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Bringing the GP to the forefront of EHR development

NTNU
Norwegian University of
Science and Technology

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Trondheim, March 2009

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videre. Det ble gjennomført fire studier i denne avhandlingen, og det ble brukt både kvantitative og kvalitative metoder. De kvantitative data ble innsamlet gjennom en nasjonal spørreundersøkelse. De kvalitative data ble innsamlet ved fokus gruppe intervjuer, ved observasjoner av allmennleger i klinisk arbeid og ved dokumentanalyse og metoder fra aksjonsforskning. En av studiene var kvantitativ og benyttet kun data samlet inn fra spørreskjemaundersøkelsen. I to av studiene var metodene triangulerte, og det ble benyttet data fra spørreskjema, intervjuer og observasjoner. Den siste studien var kvalitativ og samlet inn og analyserte data fra dokumentanalyser og metoder fra aksjonsforskning.

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Doctoral thesis

Tom Christensen

Bringing the GP to the forefront of EPR Development

Trondheim, October 7. 2008

PREFACE

I have worked as a general practitioner in a medical practice for 18 years with the same population, most of the time as a specialist in general medicine according to the rules of the Norwegian Medical Association. During this period I have also worