | | |
| Japan | Chanpattana (Chanpattana et al. 2005a) | 54 | 39 (>64) | | |
| Japan | Ishimoto (Ishimoto et al. 2000) | 51 | | 27.5 | 13–59 |
| Bengaluru, India | Eranti (Eranti et al. 2011) | 51 | | 30.3 | |
| India | Chanpattana (Chanpattana et al. 2005b) | 39 | 15 | | |
| Asia | Chanpattana (Chanpattana et al. 2010) | 38 | 4 (>64) | | |
| United Arab Emirates | Tewvik (Tewfik et al. 1998) | 33 | | 30.1 | |
| Thailand | Chanpattana (Chanpattana and Kramer 2004) | 28 | | | |
| Nepal | Ahikari (Ahikari et al. 2008) | 28 | | | |

Reasons for not prescribing ECT in Europe were attributed to lack of equipment, economy, and difficulties in recruiting anesthetist (Muller et al. 1998; Nelson 2005; Bertolin-Guillen et al. 2006; Schweder et al. 2011b).

Main findings of this review are summarized as follows:

(**1**) There is a large variation in ECT utilization and practice worldwide today. Global crude estimates of TPR (age < 65 years) is 2.34, EAR 11.2, iP 6.1, and AvE eight. Only some (usually under half) of all institutions within the same country provide ECT. Mandatory report of ECT use and monitoring by governmental agents is overall scant. Reporting of side effects, adverse events, and mortality is sparse. The results reflect that the guidelines by APA and Royal College of Psychiatrists are not internationally acknowledged, except in Western countries, and therefore the lack of implementation may be rational in these regions of the world.
(**2**) Overall, there is a considerable variation in ECT administration and parameters worldwide. Unmodified ECT is substantially used today, not only in Asia (over 90%), Africa, Latin America, but also occurs in Europe (Russia, Turkey, and Spain). The most common electrode placement is BL, but a few places in Europe and Australia/New Zealand adhere to UL as first choice. Brief-pulse wave current devices are used worldwide, but old sine-wave stimulus and apparatus still in use.
(**3**) In Western countries (Europe, USA, Australia, and New Zealand), ECT is at large administered to elderly female patients with depressive disorders. In those areas of the world (Asia, Africa, Latin America, Russia), where ECT is still often administered unmodified, it is predominantly prescribed to younger patients (often more male) with schizophrenia. ECT is administered worldwide under involuntary and guardian consent conditions (ranging from a few percent up to nearly two-thirds). (Involuntary conditions, implying also ECT administered under involuntary admission, are though in the extracted data but not always directly equivalent or indicative of involuntary [against wish] treatment.)
(**4**) New trends are revealed. ECT is used as first-line acute treatment and not only last resort for medication resistant conditions in many countries. Other professions than psychiatrists (geriatricians and nurses) are administering ECT. ECT use among outpatients (ambulatory setting) is increasing.

## Discussion

ECT utilization and practice are presented from all continents of the world in this review, representing a widespread use of ECT in the today's world. Two continents, Africa and Latin America, have sparse ECT country data, which might indicate a trend away from ECT (Levav and Gonzalez 1996), but this does not at all seem to be the case in the rest of the world. Although the report of ECT seems abundant in Europe, Asia, and America, the data do not cover all countries known to have ECT practice. For example, no "up to date" 1990 and after ECT studies are identified from either Iceland or Canada.

Large variations between continents, countries, and regions in ECT utilization, rates, and clinical practice are displayed, despite international guidelines (American Psychiatric Association 2001; Royal College of Psychiatrists 2005; Enns et al. 2010). Due to no uniform standard of reporting ECT utilization, rates are computed in the data extraction to TPR per 10,000, to make it comparable. This revealed a large worldwide TPR variation, from 0.11 (Gazdag et al. 2009a) to 5.1 (Rosenbach et al. 1997). Likewise worldwide iPs varied greatly. Although the large worldwide differences in ECT utilization have been pointed out previously (Hermann et al. 1995; Glen and Scott 2000; Bertolin-Guillen et al. 2006; Gazdag et al. 2009a), and the differences between countries on the basis of practice reports are not so easy to compare (Little 2003), overall variations in contemporary practice between the continents (Asia and Africa vs. USA, Australia and New Zealand, Europe) revealed by this review are immense. Explanations of these variations are complex, encompassing not only the diversity in organization of psychiatric services, but no doubt also grounded in professional beliefs concerning the efficacy and safety of ECT (The UK ECT Review Group 2003). On a worldwide scale, the number of patients receiving unmodified ECT is large, nearly 20,000 of patients in India (Chanpattana et al. 2005b), over 6000 in Thailand (Chanpattana and Kramer 2004), and overall in Asia estimated at 11.2 patients treated with unmodified ECT per 100,000 (Chanpattana 2010).

Diverse reasons for this high use of unmodified ECT have been put forth, such as lack of equipment, personnel and anesthesiologists, contraindication for anesthesia, convenience, emergency, and economic purposes (Chanpattana et al. 2005b). Whether these arguments are acceptable in this modern era and in light of knowledge about benefits and harms of ECT is another question. In spite of attempts to ban it (Mudur 2002), the debate defending unmodified ECT practice (Andrade et al. 2010), and voices claiming this practice to be unjustified and unethical (Grunhaus 2010) is ongoing today. Unmodified ECT is still practiced in some parts of Russia, Turkey, and Spain (Zeren et al. 2003; Nelson 2005; Bertolin-Guillen et al. 2006), and international guidelines (American Psychiatric Association 2001; Royal College of Psychiatrists 2005; Enns et al. 2010) appear to have failed (Strachan 2001) in influencing important aspects of today's ECT practice.

The practice in many countries of Asia (Chanpattana and Kramer 2004; Chanpattana et al. 2005a, b, 2010), Latin America (Levav and Gonzalez 1996), and Africa (Odejide et al. 1987; Mugisha and Ovuga 1991; Selis et al. 2008; James

 

et al. 2010) bear a resemblance to the beginning of ECTs medical history in Europe (Cerletti and Bini 1938). The Asian practice of today resembles practice that was used in Finland in 1944 and 1964 (Huuhka et al. 2000), where the majority of ECT-treated patients were diagnosed with schizophrenia (75–78%) and treated unmodified. Likewise, in 1944 in Finland, ECT was (Huuhka et al. 2000) more often given to men than women (36% women). In 1997 in Finland, a major shift occurred toward majority of patients (78%) having affective disorders (unipolar/bipolar depression) and treated modified (Huuhka et al. 2000). This shift in Western world practice and the increasing use of ECT among women is also found both in USA and Australia, in the 1980s to 1990s (Galletly et al. 1991; Rosenbach et al. 1997). Similar changes seem to be occurring in some areas of Asia (Alhamad 1999; Naqvi and Khan 2005; Ahikari et al. 2008; Chanpattana et al. 2010). One reason for the lingering ECT use among patients with schizophrenia might be availability of antipsychotic medication, such as in Thailand, where the essential drug list from the Ministry of Health does not include antipsychotics (Chanpattana and Kramer 2004). Also, shortage of anesthesiologist and negative images is another explanation that is given for having hindered Japanese psychiatrists from reforming ECT practice for a long time (Motohashi et al. 2004).

Another explanation of practice differences, diagnostic and gender disparities between Asia and Europe, Australia and New Zealand, and USA might be the historical use of ECT, being much longer in Europe where it originated in 1938 (Cerletti and Bini 1938) and its early spreading to the United States (Cerletti and Bini 1938; Hemphill and Walter 1941; Shorter 2009). In Thailand, ECT was first administered unmodified in 1950, modified in 1974, and brief-pulse wave first applied in 1992 (Chanpattana 2010). Whereas, in Japan, ECT was first administered unmodified in 1939 and modified 1958 (Chanpattana et al. 2005a), but even so the practice of unmodified ECT in Japan in the 1990s is still profuse (Motohashi et al. 2004; Chanpattana et al. 2005a).

In Europe, USA, and Australia/New Zealand, practice was almost entirely modified ECT and even in Hungary (Gazdag et al. 2004a) anesthesia was obligatory. In several countries, Chuvash Republic, Russia, Spain, and Japan, the practice of modified ECT was sometimes without muscle relaxants (Ishimoto et al. 2000; Bertolin-Guillen et al. 2006; Golenkov et al. 2010), and even assistants were used to restrain extreme motion from the convulsions in Japan (Ishimoto et al. 2000). The unusual practice of muscle relaxants without anesthesia is also undertaken in a few Asian institutions (Chanpattana et al. 2010), and availability and recruitment of anesthesiologists pointed out as a problem both in Asia and Europe (Duffett and Lelliott 1998; Motohashi et al. 2004; Schweder et al. 2011b). On the other hand, Wales has no shortage of anesthesiologists (Duffett et al. 1999).

Preferred placement of electrodes worldwide (approximately 80%) is BL, as it was from the very beginning (Cerletti and Bini 1938), except for Australia, New Zealand (O'Dea et al. 1991), Norway (Schweder et al. 2011b), Vienna (Tauscher et al. 1997), Munich (Baghai et al. 2005), and the Netherlands (van Waarde et al. 2009) where UL is the first choice, but they also use both types. Brief-pulse wave current devices appear widespread world widely. Many countries (Scandinavia, Australia, and New Zealand) adhere to brief-pulse wave and UL electrode placement as first choice (Fink 2001; Rose et al. 2003; Shorter 2009), no doubt due to the reported trade-off effect between effectiveness and memory impairment (The UK ECT Review Group 2003), but switch to BL when the clinical response is judged as too poor. In spite of sine-wave current being declared unjustified by guidelines today (American Psychiatric Association 2001), it still occurs in Europe (14–52%) (Muller et al. 1998; Gazdag et al. 2004a, 2009a; Nelson 2005; Bertolin-Guillen et al. 2006; Sienaert et al. 2006), Asia (30–58%) (Chanpattana et al. 2005a, b, 2010), and USA (2%) (Prudic et al. 2001).

Previous literature indicates a predominance of patients receiving ECT in Western countries to be elderly female with affective disorder (unipolar/bipolar depression) (Reid et al. 1998; Glen and Scott 1999; Fergusson et al. 2003; Baghai et al. 2005; Moksnes et al. 2006), as is also confirmed by this review, and also in Hong Kong (Chung et al. 2009). Except for age being younger, female and depression predominance was also the case for Saudi Arabia (Alhamad 1999) and Pakistan (Naqvi and Khan 2005). In some European sites (Brussels and Wallonia in Belgium), ECT is regarded as an "antidepressant," since it is used exclusively for the treatment of depressive disorder (Sienaert et al. 2006). In contrast, ECT in Asia it is regarded as an "antipsychotic" agent (Little 2003; Chanpattana et al. 2005a, b, 2010; Chanpattana and Kramer 2004; Ahikari et al. 2008). Discrepancies in indication could be due to differences in diagnostic practice, a lower recognition, and under treatment of depressive disorder, and also lower mental health care budgets (Chanpattana and Kramer 2004). In contrast to Asia, the typical ECT patient in the United States is said to be an elderly white female paying for treatment with insurance or private funds (Kramer 1999). Higher ECT treatment rates are found among Caucasian white ethnicity in Pennsylvania (Sylvester et al. 2000), England (Department of Health 2007), and Western Australia (Teh et al. 2005), which might imply discriminatory factors in treatment selection.

Worldwide, there is a general tendency toward a low, within-country, ECT provision by psychiatric institutions, varying from below 6% in USA (Kramer 1999), to 23–51% in Europe (Benadhira and Teles 2001; Sienaert et al. 2005a, 2006; Bertolin-Guillen et al. 2006; van Waarde et al. 2009; Schweder et al. 2011a), 66% in Australia (Chanpattana 2007), and 59–78% in Asia (Chanpattana et al. 2005a, b). In Nor-

 

way, institutions even have waiting lists for ECT treatment (Schweder et al. 2011b). Altogether, this might indicate a trend toward ECT being provided by specialized units, but could also be a result of worldwide paucity in ECT training (Duffett and Lelliott 1998; Chanpattana et al. 2005a, b; Chanpattana and Kramer 2004), and even changing treatment trends.

ECT has for a long time been over held as a last-resort treatment for medication-resistant and very severe life-threatening clinical conditions (McCall 2001; Eranti and McLoughlin 2003), as reported from USA (Prudic et al. 2001). However, a transformation in ECT indication into first-line acute treatment (life saving, catatonia, previous good response, and patient preference) is apparent not only in Europe (Muller et al. 1998; Duffett et al. 1999; Zeren et al. 2003; Schweder et al. 2011a), but also in Saudi Arabia (Alhamad 1999) and Australia (Lamont et al. 2011). Although world widely ECT is mainly administered by psychiatrists and trainee psychiatrists, another change is that of other professions than psychiatrists (geriatricians and nurses) administering ECT in Europe (van Waarde et al. 2009; Schweder et al. 2011b). The trend toward increasing ambulatory ECT and ECT use among outpatients in Europe (15–19%) (Duffett et al. 1999; Department of Health 2007; Enriquez et al. 2010; Schweder et al. 2011b) is conceivably, parallel to other ambulatory treatment tendencies, out of the best interest to the recovering patient and his caregivers.

Overall, the report of side effects, adverse events, and mortality rates is sparse. Although mortality rate is reported from Thailand (0.08%) (Chanpattana and Kramer 2004) and Texas (14 deaths per 100,000 treatments within two weeks after ECT) (Scarano et al. 2000), it is not clear if the ECT-related deaths are due to lethal side effects (e.g., cardiac arrhythmia) or comorbid somatic illnesses or anesthetic complications.

ECT is administered worldwide under involuntary and guardian consent conditions, ranging from a few percent in USA and Europe 1–3% (Reid et al. 1998; Kramer 1999; Scarano et al. 2000; Bertolin-Guillen et al. 2006; Sundhedsstyrelsen 2011a) to 20–29% (McCall et al. 1992; Muller et al. 1998; Huuhka et al. 2000; Fergusson et al. 2004). Involuntary conditions in the extracted data though cannot be taken as directly equivalent to or directly indicative of involuntary (against wish) treatment. In Asia, written informed consent is mainly obtained directly or counter signed by family members (Alhamad 1999; Chanpattana and Kramer 2004; Chanpattana et al. 2005a; Naqvi and Khan 2005). Consent given by legal bodies varies from 18% in Scotland (under the Scottish Mental Health Act) (Fergusson et al. 2004) to 60% in Sydney, Australia (by the Mental Health Review Tribunal) (Lamont et al. 2011). Mandatory ECT data reporting is almost nonexistent and found only in a few places (Texas, USA, and Australia) (Reid et al. 1998; Scarano et al. 2000; Wood and Burgess 2003). Likewise legislature regulating practice, such as obligatory anesthesia (Gazdag et al. 2004a), obligatory written informed patient consent (Schweder et al. 2011b), ECT licensed facilities (Wood and Burgess 2003), prohibited administered to persons under 16 years of age (Reid et al. 1998), involuntary by order of court or legal body (Fergusson et al. 2004; Lamont et al. 2011), is also nonexistent.

### Implications of findings

Worldwide improvement of ECT utilization and practice is needed, alongside development of an international minimal dataset standard applied in all countries. Continuous and mandatory monitoring and use of ECT health registrar reporting systems, taking into account patient confidentiality, would also ultimately reduce our knowledge gaps. This would again contribute to more uniform worldwide ECT practice, to the best for the patient.

### Strengths and limitations

Strengths of this study are the extensive search strategy, high number of included studies, methodological transparency, and summary of findings table, providing an overview of contemporary worldwide use of ECT, which has not been undertaken in such detail previously. Limitations of this review are the inclusion of nonrandomized survey/questionnaire studies, based on practitioner accounts of ECT use, influencing the precision of the estimated rates, either to be overestimated or underestimated depending on the accuracy of the source. Seemingly, more accurate are direct reports from individual hospitals studies or national registers. The overall diversity in practice data reporting unclear representativeness of region or land as a whole and large heterogeneity in reported ECT utilization rates did not lend the data to meta-analyses. National overviews of ECT data published by regulatory bodies or governmental agencies on the internet are not so easily accessed, despite such internet sites being hand searched. National government overviews do not usually appear in the databases where systematic literature search of published journal articles and studies is undertaken.

## Conclusion

Today utilization rates, practice, and ECT parameters vary greatly throughout continents and countries. Unmodified ECT is still in use (Asia, Africa, Latin America, and even in Europe). In spite of existing guidelines, there is no uniform worldwide practice. Large global variation in ECT utilization, administration, and practice advocates a need for worldwide sharing of knowledge about ECT, reflection, and learning from each other's experiences.

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### References

Agarwal, A. K., C. Andrade, and M. Venkataswamy Reddy. 1992. The practice of ECT in India: issues relating to the administration of ECT. Indian J. Psychiatry 34:285–297.

Ahikari, S. R., S. N. Pradhan, S. C. Sharma, B. R. Shrestha, S. Shrestha, and S. Tabedar. 2008. Diagnostic variability and therapeutic efficacy of ECT in Nepalese sample. Kathmandu Univ. 6:41–48.

Alhamad, A. M., and F. al-Haidar. 1999. A retrospective audit of electroconvulsive therapy at King Khalid University Hospital, Saudi Arabia. East Mediterr. Health J. 5:255–261.

Alhamad, A. M. 1999. The use of ECT in the treatment of psychiatric disorders in a teaching hospital in Saudi Arabia. Bahrain Med. Bull. 21:52–55.

American Psychiatric Association. 2001. Pp. 355 *in* R. D. Weiner, ed. The Practice of electroconvulsive therapy: recommendations for treatment, training, and privileging: a task force report of the American Psychiatric Association. The American Psychiatric Association VII, Washington, DC.

Andersson, J. E., and T. G. Bolwig. 2002. Electroconvulsive therapy in Denmark 1999. A nation-wide questionnaire study [Danish]. Ugeskr Laeger 164:3449–3452.

Andrade, C., A. K. Agarwal, and M. Venkataswamy Reddy. 1993. The practice of ECT in India: II. The practical administration of ECT. Indian J. Psychiatry 35:81–86.

Andrade, C., W. Chanpattana, B. Kramer, G. Kunigiri, B. Gangadhar, and R. Kitphati. 2010. The practice of electroconvulsive therapy in Asia: variations and deviations from the guidelines—a response to Dr Grunhaus. J. ECT 26:34–36.

Baghai, T. C., A. Marcuse, H. J. ller, and R. Rupprecht. 2005. Electroconvulsive therapy at the Department of Psychiatry and Psychotherapy, University of Munich. Development during the years 1995–2002 [German]. Nervenarzt 76:597–612.

Baudis, P. 1992. Electroconvulsive therapy in the Czech Republic 1981–1989 [Czech]. Cesk Psychiatr. 88:41–47.

Benadhira, R., and A. Teles. 2001. Current status of electroconvulsive therapy in adult psychiatric care in France [French]. Encephale 27:129–136.

Benbow, S. M., and T. G. Bolwig. 2009. Electroconvulsive therapy in Scandinavia and the United Kingdom. Pp. 236–245 *in* C. M. Swartz, ed. Electroconvulsive and neuromodulation therapies. Cambridge Univ. Press, New York.

Berg, J. E. 2009. Electroconvulsive treatment-more than electricity?: an Odyssey of facilities. J. ECT 25:250–255.

Bernardo, M., F. Arrufat, L. Pintor, S. Catarineu, E. Buisan, and C. Ballus. 1996. Patterns of the use of electroconvulsive therapy in Barcelona [Spanish]. Med. Clin. (Barc) 106:201–204.

Bertolin-Guillen, J. M., S. Peiro-Moreno, and M. E. Hernandez-de-Pablo. 2006. Patterns of electroconvulsive therapy use in Spain. Eur. Psychiatry 21:463–470.

Cerletti, U., and L. Bini. 1938. Un nuovo metodo di shockterapie: 'l' elettroshock' (riassunto). Reale Accademia Medica (Communicazione alla seduta del 28 maggio 1938-XVI della Reale Accademia Medica di Roma.), Rome.

Chang, S. S. 2009. Electroconvulsive therapy in Asia. Pp. 256–265 *in* C. M. Swartz, ed. Electroconvulsive and neuromodulation therapies. Cambridge Univ. Press, New York.

Chanpattana, W., and B. A. Kramer. 2004. Electroconvulsive therapy practice in Thailand. J. ECT 20:94–98.

Chanpattana, W., B. A. Kramer, G. Kunigiri, B. N. Gangadhar, R. Kitphati, and C. Andrade. 2010. A survey of the practice of electroconvulsive therapy in Asia. J. ECT 26:5–10.

Chanpattana, W., G. Kunigiri, B. A. Kramer, and B. N. Gangadhar. 2005b. Survey of the practice of electroconvulsive therapy in teaching hospitals in India. J. ECT 21:100–104.

Chanpattana, W., K. Kojima, B. A. Kramer, A. Intakorn, S. Sasaki, and R. Kitphati. 2005a. ECT practice in Japan. J. ECT 21:139–144.

Chanpattana, W. 2007. A questionnaire survey of ECT practice in Australia. J. ECT 23:89–92.

Chanpattana, W. 2010. One hundred twenty years of mental health care in Thailand and the development of electroconvulsive therapy. J. ECT 26:11–13.

Chung, J. P. Y., P. H. W. Yim, and E. L. W. Dunn. 2009. Clinical and treatment characteristics of Chinese patients undergoing electroconvulsive therapy in an acute psychiatric unit in Hong Kong. Hong Kong J. Psychiatr. 19:150–154.

Chung, K.-F., Y.-K. Ng, G.-C. Yiu, and H.-K. Cheung. 2003. Electroconvulsive therapy in Hong Kong. Psychiatr. Bull. 27:102–104.

Chung, K. F. 2003. Electroconvulsive therapy in Hong Kong: rates of use, indications, and outcome. J. ECT 19:98–102.

Creed, P., L. Froimson, and L. Mathew. 1995. Survey of the practice of electroconvulsive therapy in North Carolina. Convuls. Ther. 11:182–187.

Department of Health. 2007. Electro convulsive therapy: survey covering the period from January 2002 to March 2002. Available at http://www.dh.gov.uk/en/Publicationsandstatistics/Statistics/StatisticalWorkAreas/

 

Statisticalhealthcare/DH_4000216. Updated 8 Feb 2007 (accessed January 6, 2011).
Duffett, R., and P. Lelliott. 1998. Auditing electroconvulsive therapy. The third cycle. Br. J. Psychiatry 172:401–405.
Duffett, R., D. R. Siegert, and P. Lelliott. 1999. Electroconvulsive therapy in Wales. Psychiatr. Bull. 23:597–601.
Eiring, O. 2010. First in Norway with treatment flow chart for ECT [Norwegian]. PsykNytt [serial on the Internet] 8:3–5. www.helsebiblioteket.no (accessed 1 December 1, 2010).
Enns, M. W., J. P. Reiss, and P. Chan. 2010. Electroconvulsive therapy. [Position Paper 1992–27-R1]. Can. J. Psychiatry 55:1–12. Available at http://publications.cpa-apc.org/media.php?mid=978 (accessed January 13, 2011).
Enriquez, S., S. Tighe, and N. Fitzgibbon. 2010. Five years of ECT: the relationship between consent status and treatment experiences. Ir. J. Psychol. Med. 27:117–122.
Eranti, S. V., and D. M. McLoughlin. 2003. Electroconvulsive therapy—state of the art. Br. J. Psychiatry 182:8–9.
Eranti, S. V., J. Thirthalli, V. Pattan, A. Mogg, G. Pluck, L. Velayudhan, J. Chan, B. N. Gangadhar, and D. M. McLoughlin. 2011. Comparison of electroconvulsive therapy practice between London and Bengaluru. J. ECT 27:275–280.
Fergusson, G., J. Hendry, and C. Freeman. 2003. Do patients who receive electroconvulsive therapy in Scotland get better? Results of a national audit. Psychiatr. Bull. 27:137–140.
Fergusson, G. M., L. A. Cullen, C. P. L. Freeman, J. D. Hendry. 2004. Electroconvulsive therapy in Scottish clinical practice: A national audit of demographics, standards, and outcome. J. ECT 20:166–173.
Fink, M., and C. H. Kellner. 2007. Belling the cat: ECT practice standards in the United States. J. ECT 23:3–5.
Fink, M. 2001. Convulsive therapy: a review of the first 55 years. J. Affect. Disord. 63:1–15.
Frederiksen, S. O., and G. d'Elia. 1979. Electroconvulsive therapy in Sweden. Br. J. Psychiatry 134:583–587.
Galletly, C. A., C. D. Field, and C. L. Ormond. 1991. Changing patterns of electroconvulsive therapy use: results of a five-year survey. Aust. NZ J. Psychiatry 25:535–540.
Gassy, J. E., and J. M. Rey. 1990. A survey of ECT in a general hospital psychiatry unit. Aust. NZ J. Psychiatry 24:385–390.
Gazdag, G., D. Palinska, I. Kloszewska, and T. Sobow. 2009a. Electroconvulsive therapy practice in Poland. J. ECT 25: 34–38.
Gazdag, G., G. Sebestyen, E. Zsargo, J. 2009b. Survey of referrals to electroconvulsive therapy in Hungary. World J. Biol. Psychiatry 10:900–904.
Gazdag, G., N. Kocsis, and A. Lipcsey. 2004a. Changes in the use of electroconvulsive treatment in Hungarian psychiatry between 1992 and 2002. [Hungarian]. Psychiatr. Hung. 19:53–60.
Gazdag, G., N. Kocsis, and A. Lipcsey. 2004b. Rates of electroconvulsive therapy use in Hungary in 2002. J. ECT 20:42–44.
Glen, T., and A. I. F. Scott. 1999. Rates of electroconvulsive therapy use in Edinburgh (1992–1997). J. Affect. Disord. 54:81–85.
Glen, T., and A. I. F. Scott. 2000. Variation in rates of electroconvulsive therapy use among consultant teams in Edinburgh (1993–1996). J. Affect. Disord. 58:75–78.
Golenkov, A., G. S. Ungvari, and G. Gazdag. 2010. ECT practice and psychiatrists' attitudes towards ECT in the Chuvash Republic of the Russian Federation. Eur. Psychiatry 25:126–128.
Grunhaus, L. 2010. A call for action-my own personal views. J. ECT 26:32–33.
Hemphill, K. E., and W. G. Walter. 1941. The treatment of mental disorders by electrically induced convulsions. J. Ment. Sci. 87:256–275.
Hermann, R. C., R. A. Dorwart, C. W. Hoover, and J. Brody. 1995. Variation in ECT use in the United States. Am. J. Psychiatry 152:869–875.
Hermann, R. C., S. L. Ettner, R. A. Dorwart, N. Langman-Dorwart, and S. Kleinman. 1999. Diagnoses of patients treated with ECT: a comparison of evidence-based standards with reported use. Psychiatr. Serv. 50:1059–1065.
Huuhka, M. J., L. A. Korpisammal, and E. V. J. Leinonen. 2000. Historical perspective on electroconvulsive therapy in Pitkaniemi Hospital: a comparison of practice in 1940s, 1960s, and 1990s. Psychiatria Fennica 31:55–64.
Ikeji, O. C., J. U. Ohaeri, R. O. Osahon, and R. O. Agidee. 1999. Naturalistic comparative study of outcome and cognitive effects of unmodified electro-convulsive therapy in schizophrenia, mania and severe depression in Nigeria. East Afr. Med. J. 76:644–650.
Ishimoto, Y., A. Imakura, and H. Nakayama. 2000. Practice of electroconvulsive therapy at University Hospital, the University of Tokushima School of Medicine from 1975 to 1997. J. Med. Invest. 47:123–127.
James, B. O., O. Morakinyo, A. O. Lawani, J. O. Omoaregba, and O. S. Olotu . 2010. Unmodified electroconvulsive therapy: the perspective of patients from a developing country. J. ECT 26:218–222.
Kornhuber, J., and M. Weller. 1995. Patient selection and remission rates with the current practice of electroconvulsive therapy in Germany. Convuls. Ther. 11:104–109.
Kramer, B. A., and P. E. Hsin-Tung. 1990. A survey of ECT use in Asia. Convuls. Ther. 6:26–31.
Kramer, B. A. 1999. Use of ECT in California, revisited: 1984–1994. J. ECT 15:245–251.
Lalitanatpong, D. 2005. The use of electroconvulsive therapy and the length of stay of psychiatric inpatients at King Chulalongkorn Memorial Hospital, Thai Red Cross Society. J. Med. Assoc. Thai. 88:S142–S148.
Lamont, S., S. Brunero, C. Barclay, et al. 2011. Evaluation of an electroconvulsive therapy service in a general hospital. Int. J. Ment. Health Nurs. 20:223–9. doi: 10.1111/j.1447-0349.2010.00725.x [Published first online February 18, 2011]

 

Latey, R. H., and T. J. Fahy. 1985. Electroconvulsive therapy in the Republic of Ireland 1982: a summary of findings. Br. J. Psychiatry 147:438–439.

Levav, I., and U. R. Gonzalez. 1996. The use of electroconvulsive therapy in Latin America and the Caribbean [Spanish]. Acta Psiquiatr. Psicol. Am. Lat. 42:137–141.

Levav, I., and U. R. Gonzalez. 1998. The use of electroconvulsive therapy in Latin America and the Caribbean. Rev. Panam. Salud. Publica. [serial on the Internet] 3:120–123. Available at www.scielosp.org/scielo.php?script=sci_arttext&pid=S1020-49891998000200013&lng=en. doi: 10.1590/S1020-49891998000200013 (accessed July 12, 2011).

Little, J. D. 2003. ECT in the Asia Pacific region: what do we know? J. ECT 19:93–97.

Lucca, A. M., D. M. Rossini, A. M. Malaguti, R. M. Zanardi, L. P. Magri, and E. M. Smeraldi. 2010. Use of electroconvulsive therapy in the city of Milan: a naturalistic study. J. ECT 26: 148.

Magid, M., and B. M. Rohland. 2009. Electroconvulsive therapy availability in the United States. Pp. 227–35 *in* C. M. Swartz, ed. Electroconvulsive and neuromodulation therapies. Cambridge Univ. Press, New York.

McCall, W. V., R. D. Weiner, F. E. Shelp, and S. Austin. 1992. ECT in a state hospital setting. Convuls. Ther. 8:12–18.

McCall, W. V. 2001. Electroconvulsive therapy in the era of modern psychopharmacology. Int. J. Neuropsychop. 4:315–324.

Ministry of Health. 2005. Elevtroconvulsive therapy audit report. New Zealand. Available at www.moh.govt.nz (accessed October 3, 2011).

Ministry of Health. 2006. Electroconvulsive therapy annual statistics: for the period 1 July 2003 to 30 June 2005. New Zealand. Available at www.moh.govt.nz (accessed October 28, 2011).

Moksnes, K. M., and S. O. Ilner. 2010. Electroconvulsive therapy—efficacy and side-effects. Tidsskr. Nor. Laegeforen. 130:2460–2464.

Moksnes, K. M., T. Vatnaland, B. Eri, and N. H. Torvik. 2006. Electroconvulsive therapy in the Ullevaal region of Oslo 1988–2002 [Norwegian]. Tidsskr. Nor. Laegeforen. 126:1750–1753.

Motohashi, N., S. Awata, and T. Higuchi. 2004. A questionnaire survey of ECT practice in university hospitals and national hospitals in Japan. J. ECT 20:21–23.

Mudur, G. 2002. Indian group seeks ban on use of electroconvulsive therapy without anaesthesia. Br. Med. J. 324:806.

Mugisha, R. X., and E. B. Ovuga. 1991. The use of electroconvulsive therapy in the treatment of psychiatric illness at Umzimkulu Hospital in Transkei. A retrospective study. South Afr. Med. J. 79:391–393.

Muller, U., A. Klimke, M. Janner, and W. Gaebel. 1998. Electroconvulsive therapy in psychiatric clinics in Germany in 1995 [German]. Nervenarzt 69:15–26.

Naqvi, H., and M. M. Khan. 2005. Use of electroconvulsive therapy at a university hospital in Karachi, Pakistan: a 13-year naturalistic review. J. ECT 21:158–161.

Nelson, A. I., and N. Giagou. 2009. History of electroconvulsive therapy in the Russian Federation. Pp. 266–275 *in* C. M. Swartz, ed. Electroconvulsive and neuromodulation therapies. Cambridge Univ. Press, New York.

Nelson, A. I. 2005. A national survey of electroconvulsive therapy use in the Russian Federation. J. ECT 21:151–157.

Odejide, A. O., J. U. Ohaeri, and B. A. Ikuesan. 1987. Electroconvulsive therapy in Nigeria. Convuls. Ther. 3:31–39.

Okagbue, N., A. McIntosh, M. Gardner, and A. I. Scott. 2008. The rate of usage of electroconvulsive therapy in the city of Edinburgh, 1993–2005. J. ECT 24:229–231.

Okasha, T. A. 2007. Electro-convulsive therapy (ECT): an Egyptian perspective. Afr. J. Psychiatry 10:22–24.

Olfson, M., S. Marcus, H. A. Sackeim, J. Thompson, and H. A. Pincus. 1998. Use of ECT for the inpatient treatment of recurrent major depression. Am. J. Psychiatry 155:22–29.

O'Dea J. F. J., P. B. Mitchell, and I. B. Hickie. 1991. Unilateral or bilateral electroconvulsive therapy for depression? A survey of practice and attitudes in Australia and New Zealand. Med. J. Aust. 155:9–11.

Palinska, D., G. Gazdag, T. Sobow, R.T Hese, and I. Kloszewska. 2008. Electroconvulsive therapy in Poland in 2005—a nationwide questionnaire study performed in Polish psychiatric clinics [Polish]. Psychiatr. Pol. 42:825–839.

Pastore, D. L., L. M. Bruno, A. E. Nardi, and A. G. Dias. 2008. Use of electroconvulsive therapy at Instituto de Psiquiatria, Universidade Federal do Rio de Janeiro, from 2005 to 2007. Revista de Psiquiatria do Rio Grande do Sul 30:175–181.

Pippard, J. 1992. Audit of electroconvulsive treatment in two National Health Service regions. Br. J. Psychiatry 160:621–637.

Prudic, J., M. Olfson, and H. A. Sackeim. 2001. Electro-convulsive therapy practices in the community. Psychol. Med. 31:929–934.

Reid, W. H., S. Keller, M. Leatherman, and M. Mason. 1998. ECT in Texas: 19 months of mandatory reporting. J. Clin. Psychiatry 59:8–13.

Rosa, M. A., and M. O. Rosa. 2009. Electroconvulsive therapy in Latin America. Pp. 276–284 *in* C. M. Swartz, ed. Electroconvulsive and neuromodulation therapies. Cambridge Univ. Press, New York.

Rose, D., P. Fleischmann, T. Wykes, M. Leese, and J. Bindman. 2003. Patients' perspectives on electroconvulsive therapy: systematic review. Br. Med. J. 326:1363–1368.

Rosenbach, M. L., R. C. Hermann, and R. A. Dorwart. 1997. Use of electroconvulsive therapy in the Medicare population between 1987 and 1992. Psychiatr. Serv. 48:1537–1542.

Royal College of Psychiatrists. 2005. The ECT handbook: the third report of the Royal College of Psychiatrist's Special Committee on ECT. Royal College of Psychiatrists, London, xii, p. 243.

 

Saatcioglu, O., and N. B. Tomruk. 2008. Practice of electroconvulsive therapy at the research and training hospital in Turkey. Soc. Psychiatry Psychiatr. Epidemiol. 43:673–677.

Scarano, V. R., A. R. Felthous, and T. S. Early. 2000. The state of electroconvulsive therapy in Texas. Part I: reported data on 41,660 ECT treatments in 5971 patients. J. Forensic Sci. 45:1197–1202.

Schweder, L. J., B. Wahlund, P. Bergsholm, and O. M. Linaker. 2011b. Questionnaire study about the practice of electroconvulsive therapy in Norway. J. ECT 27:296–299.

Schweder, L. J., S. Lydersen, B. Wahlund, P. Bergsholm, and O. M. Linaker. 2011a. Electroconvulsive therapy in Norway: rates of use, clinical characteristics, diagnoses and attitude. J. ECT 27:292–295.

Selis, M. A., F. Kauye, and A. F. Leentjens 2008. Leentjens. The practice of electroconvulsive therapy in Malawi. J. ECT 24:137–140.

Shorter, E. 2009. History of electroconvulsive therapy. Pp. 167–79 *in* C. M. Swartz, ed. Electroconvulsive and neuromodulation therapies. Cambridge Univ. Press, New York.

Sienaert, P., and W. W. van den Broek. 2009. Electroconvulsive therapy in continental Western Europe: a litterature review. Pp. 246–255 *in* C. M. Swartz, ed. Electroconvulsive and neuromodulation therapies. Cambridge Univ. Press, New York.

Sienaert, P., B. Filip, M. Willy, and P. Joseph. 2005b. Electroconvulsive therapy in Belgium: a questionnaire study on the practice of electroconvulsive therapy in Flanders and the Brussels Capital region. J. ECT 21:3–6.

Sienaert, P., F. Bouckaert, W. Milo, and J. Peuskens. 2005a. The practice of electroconvulsive therapy in Flanders and the Brussels Capital region. A survey [Dutch]. Tijdschr. Psychiatr. 47:279–287.

Sienaert, P., M. Dierick, G. Degraeve, and J. Peuskens. 2006. Electroconvulsive therapy in Belgium: a nationwide survey on the practice of electroconvulsive therapy. J. Affect. Disord. 90:67–71.

Sijuwola, O. A. 1985. Use of electroconvulsive therapy in a Nigerian hospital. East Afr. Med. J. 62:60–64.

Socialstyrelsen. 2010. ECT-treatment, a pilot study [Swedish]. Socialstyrelsen (Artikkel nr. 2010–4-3). Available at http://www.socialstyrelsen.se/publikationer2010/2010-4-3 (accessed December 1, 2010).

Strachan, J. A. 2001. Electroconvulsive therapy—attitudes and practice in New Zealand. Psychiatr. Bull. 25:467–470.

Stromgren, L. S. 1991. Electroconvulsive therapy in the Nordic countries, 1977–1987. Acta Psychiatr. Scand. 84: 428–434.

Sundhedsstyrelsen. 2011a. Electroconvulsive therapy (ECT-therapy) and deaths—report. Version 1.0 [Danish]. Sundhedsstyrelsen. Available at http://www.sst.dk (accessed July 11, 2011).

Sundhedsstyrelsen. 2011b. Use of coercion in mental health care 2009 [Danish]. Sundhedsstyrelsen. Available at www.sst.dk/publ/Publ2011/DAF/Sundhedsdata/TvangIPsykiatrien.pdf (accessed July 11, 2011).

Swartz, C. M., ed. 2009. Electroconvulsive and neuromodulation therapies. Cambridge Univ. Press, New York.

Sylvester, A. P., B. H. Mulsant, K. N. Chengappa, A. R. Sandman, and R. F. Haskett. 2000. Use of electroconvulsive therapy in a state hospital: a 10-year review. J. Clin. Psychiatry 61:534–539.

Takebayashi, M. 2010. The development of electroconvulsive therapy in Japan. J. ECT 26:14–15.

Tauscher, J., A. Neumeister, P. Fischer, R. Frey, and S. Kasper. 1997. Electroconvulsive therapy in clinical practice [German]. Nervenarzt 68:410–416.

Teh, S. P. C., A. J. G. Xiao, E. Helmes, and D. G. Drake. 2005. Electroconvulsive therapy practice in Western Australia. J. ECT 21:145–150.

Tewfik, K. D., A. Saad, and Y. Younis. 1998. Contemporary status of electroconvulsive therapy in a teaching psychiatric unit in Al Ain, United Arab Emirates. Nord. J. Psychiatry 52:481–485.

The UK ECT Review Group. 2003. Efficacy and safety of electroconvulsive therapy in depressive disorders: a systematic review and meta-analysis. Lancet 361:799–808.

Thompson, J. W., R. D. Weiner, and C. P. Myers. 1994. Use of ECT in the United States in 1975, 1980, and 1986. J. ECT 151:1657–1661.

van Waarde, J. A., B. Verwey, W. W. van den Broek, and R. C. van der Mast. 2009. Electroconvulsive therapy in the Netherlands: a questionnaire survey on contemporary practice. J. ECT 25:190–194.

Westphal, J. R., R. Horswell, S. Kumar, and J. Rush. 1997. Quantifying utilization and practice variation of electroconvulsive therapy. Convuls. Ther. 13:242–252.

Wood, D. A., and P. M. Burgess. 2003. Epidemiological analysis of electroconvulsive therapy in Victoria, Australia. Aust. NZ J. Psychiatry 37:307–311.

Zeren, T., L. Tamam, and Y. E. Evlice. 2003. Electroconvulsive therapy: assesment of practice of 12 years' period [Turkish]. Yeni Symposium: psikiyatri, noroloji ve davranis bilimleri dergisi 41:54–63.

**Appendix A.** Search strategy.

| | Ovid MEDLINE(R) 1950 to November 2010 Week 2 | EMBASE 1980 to 2010 Week 45 | PsycINFO 1806 to November 2010 Week 3 | SveMed+ | EBSCO; Cinahl |
|---|---|---|---|---|---|
| 1 | Electroconvulsive Therapy/ | Electroconvulsive Therapy/ | Electroconvulsive exp Shock/ | *Explodesökning på Electroconvulsive-Therapy* | S7 or S14 |
| 2 | (electroconvulsive$ or electr$ convulsive$).tw. | (electroconvulsive$ or electr$ convulsive$).tw. | (electroconvulsive$ or electr$ convulsive$).tw. | (electroconvulsive$ or electr$ convulsive$) | S8 or S9 or S10 or S11 or S12 or S13 |
| 3 | (electroshock$ or electr$ shock$).tw. | (electroshock$ or electr$ shock$).tw. | (electroshock$ or electr$ shock$).tw. | (electroshock$ or electr$ shock$) | TI ((practice of electroconvulsive*) or (practice of electr* convulsive*) or (practice of electroshock*) or (practice of electr* shock*) or (practice of ect)) or AB ((practice of electroconvulsive*) or (practice of electr* convulsive*) or (practice of electroshock*) or (practice of electr* shock*) or (practice of ect)) |
| 4 | ect.tw. | ect.tw. | ect.tw. | ect | TI ((ect n1 "use of") or (ect n1 used) or (ect n1 frequen* of) or (ect n1 analys* of)) or AB ((ect n1 "use of") or (ect n1 used) or (ect n1 frequen* of) or (ect n1 analys* of)) |
| 5 | or/1–4 | or/1–4 | or/1–4 | elterapi or elektrokonvulsiv$ or elektrosjokk$ or elektrochok$ or elchok$ or eletrochock$ or elchock$ or elektrostim$ | TI ((electroshock* n1 "use of") or (electroshock* n1 used) or (electroshock* n1 frequen* of) or (electroshock* n1 analys* of)) or AB ((electroshock* n1 "use of") or (electroshock* n1 used) or (electroshock* n1 frequen* of) or (electroshock* n1 analys* of)) |
| 6 | (utiliz$ or survey$).tw. | (utiliz$ or survey$).tw. | (utiliz$ or survey$).tw. | S1 OR S2 OR S3 OR S4 OR S5 | TI ((electr* shock* n1 "use of") or (electr* shock* n1 used) or (electr* shock* n1 frequen* of) or (electr* shock* n1 analys* of)) or AB ((electr* shock* n1 "use of") or (electr* shock* n1 used) or (electr* shock* n1 frequen* of) or (electr* shock* n1 analys* of)) |
| 7 | 5 and 6 | 5 and 6 | 5 and 6 | utiliz$ or survey$ or bruk$ or anvend$ or använd$ or benytt$ | TI ((electro convulsive* n1 "use of") or (electro convulsive* n1 used) or (electro convulsive* n1 frequen* of) or (electro convulsive* n1 analys* of)) or AB ((electro convulsive* n1 "use of") or (electro convulsive* n1 used) or (electro convulsive* n1 frequen* of) or (electro convulsive* n1 analys* of)) |
| 8 | Electroconvulsive Therapy/sn, ut [Statistics & Numerical Data, Utilization] | ((electroconvulsive$ or electr$ convulsive$ or electroshock$ or electr$ shock$ or ect) adj1 ("use of" or used)).tw. | ((electroconvulsive$ or electr$ convulsive$ or electroshock$ or electr$ shock$ or ect) adj1 ("use of" or used)).tw. | praksis$ or prakti$ or frekven$ | TI ((electroconvulsive* n1 "use of") or (electroconvulsive* n1 used) or (electroconvulsive* n1 frequen* of) or (electroconvulsive* n1 analys* of)) or AB ((electroconvulsive* n1 "use of") or (electroconvulsive* n1 used) or (electroconvulsive* n1 frequen* of) or (electroconvulsive* n1 analys* of)) |

(*Continued*)

**Appendix A.** Continued.

| | Ovid MEDLINE(R) 1950 to November 2010 Week 2 | EMBASE 1980 to 2010 Week 45 | PsycINFO 1806 to November 2010 Week 3 | SveMed+ | EBSCO; Cinahl |
|---|---|---|---|---|---|
| 9 | ((electroconvulsive$ or electr$ convulsive$ or electroshock$ or electr$ shock$ or ect) adj1 ("use of" or used)).tw. | (practice of electroconvulsive$ or practice of electr$ convulsive$ or practice of electroshock$ or practice of electr$ shock$ or practice of ect).tw. | (practice of electroconvulsive$ or practice of electr$ convulsive$ or practice of electroshock$ or practice of electr$ shock$ or practice of ect).tw. | S7 OR S8 | S5 and S6 |
| 10 | (practice of electroconvulsive$ or practice of electr$ convulsive$ or practice of electroshock$ or practice of electr$ shock$ or practice of ect).tw. | (((frequen$ adj of) or (analys$ adj of)) adj1 (electrocon-vulsive$ or electr$ convulsive$ or electroshock$ or electr$ shock$ or ect)).tw. | (((frequen$ adj of) or (analys$ adj of)) adj1 (electrocon-vulsive$ or electr$ convulsive$ or electroshock$ or electr$ shock$ or ect)).tw. | s6 and s9 | S1 or S2 or S3 or S4 |
| 11 | (((frequen$ adj of) or (analys$ adj of)) adj1 (electrocon-vulsive$ or electr$ convulsive$ or electroshock$ or electr$ shock$ or ect)).tw. | or/8–10 | or/8–10 | | TI (utiliz* or survey*) or AB (utiliz* or survey*) |
| 12 | 8 or 9 or 10 or 11 | 7 or 11 | 7 or 11 | | AB ect or TI ect |
| 13 | 7 or 12 | human/ | limit 12 to yr = "1990 -Current" | | AB ((electroshock* or electr* shock*)) or TI ((electroshock* or electr* shock*)) |
| 14 | humans.sh. | 12 and 13 | | | AB ((electroconvulsive* or electr* convulsive*)) or TI ((electroconvulsive* or electr* convulsive*)) |
| 15 | 13 and 14 | limit 14 to yr = "1990 -Current" | | | (MH "Electroconvulsive Therapy") |
| 16 | limit 15 to yr = "1990 -Current" | | | | |

**Appendix B.** Excluded studies ($N = 31$).

| First author (reference) | Country or continent and reason for exclusion: (1) not relevant topic (2) no rate or prevalence data, very sparse data, review without primary data (3) parallel other language publication, not possible to find or full-text retrieve (4) too old, <1990 | Comments |
|---|---|---|
| O'Dea JF (O'Dea et al. 1991) | Australia and New Zealand (1) | Questionnaire survey of ECT practice and attitudes to medical superintendents at hospitals. Frequency of unilateral versus bilateral electrode placement main aim. Sparse ECT utilization data |
| Galletly CA (Galletly et al. 1991) | South Australia (4) | Too old, use of ECT data at hospital in Adelaide from 1981 to 1985 (five years). [Decline in use over period due to reduction of ECT for patients with schizophrenia] |
| Gassy JE (Gassy and Rey 1990) | NSW, Australia (4) | Too old, a general hospital psychiatry unit use of ECT from April 1982 to December 1987 |
| Ikeji OC (Ikeji et al. 1999) | Nigeria (2) | A prospective open-label study of 70 unmodified ECT treated patients without rate or prevalence data |
| Odejide AO (Odejide et al. 1987) | Nigeria (4) | Sparse data from <1990, records from 1982 and1984 examined. Unmodified bilateral ECT. Modified ECT was tried in 1979, but found too expensive. Thirty percent of patients ECT treated in 1984 and average no. of ECTs six, range 1–19 |
| Okasha TA (Okasha 2007) | Egypt (2) | General article about ECT use, economic aspects, problems of training, ethical issues, and discrepancies between developed and developing countries in its application. No ECT utilization data |
| Alhamad AM (Alhamad andal–Haidar 1999) | Saudi Arabia (3) | Parallel publication, same data presented as in other included reference by same author (Alhamad 1999) |
| Hermann RC (Hermann et al. 1999) | USA (1) | Retrospective study of ECT use among beneficiaries of a New England insurance company in 1994 and 1995 |
| Olfson M (Olfson et al. 1998) | USA, New York (1) | ECT use for general hospital in patients with only recurrent major depression diagnoses and estimate of effect on prompt ECT on the length of stay and cost of inpatient care |
| Fink M (Fink and Kellner 2007) | USA (1) | General about ECT practice, no primary data |
| Eranti SV (Eranti and McLoughlin 2003) | UK, USA (2) | Editorial article state of the art, no primary data |
| Thompson JW (Thompson et al. 1994) | USA (4) | Too old, National Institute of Mental Health (NIMH) data, ECT-treated patients in 1975, 1980, and 1986, focusing on data from 1980 and 1986 |
| Levav I (Levav and Gonzalez 1998) | Latin America (3) | Parallel publication in English, replication of primary data presented in earlier study/ publication in 1996 (Levav and Gonzalez 1996) |
| Glen T (Glen and Scott 2000) | Edinburgh, Scotland, UK (1) | Calculated annual and aggregate rates of ECT use by consultant teams, not relevant |
| Fergusson G (Fergusson et al. 2003) | Scotland (3) | Parallel publication, same data presented in included 2004 publication (Fergusson et al. 2004), by same first author |
| Berg JE (Berg 2009) | Diverse countries in three continents (2) | Report from visiting 14 diverse hospitals in three continents about ECT practice. ECT data unclear, insufficient and no overall ECT utilization country-specific data |
| Gazdag G (Gazdag et al. 2009b) | Hungary (2) | To analyze the referral practice of patients for ECT, no rate or prevalence data |
| Lucca AM (Lucca et al. 2010) | Milan, Italy (2) | Letter to editor about 33 patients receiving ECT, insufficient ECT utilization data |

(*Continued*)

**Appendix B.** Continued.

| First author (reference) | Country or continent and reason for exclusion: (1) not relevant topic (2) no rate or prevalence data, very sparse data, review without primary data (3) parallel other language publication, not possible to find or full-text retrieve (4) too old, <1990 | Comments |
|---|---|---|
| Stromgren LS (Stromgren 1991) | Nordic countries: Denmark, Norway Sweden, Iceland (4) | Too old, use of ECT survey in the Nordic countries, from1977–1987 |
| Frederiksen SO (Frederiksen and d'Elia 1979) | Sweden (4) | Too old, ECT survey data in 1975 |
| Kornhuber J (Kornhuber and Weller 1995) | Germany (3) | Not possible to full-text retrieve |
| Sienaert P (Sienaert et al. 2005b) | Flanders and Brussels Capital Region (3) | Parallel publication in Dutch language to already included study (Sienaert et al. 2005a) |
| Gazdag G (Gazdag et al. 2004b) | Hungary (3) | Parallel publication in Hungarian language to already included study (Gazdag et al. 2004a) |
| Palinska D (Palinska et al. 2008) | Poland (3) | Polish language and ECT utilization in Poland of later date by Gazdag G (Gazdag et al. 2009a) included |
| Latey RH (Latey and Fahy 1985) | Ireland (4) | Too old, ECT survey data from 1982 |
| Baudis P (Baudis 1992) | Czech Republic (4) | Too old, ECT survey data from 1981 to 1989 |
| Agarwal AK (Agarwal et al. 1992) | India (2) | About issues relating to administration of ECT, no ECT utilization data |
| Andrade C (Andrade et al. 1993) | India (2) | About practical administration of ECT, no ECT utilization data |
| Chanpattana WM (Chanpattana 2010) | Thailand (2) | Review article, not a primary study with data |
| Takebayashi M (Takebayashi 2010) | Japan (2) | Review article about history of the practice and guidelines of ECT in Japan |
| Kramer BA (Kramer, Hsin-Tung 1990) | Asia (China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, Pakistan, Singapore, Sri Lanka, Thailand) (4) | Too old survey of ECT use in 28 institutions from 11 Asian countries, unclear time period before 1990. (Unmodified ECT always used at 12 institutions) |

**Appendix C. Summary of findings tables of included studies ($N = 70$) according to five continents.**

**Table C1.** Australia and New Zealand ($N = 7$).

| Country | Reference | Study | Demographics | Other data | Rates | Technical parameters |
|---|---|---|---|---|---|---|
| Land (L)<br>Region (R)<br>City (C)<br>Hospital (H) | First author (reference) | Study design<br>*N*<br>Date<br>Time span | Diagnoses<br>Indication<br>Gender<br>Age<br>Ethnicity | Side effects<br>Outcome<br>Conditions<br>Training<br>Guidelines<br>Legal regulations<br>Other | TRP*<br>EAR*<br>iP*<br>AvE*<br><br>C-ECT**<br>A-ECT** | Modified/Unmodified<br>Anesthesia<br>Devices<br>Current type<br>Electrode placement<br>Dosage<br>(Monitoring) |
| Australia (L) | Chanpattana W (Chan-pattana 2007) | Study: Questionnaire survey (29 items) to hospitals providing psychiatric care.<br>$N = 136$ hospitals (83% response rate) with $N = 90$ (66%) providing ECT<br>Date: October 2002 to February 2004<br>Time span: One year and five months | Diagnoses: 82% major depression 10% schizophrenia 5% mania 2% catatonia<br>Gender: 63% women<br>Age, year groups:<br>0.2%, <18<br>7%, 18–24<br>26%, 25–44<br>28%, 45–64<br>38%, >65 | Side effects:<br>96% memory problems<br>77% headache<br>51% muscle pain<br>7% post-ECT delirium<br>2% teeth injuries<br>1% concentration difficulty<br>3% no side effects<br>ECT training provided by:<br>73% institutions<br>Guidelines not mentioned | TPR: 3.78<br>AvE: 8<br>C-ECT practiced | Modified<br>Devices:<br>Thymatron or MECTA device<br>2% old brief-pulse constant current device<br>Type: Brief pulse<br>Placement:<br>46% UL<br>24% BL<br>22% UL and BL<br>3% BL only<br>Dosage:<br>70% stimulus titration<br>28% age based<br>2% fixed dose |
| New Zealand (L) | Ministry of Health, New Zealand (Ministry of Health 2006) | Study: National health data from 21 district health boards in two periods (2003/04 and 2004/05).<br>Time span:<br>Two periods of one year | Gender:<br>69% women (both periods)<br>Age >65:<br>40% (2004/05)<br>38% (2003/04)<br>Ethnicity (2004/05; 2003/04)<br>Asian: 2%; 1%<br>European: 85%; 84%<br>Maori: 6%; 5%<br>Pacific people: 7%; 2%<br>Other: 17%; 8% | Legal regulations not consented:<br>22% (2004/05)<br>24% (2003/04) | TPR: 0.75 (both periods)<br>AvE: 7 | |

(*Continued*)

**Table C1.** Continued.

| Country | Reference | Study | Demographics | Other data | Rates | Technical parameters |
|---|---|---|---|---|---|---|
| New Zealand (L) | Ministry of Health, New Zealand (Ministry of Health 2005) | Study: Audit of technical aspects and quality of ECT delivered by site visit.<br>$N = 20$ (district health boards) sites visited, and 19 (95%) sites providing ECT<br>$N = 414$ (approximately) patients and 3506 ECT administrations<br>Date: September to November 2002<br>Time span: Two months | | Training: 10 (50%) had advanced training program<br>Guidelines: All had some forms of ECT policy, but variations<br>Other:<br>All had ECT teams<br>All ECT prescribed only by senior medical officer<br>All sites administered by consultant psychiatrists or trained/supervised registrar<br>All anesthesia by consulting anesthesiologist or trained/supervised anesthetic registrar<br>All sites had recovery ECT nurse, four sites with specially employed ECT co-ordinating nurse | Rate: 92 ECT treatments per 100,000 people (in 2001–2002)<br>AvE: 8 | Modified<br>Type: Brief-pulse wave<br>Devices and monitoring:<br>18 brief pulse with EEG<br>One without EEG monitoring |
| Australia & New Zealand (L) | O'Dea JF (O'Dea et al. 1991) | Study: Questionnaire survey (11 items) to $N = 130$ psychiatric hospitals and units.<br>$N = 96$ responded (74% response rate) and 20 of 96 (21%) did not provide ECT and two insufficient<br>$N = 74$ institutions providing ECT<br>$N = 915$ patients ECT treated in survey period<br>Date: 1989<br>Time span: Six months | Diagnoses:<br>Mentioned according to preference of choice of electrode placement, with depression as main indication.<br>$N = 577$ patients (63%) commenced treatment with unilateral ECT.<br>Most institutions (66%) began the majority of their courses with unilateral ECT | Attitudes:<br>50% considered BL ECT to be more effective for the treatment of depression in general and 39% believed BL and UL ECT to be equally effective | AvE: 12<br>[Estimated 2500 ECT-treated patients per year in Australia and New Zealand] | Modified<br>Devices:<br>Kabtronics Konvulsator<br>Duopulse<br>Ectonus and other<br>Type: Brief-pulse wave according to devices, but 19% reported as sine wave<br>Placement:<br>63% UL<br>16% BL |

(*Continued*)

**Table C1.** Continued.

| Country | Reference | Study | Demographics | Other data | Rates | Technical parameters |
|---|---|---|---|---|---|---|
| Victoria, Australia (R) | Wood DA (Wood and Burgess 2003) | Study: Descriptive analysis from aggregated statutory data<br>*N* = 1526 patients ECT treated<br>*N* = 14,116 ECT administrations.<br>Date: 1998–1999<br>Time span: One year | Diagnoses:<br>75% depression<br>10% schizophrenia<br>6% schizoaffective<br>8% bipolar<br>0.5% residual<br>Gender:<br>63% women<br>Age, year groups:<br>6%, 15–24<br>32%, 25–44<br>28%, 45–64<br>33%, >65 | Licensing:<br>All facilities providing ECT must be licensed<br>Mandatory:<br>Monthly reports<br>Other:<br>High use in age group >65 years | TPR:<br>3.99–4.44<br>EAR:<br>33.03–36.26<br>iP: 8% | No information |
| Western Australia (R) | Teh SPC (Teh et al. 2005) | Study: Register data from Mental Health Information System of Western Australia and records from state psychiatric hospitals<br>*N* = 1175 estimated ECT treated in five-year period.<br>*N* = 622 ECT treated within State psychiatric facilities from 1988 to 2001.<br>Date: 1997–2001<br>Time span: Five years | Diagnoses:<br>43% affective psychoses<br>35% depression<br>4% bipolar<br>2% schizophrenia<br>2% other<br>Gender:<br>65% women<br>Age, year groups:<br>2%, 0–18<br>71%, 19–64<br>27%, >65<br>Ethnicity:<br>1% aboriginality<br>99% nonaboriginality | Involuntary:<br>21% treated involuntary at least once (within State facilities)<br>Other:<br>Upward trend in TPR and number of ECT recipients in five-year period | TPR:<br>0.8 (1997)<br>1.3 (1998)<br>1.2 (1999)<br>1.6 (2000)<br>1.4 (2001)<br>iP: 1.0–1.7% | No information |

(*Continued*)

**Table C1.** Continued.

| Country | Reference | Study | Demographics | Other data | Rates | Technical parameters |
|---|---|---|---|---|---|---|
| Australia, Sydney, New South Wales (C) | Lamont S (Lamont et al. 2011) | Study: Audit of ECT service provision at metropolitan teaching hospital in Sydney with 28 inpatients bed, serving a population of 260,000.<br>*N* = 43 ECT-treated patients<br>Date: November 2007–November 2008<br>Time span: One year | Diagnoses:<br>67% depression<br>9% schizoaffective<br>14% schizophrenia<br>5% bipolar<br>5% schizophrenia catatonic type, neuroleptic malignant syndrome<br>Indication:<br>25% resistant to antidepressants:<br>21% resistant to antipsychotics/lithium:<br>21% suicidal<br>9% previous response<br>7% life-saving intervention<br>5% severe retardation<br>5% too distressed to wait drug response<br>5% patient preference<br>2% psychosis<br>Gender:<br>71% women<br>Age, year groups:<br>5%, 15–24<br>37%, 25–44<br>30%, 45–64<br>14%, 65–74<br>14%, >75 | Condition:<br>40% voluntary<br>60% involuntary (Mental Health Review Tribunal consent) | TRP: 1.8<br>AvE, women: 10.2<br>AvE, men: 8 | Modified<br>Anesthesia:<br>Propofol<br>Sucxamethonium<br>Device:<br>Thymatron System IV<br>Type: Brief pulse<br>Placement:<br>35% RUL<br>40% BL<br>23% Both RUL and BL |

*TPR: treated person rate = persons ECT treated per 10,000 resident population per year.
*EAR: ECT administration rate = no. of ECTs administered per 10,000 resident population.
*iP: inpatient prevalence = proportion (percent, %) ECT treated among inpatient population.
*AvE: average number of ECTs administered per patient (in a session or course).
**C-ECT: continuation-ECT.
**A-ECT: ambulatory-ECT.

**Table C2.** Africa ($N = 3$).

| Country | Reference | Study | Demographics | Other data | Rate | Technical parameters |
|---|---|---|---|---|---|---|
| Land (L)<br>Region (R)<br>City (C)<br>Hospital (H) | First author (reference) | Study design<br>*N*<br>Date<br>Time span | Diagnoses<br>Indication<br>Gender<br>Age<br>Ethnicity | Side effects<br>Outcome<br>Conditions<br>Training<br>Guidelines<br>Legal regulations<br>Other | TRP*<br>EAR*<br>iP%*<br>AvE*<br>C-ECT**<br>A-ECT** | Modified/Unmodified<br>Anesthesia<br>Devices<br>Current type<br>Electrode placement<br>Dosage<br>Monitoring |
| Malawi (L) | Selis MA (Selis et al. 2008) | Study: Naturalistic descriptive cohort<br>$N = 47$ patients ECT treated in study period<br>[$N = 780$ patients estimated ECT treated in one year]<br>[$N = 1$ national mental hospital with $N = 333$ beds]<br>Date: March to April 2006<br>Time span: One month | Diagnoses:<br>32% mania<br>30% psychosis<br>21% postpartum psychosis<br>15% depression<br>2% no diagnoses<br>Indication (main):<br>Postpartum depression and psychosis<br>Gender: 49% women<br>Age, years:<br>Range 17–37 | Guidelines and conditions:<br>Use of protocols and consent.<br>Side effects:<br>For unmodified: 39% confusion, amnesia, headache, muscle aches, oral lacerations | EAR: 0.6<br>[Calculated rate: 780 ECT treatments per year, 13 million population]<br>AvE: Range 1–10 | Unmodified until September 2007 then modified.<br>$N = 3$ patients underwent both unmodified and modified<br>Anesthesia:<br>None before 2007<br>Placement:<br>BT (bitemporal) |
| South Africa (H) | Mugisha RX (Mugisha and Ovuga 1991) | Study: Survey of case notes at hospital<br>Total:<br>$N = 1816$ case notes<br>$N = 378$ patients ECT treated<br>Date:<br>1976–1982<br>Time span:<br>Seven years | Diagnoses:<br>83% schizophrenia<br>17% other diagnoses, including depression, epilepsy, alcoholism or cannabis abuse, dementia, and unknown<br>Gender:<br>29% women, among subgroup with schizophrenia<br>Age, mean (SD) years: 30.7 (9.9)<br>[women 30.2, men 31.9] | Drop in use of ECT from 1976 to 1982. ECT discontinued after 1982.<br>Data from before 1990, but published in 1991.<br>Mainly young adult men (<35 years) treated with ECT.<br>Main indication schizophrenia, not depression | TPR: 1.26<br>[Calculated rate: 378 patients ECT treated, 3 million population]<br>iP: 21% (in seven-year period) | Unmodified<br>No anesthesia<br>Device and type:<br>No information<br>Placement:<br>No information |

(*Continued*)

**Table C2.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate | Technical parameters |
|---|---|---|---|---|---|---|
| Nigeria (H) | Sijuwola OA (Sijuwola 1985) | Study: Survey of psychiatric hospital with 500 beds, covering also neighbor countries.<br>*N* = 278 patients<br>*N* = 1529 ECT administrations<br>Time span:<br>Four weeks<br>[Data from 1985 (<1990), but included due to paucity of studies from Africa] | Diagnoses:<br>60% schizophrenia<br>23% affective disorders<br>17% other | | iP: 28%<br>AvE: 5<br>Range 4–6 | No information |

* TPR: treated person rate = persons ECT treated per 10,000 resident population per year.
*EAR: ECT administration rate = no. of ECTs administered per 10,000 resident population.
*iP: inpatient prevalence = proportion (percent,%) ECT treated among inpatient population.
*AvE: average number of ECTs administered per patient (in a session or course).
** C-ECT: continuation-ECT.
**A-ECT: ambulatory-ECT.

**Table C3.** North and Latin America, $N = 12$.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| Land (L)<br>Region (R)<br>City (C)<br>Hospital (H) | First author (reference) | Study design<br>*N*<br>Date<br>Time span | Diagnoses<br>Indication<br>Gender<br>Age<br>Ethnicity | Side effects<br>Outcome<br>Conditions<br>Training<br>Guidelines<br>Legal regulations<br>Other | TRP*<br>EAR*<br>iP%*<br>AvE*<br>C-ECT**<br>A-ECT** | Modified/Unmodified<br>Anesthesia<br>Devices<br>Current type<br>Electrode placement<br>Dosage<br>Monitoring |
| USA (L) | Hermann RC (Hermann et al. 1995) | Study: Survey data, American Psychiatric association (APA)'s Professional Activities Survey<br>Date:<br>1988–1989<br>Time span:<br>One year | Indication (main):<br>depression<br>Gender: No information<br>Age: Not reported, except proportion of residents >60 years stated not significantly related to utilization rate | Other:<br>6% of psychiatrists administered ECT to at least one patient during the last month<br>Large variability. ECT use higher in middle and upper classes | TPR: 0.4–81.2<br>TPR Nationwide: 4.9 | No information |
| USA (L) | Prudic J (Prudic et al. 2001) | Study: Postal questionnaire survey in tri-state New York City metropolitan region to all Directors of Psychiatric Services with inpatient mental health beds.<br>$N = 156$ facilities $N = 86$ of 156 (55%) provided ECT<br>$N = 59$ of 86 responded (response rate 69%).<br>No. of patients annually receiving ECT: Range 1–288<br>No. of patients ECT treated per year census reported by facilities:<br><15 patients by 21 facilities<br>>100 patients by nine facilities Date:1997<br>Time span:<br>One year | Indication (main):<br>>85% medication resistant depression (major depression) then mania and schizophrenia next most common<br>Gender: No information<br>Age, year groups:<br>45%, 18–60<br>55%, >60<br>(0%, <13) | Side effects:<br>46% post ECT cognitive impairment and cognitive evaluation usually undertaken in 80%<br>Treatment setting:<br>85% inpatient<br>14% outpatients<br>Outcome:<br>23% relapse rate of illness<br>Guidelines:<br>APA guidelines not entirely followed | AvE: 8 | Modified<br>Anesthetic agents:<br>59% methohexital<br>36% sodium pentothal<br>31% propofol<br>Type:<br>2% sine wave<br>Placement:<br>79% BL<br>21% UL<br>Dose:<br>18% dosing strategy<br>30% fixed (formula-based)<br>55% titration<br>Monitoring:<br>All used EKG, pulse oximetry and vital sign monitoring.<br>14% EEG monitoring not used.<br>53% cuff technique not used |

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**Table C3.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| Latin America and the Caribbean (L) | Levav I (Levav and Gonzalez 1996) | Study: Postal questionnaire survey to directors responsible for mental health programs and/or psychiatric hospitals $N =$ 19 Latin America countries, 17 (89%) responded and two partially. $N = 12$ Caribbean, only four (30%) provided ECT<br>Date: 1995<br>Time span: One year | No information | Comment: Haiti not included among the Caribbean territories Unknown country names of included in Latin America.<br>Public hospitals use ECT more frequent than private Trend away from use of ECT reported in eight Latin American countries and in two most populated English-speaking Caribbean<br>Guidelines:<br>In four Caribbean countries, but only in 10 out of 19 Latin American<br>Conditions:<br>Informed consent (Latin America):<br>37% always 26% sometimes<br>26% never<br>11% no data | No information | Unmodified and modified:<br>26% Latin America unmodified<br>One of four Caribbean used modified |

(*Continued*)

**Table C3.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| California, USA (R) | Kramer BA (Kramer 1999) | Study: Retrospective chart review of ECT required reports by Welfare and Institutions Code, from state department of health<br>ECT-treated patients:<br>*N* = 2671 (1990)<br>*N* = 2251 (1991)<br>*N* = 2356 (1992)<br>*N* = 2636 (1993)<br>*N* = 2529 (1994)<br>ECT facilities providing ECT:<br>*N* = 81 (1990)<br>*N* = 80 (1991)<br>*N* = 71 (1992)<br>*N* = 70 (1993)<br>*N* = 69 (1994)<br>Date: 1984–1994<br>Time span: 11 years | Diagnoses:<br>No information<br>Gender (1994):<br>69% women<br>Ethnicity (1994):<br>91% Anglo-American<br>4% Hispanic<br>2% African-American | Adverse events:<br>0.2 deaths/10,000<br>11 cardiac arrests<br>nine fractures<br>Conditions:<br>2.4–3.4% involuntary (in period 1990–1994)<br>Other:<br>Mandatory report of death if within 24 h after ECT treatment<br>Increased ECT use with age<br>Decrease in facilities providing ECT.<br>Less than 6% ECT treatment in public hospitals | TPR:<br>0.9 (1990)<br>0.7 (1991)<br>0.8 (1992)<br>0.8 (1993)<br>0.8 (1994)<br>TPR by age in years (1994):<br>0.001 <18<br>0.1 18–24<br>0.5 25–44<br>1.2 45–65<br>3.8 >65<br>AvE: 5. | No information |
| Texas, USA (R) | Scarano VR (Scarano et al. 2000) | Study: Retrospective chart review.<br>*N* = approximately 5971 ECT-treated patients<br>*N* = 41,660 ECT administrations<br>Date: 1993–1997<br>Time span: Four years | Diagnoses:<br>82% depression<br>6% schizoaffective<br>10% bipolar/mania<br>2% schizophrenia<br>Gender:<br>69% women<br>31% male<br>Ethnicity:<br>87% Anglo-American<br>9% Hispanic<br>3% African American<br>Age, year groups*:<br>0.7%, 16–20<br>37.4%, 21–50<br>53.7%, 51–80<br>8.2%, >80 | Conditions:<br>98% voluntary<br>2% consent by legal guardian.<br>Adverse events (within two weeks after ECT):<br>Five unexpected apnea, one fracture, 25 deaths [two week mortality rate 14 deaths per 100,000 treatments]<br>Outcome:<br>61% completed ECT treatment series<br>Other:<br>Report of memory impairment by physicians, no rating instruments | AvE: 7 | Placement:<br>76% BL<br>16% UL<br>8% mixed |

*[Correction added after first online publication on 20 March 2012: The "Age, year groups" for Texas, USA (R) was earlier missing from the article.]

(*Continued*)

**Table C3.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| Texas, USA (R) | Reid WH (Reid et al. 1998) | Study: Retrospective chart review.<br>*N* = 2583 mandatory reports (describing a patient treatment with an index series), approximately.<br>*N* = 15,240 ECT treatments administered in 50 hospitals (Representing 33% of all psychiatric units in Texas).<br>Date:<br>September 1993 to April 1995<br>Time span:<br>One year + seven months (19 months) | Diagnoses (approximately):<br>90% severe mood disorder (some manic), 10% schizoaffective, schizophrenia, or related diagnoses<br>2% organic affective syndrome, mood disorder due to a general medical condition, or dementia<br>Gender:<br>70% women<br>Age, year groups:<br>0.2%, 16–17<br>2%, 18–24<br>24%, 25–44<br>25%, 45–64<br>48%, >64<br>Ethnicity:<br>88% Caucasian<br>8% Hispanic<br>3% Black<br>1% Other | Conditions:<br>1% involuntary guardian consent<br>Adverse events (within two weeks after ECT):<br>Eight deaths (two possibly anesthesia related complications)<br>Other:<br>6% of institutions performed ECT during the study period<br>Legal regulations:<br>Since 1993 mandatory ECT reporting to Department of Mental Health and Mental Retardation in Texas.<br>ECT not allowed to persons <16 years.<br>Funding:<br>57% public third party payment source (including Medicare) | AvE: 5 [excluding maintenance ECT] | Placement:<br>73% BL<br>19% UL<br>8% Mixed |

(*Continued*)

**Table C3.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| USA (Medicare) (R) | Rosenbach ML (Rosenbach et al. 1997) | Study: Retrospective chart review of ECT-treated Medicare enrollees.<br>$N = 15,560$ (1992)<br>[$N = 12,000$ (1987)]<br>Date:<br>1987–1989 and 1990–1992<br>Time span:<br>Two, one-year time periods | Diagnoses (1992):<br>80% affective disorder<br>9% schizophrenia<br>Gender (1992):<br>66% women<br>Ethnicity (1992):<br>>90% Caucasian | Treatment setting (1992):<br>75% inpatients<br>11% outpatients<br>14% both<br>Other:<br>Mean no. of ECT treatment length of stay days: 57.1<br>Comments:<br>Increase in rate of ECT use 1987–1992. Increasing use among women, Caucasian, and disabled.<br>Substantial geographic treatment variation from West to Northeast in United States, an increase in outpatient ECT use | TPR (TPR in Medicare population):<br>5.1 (1992) [4.2 (1987)]<br>TPR (1992) by gender: 5.7 women 3.6 men<br>TPR (1992) by age, year groups: 16.2, <45 6.4, 45–65 4.2, >65<br>TPR (1992) for disabled <65 years: 9.2<br>TPR (1992) by region:<br>6.1, Northeast<br>4.1, South<br>5.4, North Central<br>3.8, West<br>TPR (1992) by location:<br>3.2, rural<br>4.8, small urban<br>6.0, large urban<br>AvE: 8<br>AvE (in both inpatient and outpatient setting): 13 | No information |
| North Carolina, USA (R) | Creed P (Creed et al. 1995) | Study: Postal and telephone survey to all 169 hospitals in region, with 54 having psychiatric units.<br>Structured questionnaire to those providing ECT $N =$ 24 (14%, out of 169 hospitals and 44% out of 54 psychiatric units)<br>Date:<br>September 1992 to August 1993<br>Time span:<br>One years | Patient demographic data: No information | Training:<br>55% provided on-the-job training for ECT nursing staff<br>Other:<br>No. of physicians at each facility administering ECT, Range 1–6<br>Resident physicians administering ECT in 25% of facilities | Estimated rate data:<br>No. of combined inpatient and outpatient ECT treatments per year: Range <100 to >1,300 | Devices:<br>Unclear, report of only use of recommended ECT machines<br>Monitoring: 75% use combination of EEG and cuffed distal limb |

(*Continued*)

**Table C3.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| Louisiana, USA (Medicare) (C) | Westphal JR (Westphal et al. 1997) | Study: Retrospective chart review of elderly (≥65 years) ECT treated in Louisiana Medicare population.<br>*N* = 218 ECT administrations in ≥65 years Medicare population<br>Date:<br>1993 and 1994<br>Time span:<br>Two years | Age, age groups ≥65 years:<br>54%, 65–74<br>37%, 75–84<br>8%, ≥85<br>Gender:<br>79% women<br>Ethnicity:<br>89% Caucasian 7% Black 4% Other | Comment:<br>Within Louisiana variability in rates between urban parishes, TPR 2.8 versus rural TPR 1.9 was nonsignificant—but significant nonrandom variation found when comparing treatment for major depression and inpatient ECT | TPR (Medicare population ≥65 years): 2.38<br>[TPR rural parishes: 1.9<br>TPR urban parishes: 2.8] | No information |
| North Carolina, USA (H) | McCall WV (McCall et al. 1992) | Study: State hospital survey of all patients referred for ECT<br>*N* = 82 ECT-treated patients<br>Date:<br>1989 to 1991<br>Time span:<br>Two years | Diagnoses:<br>73% of depressed patients receiving ECT were women, constituted 52% of all patients with severe depression<br>Gender:<br>Percent women among ECT patients by diagnoses:<br>73% major depression<br>58% bipolar, manic<br>68% schizoaffective<br>16% schizophrenia<br>Percent men among ECT patients by diagnoses:<br>27% major depression<br>42% bipolar, manic<br>32% schizoaffective<br>84% schizophrenia<br>Age mean (SD) years:<br>44.3 (15) Range 19–75<br>50.9 (15.1) for depression<br>38.4 (13.2) for mania, schizophrenia, and schizoaffective | Conditions:<br>29% treatment by guardian consent<br>Other:<br>ECT given to patients with schizophrenia, mania, or schizoaffective disorder younger than those with depression | iP: 1.3%<br>C-ECT: 5% (Given to four patients: three women, one man) | Modified<br>Device:<br>MECTA SR1 constant current device.<br>Placement:<br>No information |

(*Continued*)

**Table C3.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| South West Pennsylvania, State Hospital, USA (H) | Sylvester AP (Sylvester et al. 2000) | Study: Retrospective chart review of all receiving ECT, in one state hospital giving psychiatric services to South West Pennsylvania.<br>*N* = 21 ECT-treated patients in 10 year period (charts available for 17 patients)<br>Date:<br>1986–1995<br>Time span:<br>10 years | Diagnoses:<br>47% major depression<br>25% bipolar<br>29% schizoaffective, schizophrenia<br>Indications:<br>Suicidal ideation or passive death wish<br>Refusal of oral food intake Weight loss, daily life disability, and poor hygiene. Disorganized psychotic, aggressive behavior<br>Gender:<br>71% women<br>Age, 59% >60 years<br>Range: 28–78 years<br>Ethnicity:<br>94% Caucasian | Conditions:<br>All on civil commitment and nine (53%) patients judged incompetent of consent<br>Other:<br>59% of ECT treated >60 years and only 46% of all admitted patients female. Ten (58%) patients had documented previous ECT | iP: 0.4%<br>AvE: 12 | Devices:<br>Until 1991, MECTA-D After 1991 MECTA-SRI<br>Type and dosage:<br>Brief pulse, square wave, and constant current stimuli dose |
| Rio de Janeiro, Brazil (H) | Pastore DL (Pastore et al. 2008) | Study: Medical record survey of ECT-treated patients at federal psychiatric university hospital.<br>*N* = 69 ECT-treated patients<br>Date:<br>June 2005 to June 2007<br>Time span:<br>Two years | Diagnoses:<br>49% schizophrenia<br>29% bipolar/mania<br>16% depression<br>6% other<br>Indication: Violence, suicidal attempts, self injury<br>Gender:<br>71% women<br>Age, mean 41.3 years | Side effects: Most common (reported as mild and transient): Anterograde amnesia, disorientation, headache. Rare: Myalgia, nausea, fatigue. No deaths.<br>Other:<br>Clonidine given to hypertensive patients | AvE: 8 | Modified<br>Anesthesia:<br>Alfentanil or propofol and succinylcholine muscle relaxant<br>Device: EMAI trademark<br>Placement: BL |

* TPR: treated person rate = persons ECT treated per 10,000 resident population per year.
*EAR: ECT administration rate = no. of ECTs administered per 10,000 resident population.
*iP: inpatient prevalence = proportion (percent,%) ECT treated among inpatient population.
*AvE: average number of ECTs administered per patient (in a session or course).
**C-ECT: continuation-ECT.
**A-ECT: ambulatory-ECT.

**Table C4.** Europe $N = 33$.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| Land (L)<br>Region (R)<br>City (C)<br>Hospital (H) | First author (reference) | Study design<br>*N*<br>Date<br>Time span | Diagnoses<br>Indication<br>Gender<br>Age<br>Ethnicity | Side effects<br>Outcome<br>Conditions<br>Training<br>Guidelines<br>Legal regulations<br>Other | TRP*<br>EAR*<br>iP%*<br>AvE*<br>C-ECT**<br>A-ECT** | Modified / Unmodified<br>Anesthesia<br>Devices<br>Current type<br>Electrode placement<br>Dosage (Monitoring) |
| Belgium (L) | Sienaert P (Sienaert et al. 2006) | Study: Questionnaire (30 items) survey to psychiatric hospitals and wards of general hospitals<br>$N = 149$ (Response rate 100%), only 32 (21.5%) provided ECT<br>Date:<br>2003–2004<br>Time span:<br>One year | Diagnoses:<br>81% depressive episode<br>6% psychoses<br>2% mania<br>0.9% other<br>Gender and age:<br>No information | Conditions:<br>44% written informed consent<br>65% patient information<br>Training:<br>34%<br>Other:<br>53% of the hospitals administered <10 ECT sessions per month<br>Within-country significant difference in TPR utilization rates<br>Attitudes psychiatrists: ECT is not used enough: 84.3% | TPR, Flanders: 2.6<br>TPR, Wallonia: 5.5<br>TPR, Brussels Capital Region: 10.6<br>TPR, Belgium total: 4.37<br>C-ECT: Rarely used (none (44%), 0–5 (47%))<br>A-ECT: Rarely used (none (44%), 0–5 (44%)) | Modified<br>Anesthesia: 75% Propofol<br>Current type: 34% sine wave<br>Electrode placement & dose:<br>BT: 66%<br>UL: not used<br>37% combined BT and fixed high stimulus dose |
| England (L) | Department of Health (www.dh.gov.uk) (Department of Health 2007) | Study: National survey data (for governmental and private institutions)<br>$N = 12{,}800$ ECT administrations<br>$N = 2{,}272$ patients<br>Date:<br>January to March 2002<br>Time span:<br>Three months | Diagnoses (ICD-10):<br>81% mood disorders<br>6.5% schizophrenia, schizotypal, delusional disorder<br>12.5% other<br>Gender:<br>71% Women<br>Age, year groups:<br>0%, <16<br>0.2%, 16–18<br>2%, 19–24<br>23%, 25–44<br>29%, 45–64<br>24%, 65–74<br>22%, >75 | Conditions:<br>16% Involuntary<br>(Of the 600 patients formally detained while receiving ECT treatment, 60% did not consent to treatment)<br>Other:<br>No patients under 16 years, but 0.2% young patients age 16–18 years<br>Decrease in use of ECT since 1999 | TPR: 1.84*<br>(TPR, women: 2.56 TPR, men: 1.12)<br>AvE: 5.6 (range 4.8–6.2)<br>A-ECT: 19% | No parameters |

*[Correction added after first online publication on 20 March 2012: The Rate Data for England (L) has been changed.]

(*Continued*)

**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| | | | Ethnicity:<br>(patients per 100,000 ethnic origin)<br>4.2 White<br>1.8 Asian or Asian British<br>1.2 Black or Black British<br>1.0 Mixed<br>2.1 other | | | |
| Hungary (L) | Gazdag G (Gazdag et al. 2004a) | Study: Semi structured (13 item) questionnaire survey to psychiatric departments.<br>$N = 76$ departments, 43 answered (Response 57%, ECT not used in 43%)<br>Date:<br>2002<br>Time span:<br>One year | Diagnoses:<br>64% schizophrenia, schizoaffective<br>32% affective disorder (including mania, organic affective)<br>4% other<br>Gender:<br>59% women<br>Age: No information | Legal: Anesthesia obligatory<br>Other:<br>Within-country variability, ECT administered in little over one-half of all departments | TPR: 0.31<br>iP: 0.6% (up to 2.6%)<br>AvE: 6.<br>(range 3–17) | Modified ECT<br>Anesthesia:<br>57% propofol<br>36% thiopental<br>7% etomidate<br>Devices and type:<br>52% (sine wave) ICOMAT devices, 38% (brief pulse, square wave, constant currant) Siemans 10% (brief pulse) Thymatron<br>Electrode placement:<br>Mainly bitemporal (BL), also bifrontal (BF) in 2 units and UL in 1 unit |
| Poland (L) | Gazdag G (Gazdag et al. 2009a) | Study: Semistructured questionnaire (20 items) survey to all Polish psychiatric inpatient facilities<br>$N = 58$ responded facilities (100% response rate)<br>$N = 25$ confirmed use of ECT, but only $N = 20$ (34%) facilities administered ECT during study period<br>$N = 435$ ECT-treated patients in period<br>Date: 2005<br>Time span: One year | Diagnoses:<br>Depression, mania, schizophrenia and schizoaffective, and other disorders<br>Gender:<br>65% women<br>Age: >18 years (but six units offered to patients <18 years) | Conditions:<br>Written informed consent obligatory For involuntary approval from court necessary<br>Legal:<br>Requires specialist in anesthesiologist<br>Other:<br>Only one-third of facilities treated patients with ECT during study period.<br>ECT administered under pregnancy in 10 settings | TPR: 0.11<br>iP: 0.79% (up to 6.46%)<br>AvE: 9<br>C-ECT: 25%<br>A-ECT: ECT not performed in Polish outpatient clinics | Modified<br>Anesthesia:<br>58% thiopenthal<br>23% propofol<br>15% etomidate<br>4% midazolam<br>Devices: Mecta JR-1, Mecta SR-1 & Spectrum 5000, Thymatron IV, Pabel ES and Siemens E2077 Type: 30% sine wave 70% brief pulse<br>Placement:<br>All BL<br>Two facilities used UL or BF as second choice |

(*Continued*)

**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| Germany (L) | Muller U (Muller et al. 1998) | Study: Questionnaire survey to psychiatric hospitals and university clinics.<br>$N = 451$ clinics (Response rate 64%)<br>$N = 1050$ patients ECT treated<br>Clinics (59%) providing ECT were:<br>82% university clinics<br>74% state hospitals<br>48% special hospitals<br>68% psychiatric wards<br>Date:<br>April to October 1995<br>Time span:<br>Seven months | Diagnoses (diagnostic indication for ECT given by clinics):<br>79% catatonia<br>58% depression<br>24% malignant neuroleptic syndrome<br>2% neurological disorders<br>Gender:<br>No information<br>Age:<br>18–64 years, seldom elderly patients | Side effects reported (common to rare): amnesia, headache, cognitive problems, organic psychoses, dental injuries, neurologic disease<br>Conditions:<br>20% involuntary (nonconsent)<br>Patient information:<br>43% oral<br>42% oral and written<br>15% written<br>Other:<br>Reasons for not providing ECT: No equipment and not enough knowledge or for political reasons<br>Attitudes:<br>96% positive | TPR, East Germany: 0.15 TPR, West Germany: 0.36 (between 1992 &1994) TPR total: 0.26<br>C-ECT:14% | Modified<br>Anesthesia: 64% barbiturate<br>38% etomidate<br>20% propofol<br>Devices: 21%Thymatron DG<br>39% Siemens konvulsator 2077S<br>2% other machines<br>Type:<br>21% brief pulse<br>39% sine wave<br>Dose:<br>39% titration<br>18% fixed<br>Placement:<br>21% UL<br>19% BL<br>18% both BL & UL<br>39% no data |
| Spain (L) | Bertolin-Guillen JM (Bertolin-Guillen et al. 2006) | Study: Questionnaire survey to all hospitals with psychiatric unit in Spain.<br>$N = 233$ hospitals (response rate 100%)<br>$N = 108$ (46%) provided ECT (28% prescribed and 25% neither prescribed nor applied ECT)<br>Date:<br>January to June 2001<br>Time span:<br>Six months | Diagnoses:<br>34% depression<br>26% schizophrenia<br>12% mania<br>11% psychoses<br>8% other not diagnostic (including pregnancy, suicide risk)<br>3% OCD<br>3% organic<br>3% other (anxiety, neurotic, personality disorder)<br>No age, gender, or diagnostic information | Conditions:<br>98.7% informed consent (1.3% involuntary)<br>Training:<br>92% ECT given of psychiatrist or resident<br>Other:<br>Variety of diagnostic indication.<br>59 (25%) hospitals neither applied nor prescribed ECT<br>Reasons for not providing ECT:<br>49% lack of technical means<br>27% no ECT type of patients | TPR: 0.61 (range 0.03–1.7)<br>AvE: 9<br>C-ECT:16% of patients<br>C-ECT practice: 35% of institutions using monthly or decreasing frequency regimes | Modified mainly 0.6% unmodified 2.3% without muscle relaxants<br>Type:<br>65% brief pulse<br>14% sine wave<br>3% both<br>18% unknown<br>Placement:<br>90% BL |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| | | | | Other reasons: therapeutic inefficacy; inexperience; ethical or moral concerns; side effects; bureaucratic problems; lack of protocols; attitudes. | | |
| Russia (L) | Nelson AI (Nelson 2005) | Study: Questionnaire survey to 1468 hospitals representing 54 of the 89 Russian states, which represents 80% of the population<br>*N* = 114 responded hospitals (out of 1468, 8% response rate) *N* = 52 (out of 114, 46%) provided ECT<br>Date:<br>November 2003 to June 2004<br>Time span:<br>eight months | Diagnoses:<br>No information<br>No age, gender, or diagnostic information<br>Indication:<br>71% equivalent to drug therapy<br>29% last resort<br>27% medication resistance<br>25% as first-line treatment<br>12% as lifesaving | Other:<br>No specific license, credentials or privileging required for provision of ECT<br>Reasons for not prescribing ECT:<br>Lack of equipment or space<br>Unfamiliarity with ECT<br>Absence of consideration<br>Attitudes:<br>57% positive physician attitudes toward ECT | TPR: 0.54<br>iP: 1.4%<br>AvE: 8<br>A-ECT: 2% of institutions<br>C-ECT: 26% of institutions<br>(Although no mention of m-ECT in official Russian ECT guidelines) | Modified and unmodified<br>Unmodified ECT>80%<br>Device:<br>Modern elikon-01 (from Ukraine)<br>EKT-01<br>FILAT Siemens-400<br>Siemens konvulsator 2077<br>Type:<br>39% brief pulse<br>26% sine wave<br>Placement:<br>94% BL<br>13% UL<br>4% BF |
| Netherlands (L) | van Waarde JA (van Waarde et al. 2009) | Study: Questionnaire survey sent to 35 University, psychiatric and general hospitals providing ECT.<br>Total *N* = 142 university, general, psychiatric hospitals 35/142 (25% providing ECT)<br>*N* = 35 (Response rate 94%, 33 responded)<br>Date:<br>February 2008<br>Time span:<br>Questionnaire period to psychiatrists, six weeks | Diagnoses:<br>sparse information, ECT administered to patients with comorbid physical diseases, patients with malignant neuroleptic syndrome or other catatonic disorders | Training:<br>20 of 33 (61%) of institutions trained psychiatrists to administer ECT<br>50% of psychiatrists had attended certified course in ECT treatment<br>ECT sometimes administered by other profession (geriatrician and physician)<br>Used international guidelines (APA, RCP, DAP)<br>Other:<br>Most institutions had long experience, used ECT five to 25 years (median 18 years) | AvE: 8.5 (per 10,000)<br>C-ECT: Many could manage<br>C-ECT on an outpatient (ambulatory) basis. | Modified<br>Type:<br>Brief pulse and constant current device used according to guidelines 88%. (91% had local protocols)<br>Placement (more than one answer allowed):<br>55% BL (25% BL only)<br>2% BF<br>40% RUL<br>2% RFT<br>2% not described<br>Mainly UL first, then change to BL |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| France (L) | Benadhira R (Benadhira and Teles 2001) | Study: Questionnaire survey to all 815 French Psychiatric Public Hospital services<br>*N* = 391 (response rate 48%) 51% of, responded hospitals administered ECT<br>Period:<br>1996–1997<br>Time span:<br>One year | Diagnoses:<br>63% medication resistant depression<br>18% schizophrenia<br>10% mania<br>Gender and age: not reported | Other:<br>Only half of all hospitals in France administer ECT | No rate/prevalence data | Modified<br>Anesthesia:<br>65% Propofol<br>24% Thiopenthal<br>Device:<br>55% Thymatron DG/Mecta SRI 44%Lapipe et Rondepierre<br>Type: brief pulse and sine wave<br>Placement: 18% UL |
| Denmark (L) | Andersson JE (Anders-son and Bolwig 2002) | Study: Questionnaire survey to hospitals in Denmark, Greenland, and Faroe Islands<br>*N* = 35 clinics, (100% response) All provided ECT<br>*N* = 1556 patients received ECT<br>Period: 1999<br>Time span:<br>One year | Diagnostic indication from 35 units (%):<br>35 (100%) depression<br>28 (80%) delirium<br>22 (63%) mania<br>12 (34%) schizophrenia<br>5 (14%) other | Training:<br>Provided by 49% (17 of 35) institutions.<br>Psychiatrist administering ECT.<br>In most institutions, junior doctors performed ECT. | TPR: 3.0<br>iP: 5% (1.8–10.0%)<br>AvE: 9 (range 6–18) | Anesthesia, 33 units (%):<br>28 (85%) Barbiturate<br>3 (9%) propofol<br>2 (6%) unknown<br>Devices and Type:<br>Thymatron or Mecta (brief-pulse wave) one Siemens konvulsator device (sine wave) |
| Denmark (L) | Sundheds-styrelsen (Sund-hedsstyrelsen 2011a) | Study: National register data, 2000–2007<br>*N* = 17 psychiatric units, hospitals<br>No. of ECT-treated patients/ECT administrations per year:<br>260/2336 (2000)<br>313/3237 (2001)<br>460/4686 (2002)<br>1399/15,174 (2003)<br>1563/16,606 (2004)<br>1786/19,173 (2005)<br>1774/19,389 (2006)<br>1772/19,127 (2007) | Main indication:<br>Elderly depressed patients | Side effects:<br>No. of deaths 24 h after ECT in study period = 6 and evaluated as not ECT-related<br>Conditions:<br>Prevalence of involuntary ECT treated patients (supplementary ECT data from same online source (www.sst.dk) in Use of coercion in Mental Health Care, 2009 (Sundhedsstyrelsen 2011b):<br>2.8%[722/25,199] (2002) | AvE per year:<br>11.1 (2000)<br>9.2 (2001)<br>9.8 (2002)<br>9.2 (2003)<br>9.5 (2004)<br>9.3 (2005)<br>9.1 (2006)<br>9.2 (2007) | No information |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| | | Period: 2000–2007<br>Time span:<br>Seven years | | 2.6%[667/25,291] (2003)<br>2.8%[714/24,872] (2004)<br>2.9%[734/24,501] (2005)<br>3.1%[765/24,308] (2006)<br>3.1%[736/24,129] (2007)<br>3.3%[821/24,311] (2008)<br>3.2%[848/26,014] (2009)<br>Guidelines: Not all institutions followed all instructions, developed by Sunhedsstyrelsen guidelines no. 9001, 20 November 2000.<br>Other:<br>High increase in no. of ECT-treated patients from 2000 to 2007. | | |
| Norway (L) | Schweder, LJ (Schweder et al. 2011a) | Study: Questionnaire survey to psychiatric hospitals, mental health care community centers, including child and adolescent psychiatry about ECT practice.<br>$N = 125$ (Response rate 54%, but 69% from hospitals)<br>ECT was performed in 72% of the hospitals<br>Date:<br>2004<br>Time span:<br>One year | Diagnoses:<br>70% unipolar depression<br>19% bipolar depression<br>1% mania<br>4% schizoaffective disorders<br>1% schizophrenia, polymorphic psychoses<br>3% mixed episodes<br>1% Parkinson disease<br>1% other<br>Indication (main):<br>60% lack of psychopharmacological effect<br>Gender:<br>65% Women<br>Age, year groups:<br>0%, <18<br>8%, 18–24<br>13%, 25–44<br>30%, 45–64<br>55%, >65 | Other:<br>63% wished to offer more ECT, but unable to due to low capacity<br>Approximately eight weeks waiting list for ECT treatment<br>Reasons for not providing were mostly lack of equipment or anesthesiologist and not large enough institution<br>Attitudes:<br>96% psychiatrists positive attitudes toward ECT | TPR: 2.4 (significant TPR Regional variation 1.83 to 3.44)<br>iP: 5.3% (range 4.2–6.9%) | |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| Norway (L) | Schweder LJ (Schweder et al. 2011b) | Study: Questionnaire survey about ECT practice to psychiatric hospitals, mental health care community centers, including child and adolescent psychiatry.<br>$N = 125$ (total response rate 54% and 69% from hospitals)<br>Date:<br>2004<br>Time span:<br>One year | No information | Side effects according to much/very much impaired:<br>26% memory impairment:<br>5% headache<br>Outcome:<br>78% very much/much improved<br>21% minimal/no change<br>1% worse<br>Conditions:<br>100% provided information about ECT<br>50% written informed consent<br>Training/administration: Administration of ECT by 96% junior doctors, with or without psychiatrist present and 6% by nurses<br>Other:<br>Local guidelines, pretreatment examination, equipment, facilities, drugs during ECT also reported | No. of ECTs: 1-3 (7%), 4-6 (23%), 7-9 (30%), 10-12 (24%), >12 (15%)<br>C-ECT practice: 88% of the units<br>C-ECT: 14% of patients<br>A-ECT practice: 63% of the units<br>A-ECT: 15% of patients | Modified<br>Anesthetics: 94% thiopental<br>6% propofol<br>Device and Type:<br>Thymaton or Mecta device (brief pulse)<br>Placement:<br>94% UL<br>63% BL<br>2% BF |
| Sweden (R) | Socialstyrelsen (www.socialstyrelse.se) (Social-styrelsen 2010) | Study: Pilot study of ECT use in hospitals, in middle region of Sweden<br>Middle Sweden:<br>$N = 7$ hospitals<br>$N = 441$ ECT-treated patients, in total population 1.2 mill<br>Skellefteå: One psychiatric unit $N = 1029$ ECTs $N = 109$ patients, population 57,530<br>Date:<br>2009<br>Time span:<br>One year | Diagnoses:<br>55% depression<br>5% mania or schizophrenia<br>9% unknown diagnoses<br>Gender:<br>59% women,<br>Mean age in years: 54.5 (range 15–92) | Other:<br>No national data | TPR Middle Sweden: 3.67 TPR<br>Skellefteå: 1.89<br>AvE Middle Sweden: 8 (range 1–22)<br>AvE, Skellefteå: 10 | No information |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| Belgium (R) | Sienaert P (Sienaert et al. 2005a) | Study: Questionnaire survey (30 item) sent to all psychiatric hospitals and psychiatric wards, in Flanders and Brussels Capital Region $N = 88$ (hospitals and wards) $N = 23$ (100% response rate) 26% providing ECT<br>Date:<br>2003–2004<br>Time span:<br>One year | Diagnoses (main indication): 88% major depression 8% schizophrenia 3% mania 1% other Gender and age: Not reported | Training/administration: Administration performed by: 57% psychiatrist 43% trainee psychiatrist without supervision 9% trainee psychiatrist with supervision Guidelines: 44% followed guidelines<br>Other:<br>75% of psychiatrist had attended a specific ECT course Psycotropic drug use also reported<br>Attitude:<br>96% expressed a concern of ECT under use | TPR: 4.7 | Modified ECT<br>Anesthesia:<br>74% propofol<br>17% thiopental<br>13% etomidate<br>4% methohexital<br>4% ketamine<br>4% sevoflurane<br>13% others<br>Device and type:<br>52% Mecta or Ectron (brief pulse)<br>30% Siemens konvulsator (sine wave)<br>Dosage:<br>48% fixed high dose<br>48% dose titration strategy<br>Placement (more than 1 answer allowed):<br>65% bitemporal<br>22% bifrontal<br>8.6% unilateral<br>13% used more than one electrode placement |
| Wales, UK (R) | Duffett R (Duffett et al. 1999) | Study: Survey questionnaire and visits to all clinics in Wales.<br>$N = 17$ hospitals by phone<br>$N = 321$ patients received ECT<br>Period: first six months in 1996<br>Time span:<br>Six months | Diagnoses:<br>82% depression<br>7% schizoaffective<br>5% schizophrenia<br>5% mixed affective disorder<br>1% mania<br>1% puerperal psychosis<br>Indication:<br>80% Failure to respond 13% Life-saving procedure<br>5% patient choice<br>Gender:<br>71% women Mean age: 56.9 years women 55.5 years men | Outcome:<br>59% much or very much impaired<br>31% improved<br>1.5% worse<br>Conditions:<br>9% were given ECT against their consent<br>20% detained under Mental Health Act Information about pharmacotherapy | TPR: 2.2<br>AvE: 6.7 (range 1–8)<br>A-ECT: 16% of patients | No information about ECT parameters |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| England (R) | Duffett R (Duffett and Lelliott 1998) | Study: Survey, questionnaire, visits, and telephoning ECT clinics (ECT practice audit) $N = 215$ clinics (Response rate 84%) $N = 130$ observed ECT-treated patients Period:1995–1996<br>Time span:<br>One year | Diagnoses, age: No information<br>Gender:<br>64% women | Training: 42% had attended an ECT course Usually junior doctors give ECT Guidelines: 36% followed guidelines<br>Other:<br>7% used old not more recommended device 15% difficulties in obtaining anesthesiologist | No rate data | Modified Anesthesia: 17% propofol Devices: 18% Thymatron 11% Mecta 5% Neurotronics 24% Ectron 5a/b 34% Ectron 5 Type: Brief pulse and sine wave Placement: Mainly BL 7% UL |
| England (R) | Pippard J (Pippard 1992) | Study: Survey, visits by first author to hospitals in North–East Thames (NET) and East Anglian (EA).<br>NET covered 16 health authority districts where ECT was provided in 22 NHS hospitals and three private hospitals ($N = 25$)<br>EA covered eight health authority districts, where ECT was provided in 13 NHS hospitals and two private nursing homes ($N = 15$)<br>Date of audit: 1991 Data from:1988–1989<br>Time span:<br>One year | | Other: A practical description of ECT use in the units visited<br>Replacement of old sine-wave devices began in 1982.<br>Guidelines: By Royal college of psychiatrist, 1989 used.<br>Training/administration:<br>Training programs for ECT inadequate and in one-third of hospitals there was almost none.<br>ECT performed by:<br>25% patients own doctor<br>74% by duty doctor in training on call | [TPR (NET): 1.47]<br>[TPR (EA): 3.7]<br>[TPRs <1990] | Modified ECT<br>Type: sine wave<br>[Devices in use before 1990: Ecton Mark 4 Series 2+ and 3+ (updated models) Series 5 (1987)] |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| Ireland (R) | Enriquez S (Enriquez et al. 2010) | Study: Survey of annual reports from Limeric mental health services Data-gathering process<br>$N = 126$ ECT-treated patients with $N = 153$ series/courses<br>Period: 2003 to 2008<br>Time span: Five years | Diagnoses:<br>95% depression<br>4% nonaffective psychosis<br>1% mania<br>Gender:<br>66% women<br>Age, mean (SD) years: 50.6 (16.7) (range 18–87) | Adverse events:<br>0.7% cardiac arrests<br>3% cardiac arrhythmias<br>0% prolonged seizure<br>21% cognitive impairment<br>1.3% respiratory difficulties<br>0.7% oro-pharyngeal bleeding<br>1.3% hypotension<br>Conditions:<br>7% involuntary<br>14% not able to written consent<br>Other:<br>Annual reports from 2005 to 2007,but with limited information | TPR: 1.7 (variation in use)<br>AvE: 6.5 (range 1–13)<br>A-ECT: 18% | Device: Mecta spectrum 5000M<br>Placement: 85% BL |
| Chuvash republic, Russia (R) | Golenkov A (Golenkov et al. 2010) | Study: Annual statistical hospital reports<br>Date: 1998–2007 | Diagnoses:<br>88% schizophrenia<br>Gender:<br>56% women<br>Age, mean (SD) years: 34.4 (10.6) (range 15–64) | Outcome: 10.6% significant improvement 48.9% moderate improvement<br>Consideration: Qualified anesthetist is mandatory<br>Other:<br>61% of inpatients diagnosed with schizophrenia.<br>Also about attitudes: Authors say answers revealed a high level of false beliefs and markedly negative attitudes | TPR (for 2006 & 2007): 0.8<br>AvE: 10.3 (SD 2.0) (range 2–20)<br>A-ECT: are lacking | Modified, but only 40% used muscle relaxants<br>Device: Elicon-01 machine<br>Type: Square wave (brief pulse)<br>Placement: BL only |
| Vienna, Austria (C) | Tauscher J (Tauscher et al. 1997) | Study: Prospective study in a hospital.<br>$N = 21$ ECT-treated patients<br>Date: September 1994 to August 1995.<br>Time span: One year | Diagnoses:<br>72% Depression<br>14% schizoaffective psychoses<br>14% catatonic schizophrenia<br>Gender:<br>81% women<br>Age, mean years: 49 (range 23–69) | Side effects:<br>33% headache<br>14% reversible disorientation or amnesia<br>Outcome:<br>mean CGI: –3.7<br>Guidelines:<br>Local guidelines as well as by American Psychiatric Association | iP: 3%<br>AvE: 8.9 (range 5–15) | Modified<br>Anesthesia: Propofol or methohexital<br>Device: Thymatron<br>Placement: mainly UL, switch to BL if no effect after 6 ECTs |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| Barcelona (C) | Bernardo M (Bernardo et al. 1996) | Study: Descriptive, interview of hospitals.<br>$N = 20$ hospitals<br>Date:<br>August 1993 | Diagnoses:<br>83% depression<br>17% schizophrenia | | No rate data | Type: Mainly sine wave |
| London, United Kingdom and Bengaluru, India (C) | Eranti SV (Eranti et al. 2011) | Study: Retrospective case note study of all patients referred for ECT and comparison between centers (teaching hospitals) in UK and India<br>$N = 46$ hospitals, London (Lo)<br>$N = 345$ hospitals Bengaluru (Be)<br>Date:<br>2001, London and 2002, Bengaluru<br>Time span:<br>One year | Diagnoses:<br>Depression<br>89% Lo, 40% Be<br>Manic episodes<br>4% Lo, 7% Be<br>Schizophrenia<br>& other psychosis<br>2% Lo, 41% Be<br>Schizoaffective disorder<br>4% Lo, 4% Be<br>Organic psychosis<br>0 Lo, 1% Be<br>Catatonia:<br>0 Lo, 7% Be<br>Indications:<br>Not eating and drinking:<br>21% Lo, 6% Be<br>Stupor<br>6% 1 Lo, 10% Be<br>Suicide:<br>14% Lo, 33% Be<br>Previous good response<br>18% Lo, 12% Be<br>Treatment resistance<br>38% Lo, 12% Be<br>Gender (women):<br>69.6% Lo, 51.2% B<br>Age, mean (SD) years:<br>62.8 (16.0) Lo<br>30.3 (10.4) Be | Treatment response Complete recovery:<br>10% Lo, 26% Be<br>Major improvement:<br>50% Lo, 55% Be<br>Minor improvement or no change<br>40% Lo, 19% Be<br>Side effects:<br>Confusion/amnesia:<br>29% Lo, 12% Be<br>Anesthetic complication<br>6% Lo, 13% Be<br>Headache<br>1% Lo, 37% Be<br>Injuries 0 Lo, 2% Be<br>Other:<br>ECT-treated patients were much younger and, more often men in Bengaluru compared to London | IP%:<br>0.9%<br>Lo 8.2% Be<br>AvE:<br>8.75 (6.02) Lo<br>6.67 (2.83) Be | Modified (Lo and Be)<br>Anesthesia:<br>Methohexitone, Propofol, etomidate (Lo)<br>Thiopentone (Be)<br>Type: Brief-pulse wave (Lo and Be)<br>Device:<br>Thymatron DGx (Lo)<br>NIVIQURE (Technonivilac, Bangalore, India) Be<br>Dosage:<br>Half-age method (Lo)<br>Determined by motor seizure threshold (Be) |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| | | | Ethnicity (among depressed patients):<br>Caucasian:<br>88% Lo, 0 Be<br>Afro Caribbean.<br>8% Lo, 0 Be<br>South Asian:<br>4% Lo, 100% Be | | | |
| Edinburgh, Scotland (C) | Glen T (Glen and Scott 1999) | Study: Register database survey of ECT records at Royal Edinburgh Hospital<br>Total no. of ECT treated patients, by year:<br>*N* = 145, 1992–1993<br>*N* = 138, 1993–1994<br>*N* = 93, 1994–1995<br>*N* = 94, 1995–1996<br>*N* = 78, 1996–1997<br>Total no. of ECTs, by year:<br>*N* = 1189, 1992–1993<br>*N* = 1013, 1993–1994<br>*N* = 774, 1994–1995<br>*N* = 557, 1995–1996<br>*N* = 696, 1996–1997<br>Date:<br>1992 to1997<br>Time span:<br>Five years | Gender: 71% women<br>Gender age group 18–64: 67% women<br>Gender age group >65: 83% women | The rate of ECT use was on average three times higher for population of age >65 years than in the general adult population "rate of ECT use fell progressively and significantly ($p$,0.01) from 2.9 to 1.4 treatments"<br>ECT-treated patients in 1997 were 58% less than the number treated in 1992.<br>As measured by the number of treatments per thousand population—there was an overall 53% reduction in rate of ECT use | TPR in age groups 18–64 and >65, by year:<br>3.4 and 10.3, 1992–93<br>3.2 and 8.6, 1993–1994<br>2.3 and 6.1, 1994–1995<br>2.5 and 4.5, 1995–1996<br>1.7 and 6.1, 1996–1997<br>EAR for age groups 18–64 and >65, by year:<br>2.9 and 7.9, 1992–1993<br>2.3 and 8.0, 1993–1994<br>1.9 and 5.1, 1994–1995<br>1.6 and 2.3, 1995–1996<br>1.4 and 6.6, 1996–1997<br>AvE in age group 18–64: Range 6–8<br>AvE in age group >65: Range 5–10 | Placement: all BL |
| Edinburgh (C) | Okagbue N (Okagbue et al. 2008) | Study: Survey data from computerized ECT treatment records at Royal Edinburgh Hospital<br>No. of patients ECT treated by year:<br>*N* = 146 (1993) | No information | Other: Four patients younger than 18 years treated before 1998, none after<br>Usage diminished significantly ($P < 0.01$) over time, for both adult 18–64 and >64 years age groups | TPR by year:<br>3.3 (1993)<br>2.9 (1994)<br>2.1 (1995)<br>2.1 (1996)<br>1.8 (1997)<br>1.6 (1998)<br>1.4 (1999) | No information |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| | | *N* = 130 (1994)<br>*N* = 94 (1995)<br>*N* = 95 (1996)<br>*N* = 78 (1997)<br>*N* = 73 (1998)<br>*N* = 62 (1999)<br>*N* = 71 (2000)<br>*N* = 76 (2001)<br>*N* = 64 (2002)<br>*N* = 60 (2003)<br>*N* = 61 (2004)<br>*N* = 61 (2005)<br>Total *N* = 1071<br>Periode: 1993 to 2005 Time span:13 years | | Some overlapping rate data (1992–1997) to previous reference, Glen T (Glen and Scott 1999) | 1.6 (2000)<br>1.7 (2001)<br>1.4 (2002)<br>1.3 (2003)<br>1.3 (2004)<br>1.3 (2005) | |
| Munich (C) | Baghai TC (Baghai et al. 2005) | Study: Survey of ECT treated patients at university hospital<br>*N* = 445 ECT-treated patients<br>*N* = 4803 ECT administrations<br>Date:<br>1995 to 2002<br>Time span:<br>Eight years | Diagnoses:<br>63% depression<br>17% schizophrenia<br>9% bipolar<br>6% schizoaffective<br>0.2% mania<br>2% other<br>Gender:<br>66% women<br>Mean age: 51.2 ± 15.4 years<br>Side effects:<br>61% no amnesia<br>32% mild amnesia<br>6% severe amnesia<br>0.3% severe cardiac | | iP: 4% | Modified<br>Device and Type: Thymatron (brief pulse)<br>Placement from 2000:<br>60% UL<br>35% BL |
| Dikemark Hospital, Norway (H) | Moksnes KM (Moksnes and Ilner 2010) | Study: Retrospective survey of medical records from three units at Dikemark psychiatric hospital<br>*N* = 141 ECT-treated patients<br>*N* = 1960 ECT administrations<br>Period: 1960–1995<br>Time span:<br>35 years | Diagnoses:<br>88% affective disorder<br>6% organic<br>6% schizophrenia, schizoaffective<br>Gender:<br>74% women<br>Age, mean (SD) years:<br>64 (10.9) (range 29–87) (16%, 29–59 years) | Other:<br>ECT mainly given to elderly population only 16% under 59 years, none under 18 | Prevalence among inpatients:<br>1990–1995: 1.7%<br>[1980–1989: 1.0%]<br>[1960–1979: 0.3%]<br>AvE: 8 (Average no. of courses 1.7) | Modified<br>Devices:<br>80% Siemens konvulsator<br>After 1992, the new Thymatron apparatus with brief-pulse wave stimulation |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| Ullevaal University Hospital, Oslo (H) | Moksnes KM (Moksnes et al. 2006) | Study: Retrospective survey of medical records at Dikemark and Ullevaal hospital.<br>*N* = 383 ECT-treated patients (1988–2002)<br>Date:<br>1988–2002<br>Time span:<br>15 years | Diagnoses:<br>No information<br>Gender:<br>69% women<br>Age in years:<br>mean women: 67<br>mean men: 65 (range 23–91)<br>(58% > 65) | Guidelines:<br>Local developed by author, Dikemark Hospital in accordance with International by APA and Royal College of Physician<br>Data for [1988: 0.5–1.7%]<br>[1989: 0.7–2.8%] | TPR 2002: 2.8<br>iP and EAR, by year:<br>0.8% and 2.8, 1990<br>1.5% and 4.8, 1991<br>2.1% and 9.2, 1992<br>2.1% and 10.7, 1993<br>1.9% and 7.4, 1994<br>2.4% and 11.1, 1995<br>3.8% and 16.5, 1996<br>3.2% and 15.0, 1997<br>5.2% and 19.3, 1998<br>5.7% and 24.9, 1999<br>3.3% and 15.1, 2000<br>4.0% and 20.3, 2001<br>2.9% and 14.5, 2002<br>AvE: 8.8 | Modified<br>Devices:<br>Until 1995 Siemens konvulasor<br>After 1995<br>Thymatron<br>Type: sine wave until 1995 and brief pulse >1995<br>Placement: UL |
| Hospital Innland, Norway (H) | Eiring O (Eiring 2010) | Study: Health region "Innlandet" psychiatric hospital ward survey, three local hospitals<br>*N* = 162 ECT-treated patients<br>Date:<br>2008<br>Time span:<br>One year | Diagnoses:<br>No information | No information about diagnoses | TPR: 4.3 (Calculated by authors according to national resident population data from www.ssb.no. Population "Innlandet" 2006: 371714 (162/371714)<br>AvE: Range 6–8 | Modified<br>Dosage:<br>Age-dose or stimulus-titration method<br>Placement:<br>RUL or BL |
| Pitkaniemi Hospital, Finland (H) | Huuhka MJ (Huuhka et al. 2000) | Study: Clinical record survey of all ECT-treated patients at hospital in 1944, 1964, and 1997.<br>*N* = 46 patients (1997)<br>*N* = 2289 ECT treatments (1997)<br>Dates: [1994, 1964] 1997<br>Time span:<br>One year | Diagnoses (1997):<br>78% Affective disorders<br>22% Schizophrenia<br>Gender (1997):<br>76% women<br>Age, mean years (1997):<br>58.9 (range 18–83) | Side effects (1997):<br>24% some problems during the treatment, none serious<br>13% amnesia<br>9% headache<br>2% minor cardiac complication<br>Conditions (1997):<br>26% Involuntary | iP (1997): 2.0%<br>AvE (1997): 8 (range 3–12). | (1997) Modified<br>Anesthesia:<br>Propofol or methohexital, and succinylcholine muscle relaxant 100% oxygenation<br>Device: Siemens konvulsator 2077<br>Placement: BL only |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| | | | | Other:<br>Drop in iP over time from 14.4%, 1944 to 2.2% in 1964 and 2.0% in 1997.<br>In 1944 and 1964, main indication schizophrenia, whereas in 1997 >75% had affective disorders.<br>ECT was administered unmodified in 1944 and 1965.<br>ECT administered more often to young men with schizophrenia in 1944 and 1964.<br>Use of psychotropic drug treatment during ECT | | Monitoring:<br>Oxymetry and EEG monitored Cuff method used<br>Other:<br>Treatment frequency, 3 times weekly |
| Hospital, Istanbul, Turkey (H) | Saatcioglu O (Saatcioglu and Tomruk 2008) | Study: Retrospective case review study of ECT-treated patients admitted to Bakirkoy Research and Training Hospital for Psychiatric and Neurological Diseases, Istabul<br>$N = 1531$ patients and<br>$N = 13,618$ ECT administrations<br>Date:<br>1 January 2006 to 30 June 2007<br>Time span:<br>One and half year | Diagnoses:<br>37% schizophrenia, schizoaffective<br>30% bipolar<br>15% depressive disorder<br>14% nonorganic Psychotic disorder<br>4% Other (OCD, substance abuse)<br>Gender:<br>44% women<br>Age, mean (SD) years:<br>35.1 (10.9)<br>Age, year groups:<br>1%, <18<br>15%, 18–24<br>65%, 25–44<br>17%, 45–64<br>1%, >64<br>Side effects:<br>79.7% Memory problems<br>34.5% Headache<br>27.8% Muscle pain | Outcome:<br>Improvement:<br>79% completely<br>19% partially<br>2% minimum | iP: 12%<br>AvE: 9 (range 1–18) | Modified<br>Anesthesia Propofol & succinylcholine (muscle relaxant) & oxygenation<br>Device:<br>Thymatron IV<br>Type: Brief pulse<br>Placement:<br>Bifrontotemporal (BL) standard |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| Scotland (H) | Fergusson GM (Fergusson et al. 2004) | Study: Audit of clinics from 1997 to 1999<br>$N = 36$ sites providing ECT<br>ECT-treated patients:<br>$N = 794$ (1997)<br>$N = 717$ (1999)<br>Date:<br>February 1997 to July 1999<br>Time span:<br>Two years and five months | Diagnoses:<br>87% depressive episode<br>6% schizophrenia/ schizoaffective 3% manic episode<br>Indications for ECT:<br>55% resistant to antidepressants<br>39% previous good response<br>Gender:<br>70% women<br>Age (ECT among depressed inpatients), year groups:<br>3.4%, 15–24<br>4.8%, 25–44<br>11.6%, 45–64<br>13.6%, 65–74<br>12.7%, >75<br>Ethnicity:<br>Mainly (99%) to white adult patients suffering from a depressive disorder | Conditions:<br>18% receiving treatment under the safeguards of the Mental Health (Scotland) Act 1984<br>Gender comment: Ratio of women to men, approximately: 2:1.<br>Age comment: ECT not given disproportionately to the elderly<br>Legal status:<br>76% voluntary (involuntary 24%)<br>82% consent given<br>18% under Mental Health (Scotland) Act of 1984<br>Training and supervision: Initial training of junior doctors evaluated good, but difficulties in providing continued supervision.<br>Clinical global index scale (CGI):<br>61% of the 29 patients with schizophrenia and<br>68% of the 13 patients with manic-episode were rated as at least "much improved" and none as worse | EAR (1997): 15.5<br>EAR (1999): 13.0<br>AvE (1997): 6.8<br>AvE (1999): 6.6<br>AvE (total): 7 (range 1–19) | 95% BL (in accordance with advice in the Royal college of psychiatrists handbook, 1995)<br>Equipment evaluated as: All, up to date |

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**Table C4.** Continued.

| Country | Reference | Study | Demographics | Other data | Rate* | Technical parameters |
|---|---|---|---|---|---|---|
| Cukurova University Psychiatry Service, Turkey (H) | Zeren T (Zeren et al. 2003) | Study: Retrospective chart review of hospital ECT-treated patients at Cukurova University, Department of psychiatry. University, Dept. of psychiatry.<br>*N* = 384 ECT-treated patients<br>Date:<br>1990–2001<br>Time span:<br>12 years | Diagnoses:<br>45% psychotic<br>49% affective<br>6% other (including postpartum psychoses, dissociative, personality disorders, obsessive compulsive)<br>Gender:<br>52% women<br>Age, year groups:<br>5%, <18<br>92%, 18–64<br>3%, >64 Mean age 33.1 years<br>Education:<br>Average no. of education years: 8.7.<br>54% of patients undergoing ECT had high school and higher education | | iP: 14%<br>AvE: 8<br>Side effects: 53% for unmodified 41% for modified (memory impairment, muscle pain, headache, confusion, prolonged seizure, cardiovascular, ECT induced mania/hypomania, bone fracture)<br>Outcome:<br>82% moderate to marked improvement | Unmodified *N* = 179 (47%)<br>Modified *N* = 205 (53%)<br>Since 1996 all ECT performed under anesthesia. Until 1996 use of anesthesia judged according to age (<40 years) or medical condition.<br>Device constant current brief pulse Siemens<br>Placement: all BL (bitemporal)<br>Frequency: 3 times week |

*TPR: treated person rate = persons ECT treated per 10,000 resident population per year.
*EAR: ECT administration rate = no. of ECTs administered per 10,000 resident population.
*iP: inpatient prevalence = proportion (percent,%) ECT treated among inpatient population.
*AvE: average number of ECTs administered per patient (in a session or course).
**C-ECT: continuation-ECT.
**A-ECT: ambulatory-ECT.

**Table C5.** Asia $N = 15$.

| Country | Reference id | Reference | Study | Demographics | Other data | Rates | Technical parameters |
|---|---|---|---|---|---|---|---|
| Land (L)<br>Region (R)<br>City (C)<br>Hospital (H) | Ref id | First author (reference) | Study design<br>*N*<br>Date<br>Time span | Diagnoses<br>Indication<br>Gender<br>Age<br>Ethnicity Other | Side effects<br>Outcome<br>Conditions<br>Training<br>Guidelines<br>Legal regulations<br>Other | TRP*<br>EAR*<br>iP%*<br>AvE*<br>C-ECT**<br>A-ECT** | Modified/Unmodified<br>Anesthesia<br>Current type<br>Electrode placement<br>Devices<br>Dosage<br>Monitoring |
| Japan (L) | 295 | Motohashi N (Motohashi et al. 2004) | Study: Questionnaire survey to university and national hospitals<br>$N = 121$ hospitals (71% response rate)<br>$N = 56$ providing ECT (65%) and given a new questionnaire (82% response rate)<br>Date:<br>Between 1997 and 1999<br>Time span:<br>Three years | Diagnoses (no numbers):<br>Depression<br>Schizophrenia<br>Schizoaffective disorder<br>Indications:<br>Stupor, catatonic, or manic excitement, and suicide risk<br>Other:<br>Elderly or patients with medical conditions received most modified ECT | Side effects (major of modified):<br>amnesia, delirium, headache<br>Side effects (major of unmodified):<br>amnesia, bone fracture, delirium, prolonged apnea<br>Conditions:<br>Consent obtained at least from families<br>Guidelines used in 28% of institutions<br>Other:<br>Number of ECTs administered per year varied from 0.5 to 120 | AvE: Range 5–10 | 33% modified 20% ($N = 9$) facilities used only unmodified ECT<br>Anesthetic agents: amobarbital, thiamylal, thiopental and propofol<br>Devices:<br>Constant voltage sine-wave current approved ECT devices<br>Type:<br>Sine wave<br>Placement:<br>100% BL UL only sometimes used at one unit |
| Japan (L) | 1954 | Chanpattana W (Chanpattana et al. 2005a) | Study: Questionnaire (29 item) survey sent to head of the psychiatry department of university hospitals, director of psychiatric, and general hospitals.<br>$N = 248$ hospitals contacted<br>$N = 100$ (33 university, 33 psychiatric, 34 general) (40% response rate) | Diagnoses:<br>50% schizophrenia<br>37% major depression<br>7% catatonia<br>4% mania<br>2% other (dysthymia, neuroleptic malignant syndrome, personality disorder, Parkinson, other) | Psychiatrist administered ECT unassisted at one hospital.<br>Practice of continuation and maintenance-ECT (M-ECT) in 18 hospitals. M-ECT given to 20% to 1% of ECT patients.<br>Training programs for psychiatry residents in 65 (78%) hospitals, rated as | AvE: 9 | 55% unmodified: (670 patients received 6364 unmodified ECTs, 57% of total number of treatments at 60 (72%) institutions (14 university, 23 psychiatric and 23 general hospitals) |

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**Table C5.** Continued.

| Country | Reference id | Reference | Study | Demographics | Other data | Rates | Technical parameters |
|---|---|---|---|---|---|---|---|
| | | | $N = 83$ (83%) provided ECT<br>$N = 1210$ patients treated<br>$N = 11,146$ ECTs<br>Date:<br>2001–2003 | Gender:<br>women 54%<br>Age, year groups:<br>2%, <18<br>3%, 18–24<br>15%, 25–44<br>40%, 45–64<br>39%, >64 | inadequate/fair to nonexistent/poor in seven hospitals.<br>Consent: Written informed consent from family member in 48 hospitals, informal consent in three hospitals | | Devices:<br>Mainly Sakai-C1 (Japanese built sine-wave ECT device) and some Thymatron DGx<br>Type:<br>58% sine wave 19% brief pulse 6% both 17% did not know<br>94% unmodified |
| Thailand (L) | 2139 | Chanpattana W (Chanpattana and Kramer 2004) | Study: Questionnaire survey sent to 67 hospitals/psychiatric units/institutions in Thailand.<br>$N = 53$ responded (response rate 79%)<br>ECT provided by: $N = 26$ (49%) hospitals<br>$N = 6,914$ (approximately) patients received $N = 51,565$ ECT treatments<br>Date:<br>September 2001 to August 2002<br>Time span:<br>One year | Diagnoses:<br>74% schizophrenia<br>16% mania or major depression<br>7% catatonia<br>2% drug abuse<br>1% other (psychotic, dysthymia, personality disorder, obsessive compulsive disorder)<br>Gender:<br>28% women<br>Age, year groups:<br>4%, <18<br>24%, 18–24<br>53%, 25–44<br>16%, 45–64<br>3%, >64 | Side effects:<br>Memory loss, headache, muscle pain, teeth injury, fracture but no deaths in survey period<br>Conditions:<br>Written informed consent mainly obtained from family members<br>Training:<br>Five of 26 (19%) institutions with acceptable training<br>Other:<br>94% received treatments in psychiatric hospitals<br>Mortality rate estimated: 0.08% (no ECT-related death in survey period)<br>Reasons for not providing ECT: Facility too small and is an unnecessary treatment Reasons for unmodified ECT: lack of anesthesiologist, convenience, lack of personnel, lack of equipment, economy, risk of anesthesia | TPR: 1.15<br>AvE: 7<br>C-ECT practice: 42% (11 of 26) institutions given for six to nine months to prevent relapse<br>A-ECT and C-ECT are practiced | Devices:<br>46% MECTA Spectrum, MECTA SR-1, or Thymatron DGxn,<br>8% two brands<br>35% Ectonus 5A, Ectonustim, Ectron, Medcraft B-25, and Siemens konvulasor<br>11% unknown<br>Type:<br>42% brief pulse<br>12% sine wave<br>46% unknown<br>Placement:<br>All BL |

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**Table C5.** Continued.

| Country | Reference id | Reference | Study | Demographics | Other data | Rates | Technical parameters |
|---|---|---|---|---|---|---|---|
| Asia, Pacific Region (L) | 3715 | Little JD (Little 2003) | Study: Survey by mail to practitioners attending first Asian pacific ECT conference and 3361 brochures sent out by automatic mailing system to countries in Asia Pacific Region. Contact addresses for 23 of 34 countries identified.<br>*N* = 12 responses from practitioners having practiced in 12 countries<br>*N* = approximately 668 patients ECT treated *N* = approximately 2257 inpatients<br>Date:<br>2000<br>Time span:<br>One year | Diagnoses:<br>68% schizophrenia<br>18% mania<br>4% depression<br>Other:<br>Data from countries Fiji Kiribati, Malaysia (USM), Malaysia (Sabah), Nepal Palau, Philippines, Solomon Island, and Thailand.<br>ECT not available: Brunei, Cambodia, Micronesia, Palau | Side effects: (reported not common), memory impairment most commonly reported<br>Outcome:<br>Response rate to ECT approximately 86%<br>Other:<br>No ECT services in Brunei, Cambodia, Micronesia and Palau<br>Other:<br>Indicates large variation in practice in Asia Pacific Region. Attitudes: Cultural attitude generally negative, except for the Philippines where ECT was generally well accepted | iP: Varied from 1% to 9%, except for Nepal 26% | Modified<br>Devices:<br>Thymatron in Malaysia and Thailand Mecta in Nepal and Thailand Ectonus series 5B in Sabah (a state of Malaysia)<br>Type:<br>All brief-pulse wave, except sine wave in Kiribati and Solomon Islands<br>Placement:<br>BL preferred |
| Asia (L) | 561 | Chanpattana W (Chanpattana et al. 2010) | Study: Survey (29 item) questionnaire of ECT-treated patients to psychiatric treatment facilities and countries in Asia<br>*N* = 977 psychiatric facilities (334 responded, response rate 34%),<br>*N* = 45 countries in Asia (Russia excluded) (29 responded, response rate 64%)<br>*N* = 23 of 29 (79%) countries provided ECT in 257 institutions<br>*N* = 39,875 patients who received *N* = 240,314 ECTs | Diagnoses:<br>42% schizophrenia<br>32% major depression<br>14% mania<br>7% catatonia<br>2% drug abuse<br>2% dysthymia<br>1% other<br>Gender:<br>38% women<br>Age, year groups:<br>6%, <18<br>29%, 18–24<br>44%, 25–44<br>17%, 45–64<br>4%, >64 | Countries (*N* = 23) in survey with ECT practice:<br>Bangladesh, China, Hong Kong, India, Indonesia, Iran, Iraq, Israel, Japan, Jordan, South Korea, Malaysia, Myanmar, Nepal, Oman, Pakistan, Philippines, Singapore, Sri Lanka Thailand, Turkey, United Arab Emirates, Vietnam<br>Countries (*N* = 6) in survey without ECT practice:<br>Bhutan, Brunei, Cambodia, Georgia, Laos, and Lebanon | AvE: 7<br>[*N* = 129,906 unmodified ECTs administered to *N* = 22,194 patients (55.7%) at *N* = 141 (54.9%) institutions in *N* = 14 (61%) of the 23 countries] | Unmodified:<br>36% unmodified always<br>19% unmodified, ranging from 1–98% of the time<br>Modified:<br>45% always modified<br>Anesthesia:<br>30% institutions used anesthetic agents (thiopental, propofol, sevoflurane, diazepam, thiamylal, flunitrazepam, methohexital) without muscle relaxant |

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**Table C5.** Continued.

| Country | Reference id | Reference | Study | Demographics | Other data | Rates | Technical parameters |
|---|---|---|---|---|---|---|---|
| | | | Date:<br>2001–2003 | | Other:<br>Large variation in Asian countries Unmodified in 36% and sine wave in 42% of institutions Only 45% always modified, that is,. never unmodified | | $N = 8$ of 141 (5.7%) institutions (four Japan, three Malaysia, one South Korea used routinely succinylcholine muscle relaxant without anesthesia<br>Devices:<br>58% (115/197) institutions brief-pulse ECT devices<br>Placement:<br>77% BL<br>Monitoring:<br>23% of institutions used EEG |
| Katmandu, Nepal (C) | 114 | Ahikari SR (Ahikari et al. 2008) | Study: Naturalistic prospective hospital (Kathmandu Medical College Teaching Hospital) study. $N = 210$ hospital admitted patients $N = 47$ ECT treated<br>Date:<br>May 2005 to April 2006<br>Time span:<br>One year | Diagnoses:<br>34% schizophrenia, psychotic disorder 23% severe (major) depression 28% bipolar depression 15% other<br>Gender:<br>28% women Age, years in groups: 11%, 10–19 57%, 20–29 19%, 30–39 6%, 40–49 6%, 50–59 | Other: Psychotropic drugs used concurrently | iP: 22% AvE: 6 (range 2–16) | Modified Anesthesia: Propofol or Sodium Thiopental plus Succinylcholine muscle relaxant Device: ECTON constant current brief-pulse ECT device, manufactured by RMS, Chandigarh, India. Type: All brief pulse in study |
| Hong Kong (C) | 2296 | Chung KF (Chung 2003) | Study: Prospective questionnaire survey of treated patients to all public hospitals with ECT treatment facilities 40 public hospitals in Hong Kong, and nine of 13 inpatient psychiatric services with ECT treatment facilities<br>$N = 167$ ECT-treated patients | Diagnoses (for $N = 164$):<br>40% depression<br>23% schizophrenia<br>19% bipolar, manic or mixed<br>10% bipolar, depressed<br>9% schizoaffective<br>1% acute or transient psychotic disorder<br>Indications:<br>Mainly failure to respond to alternative treatment, | Side effects:<br>Memory outcome:<br>1% much worse<br>24% worse<br>71% no change<br>4% improved<br>Outcome:<br>83% Much or very much improved<br>13% minimally improved<br>2% no change<br>3% worse | TPR: 0.27–0.34<br>iP: 1.3–1.8%<br>AvE: 7.7<br>Range 5–8<br>A-ECT and C-ECT: Rarely used | No information about anesthesia<br>Devices:<br>All Mecta US domestic version SR1 except one facility using Mecta Spectrum 5000M.<br>Placement:<br>77% BL 119<br>22% UL 34<br>1% mixed |

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**Table C5.** Continued.

| Country | Reference id | Reference | Study | Demographics | Other data | Rates | Technical parameters |
|---|---|---|---|---|---|---|---|
| | | | Date:<br>April 2001 to March 2002<br>Time span:<br>One year | Gender:<br>68% women<br>Age, year groups:<br>3%, <16<br>2%, 16–7<br>11%, 18–24<br>44%, 25–44<br>25%, 45–64<br>14%, 65–80<br>1%, >80 (total 15% >65 years) | Conditions:<br>13% Involuntary (judged incapable of giving informed consent) | | |
| Hong Kong (C) | 441 | Chung KF (Chung et al. 2003) | Study: Survey, (postal questionnaire and site visit) to public inpatient psychiatric units in Hong Kong. (Response rate 100% from public ECT units and 91% from private psychiatric service)<br>*N* = 13 psychiatric units, and 8 (62%) providing ECT<br>Date:<br>October 1999 to August 2000<br>Time span:<br>One year | No information | Training:<br>Junior doctors given informal ECT briefing and at least one supervised<br>ECT administration before treatment on their own<br>Other:<br>Hospital policy required patient assessment every one to two treatments during ECT course, but only practiced in four of nine patients observed | TPR (1998): 0.34 | Modified and unmodified.<br>Anesthesia: 87% provided anesthesia<br>Devices:<br>Seven Mecta US domestic version SR1.<br>One Mecta spECTrum 5000M.<br>Three of four private units had Ectron Mark 4.<br>Dose:<br>63% used preselected stimulus dosing<br>Placement: BL |
| India (H) | 218 | Chanpattana W (Chung et al. 2003) | Study: Survey questionnaire (29 items) about ECT practice during the last year, to all medical colleges and psychiatric hospitals in India.<br>*N* = 188 contacted institutions<br>*N* = 74 responded (Response rate 39%) | Diagnoses:<br>37% schizophrenia<br>34% major depression<br>18% mania<br>6% catatonia<br>3% dysthymia<br>2% personality disorder, Parkinson's disease, neuroleptic malignant syndrome, other | Side effects:<br>headache, muscle pains, memory problems, and with unmodified fractures, dislocations, teeth injury, one death Training: reported ECT teaching program 89% to medical students 59% psychiatry residents | AvE: 6<br>C-ECT: Variation from 1–10% to 60% of patients | Unmodified and modified.<br>*N* = 20 (30%) institutions always unmodified<br>Anesthetic agents in use sometimes (and not always together): Thiopental, diazepam, methohexital. Succinylcholine and atropine |

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**Table C5.** Continued.

| Country | Reference id | Reference | Study | Demographics | Other data | Rates | Technical parameters |
|---|---|---|---|---|---|---|---|
| | | | $N = 66$ of 74 (89%) administered ECT<br>$N = 19,632$ patients received 114,111 ECTs in survey period<br>$N = 10,234$ (52%) patients received 52,459 unmodified ECTs in 33 (50%) institutions<br>Date:<br>September 2001 to August 2002<br>Time span:<br>One year | Gender:<br>women 39%<br>Age, year groups:<br>1%, <18<br>6%, 18–24<br>34%, 25–44<br>44%, 45–64<br>15%, >65 | Other:<br>Reasons for unmodified ECT:<br>MemoryLack of anesthesiologist, lack of equipment, lack of personnel, contraindication for anesthesia, emergency, convenience, and economic purpose | | Devices:<br>30% Indian built ECT devices 66% no report of device name [only one MECTA-JR2 or Thymatron DGx]<br>Type:<br>50% brief pulse 30% sine wave 9% both wave types 11% unknown<br>Placement:<br>82% BL always 15% BL mainly |
| Chulalongkorn Memorial Hospital, Thailand (H) | 173 | Lalitanatpong D (Lalitanat-pong 2005) | Study: Medical hospital record survey of patients admitted to psychiatric ward.<br>$N = 51$ ECT treated<br>Date:<br>August to September 2004<br>Time span:<br>One month | Diagnosis and (mean age in years):<br>49% schizophrenia—(35.5)<br>23% bipolar—(38.1)<br>8% acute psychosis—(24.0)<br>6% depression—(47.7)<br>4% dementia—(75.5)<br>10% other—(27.6)<br>ECT indication: severe violence, suicide, refractory treatment<br>Gender:<br>63% women Age, mean years: 36.7 | Side effects (most common): headache, transient amnesia, dental complications<br>Mean length of stay in days for ECT treated 25.9 ± 15.8 compared to non-ECT treated 17.8 ± 12.7 (difference not significant) | No prevalence or rate data<br>A-ECT: Practiced | Modified<br>Type:<br>Multiple ECT types stated, otherwise no information |
| Pamela Youde Nethersole Eastern Hospital, Chai Wan, Hong Kong (H) | 527 | Chung JPY (Chung et al. 2009) | Study: A retrospective review of case records at hospital in Hong Kong serving 0.8 million.<br>$N = 34$ ECT-treated patients<br>Date:<br>June 2006 to April 2009<br>Time span:<br>Three years | Diagnoses:<br>65% depression<br>23% bipolar<br>6% schizophrenia<br>6% schizoaffective<br>Gender:<br>88% women<br>Age, mean (SD) years:<br>62 (19) (range, 21–87)<br>60% >65 years or older | Side effects: 71% headache, postictal confusion, nausea, dizziness, memory loss (most common)—dental injury, transient bradycardia, oxygen desaturation bronchospasm (less common) | iP: 0.6%<br>AvE: 6 (range 3–10) | Modified<br>Device: MECTA Spectrum 5000Q constant current stimulus<br>Type:<br>Brief-pulse wave<br>Placement: BL |

(*Continued*)

**Table C5.** Continued.

| Country | Reference id | Reference | Study | Demographics | Other data | Rates | Technical parameters |
|---|---|---|---|---|---|---|---|
| Tokushima, University Hospital, Japan (H) | 7782 | Ishimoto Y (Ishimoto et al. 2000) | Study: Retrospective review of patient charts at university hospital<br>*N* = 185 ECT-treated patients<br>*N* = 3067 admitted patients<br>Date:<br>Between 1975 and 1997<br>Time span:<br>23 years | Diagnoses:<br>71% schizophrenia<br>6% manic depressive psychosis<br>5% atypical psychosis<br>14% psychogenic reactions<br>4%other<br>Indication:<br>Drug resistance or need of rapid improvement<br>Gender:<br>51% women Age, mean (SD) years: 27.5 (8.8) (range 13–59) | Side effects:<br>37% of patients—amnesia, headache, pyrexia. One case of compression fractures of vertebrae<br>Other:<br>Assistants restrained patients shoulders, arms and thighs to prevent extreme motion | iP: 6%<br>AvE: 10 (range 1–43) | Modified, but without muscle relaxant<br>Anesthesia: Thiamylal sodium (short-acting barbiturate)<br>Device: C-1 Sakai Medical, Tokyo, Japan.<br>Type: Sine wave (according to device type)<br>Placement: BL<br>Monitoring: Pulse and blood pressure check |
| Hospital, Saudi Arabia (H) | 2640 | Alhamad AM (Alhamad 1999) | Study: Retrospective clinical review of all ECT-treated inpatients at King Khalid University hospital *N* = 127 ECT-treated patients<br>Date:<br>1985 to 1994<br>Time span:<br>10 years | Diagnoses:<br>61% major depressive illness (unipolar, bipolar, postpartum, and atypical depression) 13% manic episode (bipolar mixed state, postpartum) 9% schizoaffective 11% schizophrenia 3% brief reactive, organic psychoses 2% other<br>Indication: 69% no response to medication 35% as a first-choice emergency treatment<br>Gender:<br>60% women<br>Age, mean (SD) years:<br>27.9 (9.23) (range 15–60)<br>Ethnicity:<br>82% Saudi Arabian<br>Other:<br>94% living in urban area<br>52% married<br>52% secondary, university, or higher education level | Side effects: 3.6% amnesia or disorientation<br>Outcome:<br>76% good response 79% of nonresponders were schizophrenic patients 59% maintained long term improvement<br>Training/administering A two-lecture course on ECT every year for junior doctors and practical demonstration and training ECT given by junior doctors<br>Consent: Patients have to sign informed consent, counter-signed by a near relative | iP: 5%<br>AvE: 8 | Modified<br>Muscle relaxant mainly suxamethonium<br>Device: Siemens konvulsator 2077S<br>Type: Brief pulse<br>Placement: BL |

(*Continued*)

**Table C5.** Continued.

| Country | Reference id | Reference | Study | Demographics | Other data | Rates | Technical parameters |
|---|---|---|---|---|---|---|---|
| Hospital, Karachi, Pakistan (H) | 3515 | Naqvi H (Naqvi and Khan 2005) | Study: Retrospective study<br>*N* = 136 ECT treated of total 4013 admitted patients<br>*N* = 126 (Data available for only 126 [93%[ECT-treated patients)<br>Date:<br>January 1990 to January 2003<br>Time span:<br>Three years | Diagnoses:<br>69% major depressive disorder<br>10% bipolar<br>5% schizophrenia<br>4% postpartum depression<br>2% schizoaffective<br>2% paranoid psychosis<br>3% brief psychotic disorder<br>5% others<br>Indications:<br>Drug resistance, life-threatening situation<br>Gender:<br>56% women<br>Age%, year groups:<br>48%, 20–40<br>38%, 41–50<br>7%, >60 | Side effects: Tongue biting, loosening of dentures, postictal malaise, confusion, headache. One case of arrhythmia and ECT terminated Consent: Written informed consent when family agree | iP: 3.4% AvE: 6 (range 1–20) | Modified Device and type: Brief pulse, constant-current device Placement: BL Monitoring: Observation of seizures, no EEG |
| Al Ain, United Arab Emirates (H) | 4055 | Tewvik KD (Tewfik et al. 1998) 1998 | Study: Computerized psychiatric inpatient register<br>*N* = 51 ECT treated<br>Date:<br>1995 and 1996<br>Time span:<br>Two years | Diagnoses:<br>43% depression<br>43% schizophrenia<br>8% schizoaffective<br>6% other<br>Age, mean (SD) years: 30.1 (10.5)<br>Gender:<br>33% women | | iP women: 6%<br>iP men: 4%<br>[total iP (approximately): 5%]<br>AvE: 6. | Modified<br>No anesthesia or device type information<br>Placement: BL |

*TPR: treated person rate = persons ECT treated per 10,000 resident population per year.
*EAR: ECT administration rate = no. of ECTs administered per 10,000 resident population.
*iP: inpatient prevalence = proportion (percent,%) ECT treated among inpatient population.
*AvE: average number of ECTs administered per patient (in a session or course).
**C-ECT: continuation-ECT.
**A-ECT: ambulatory-ECT.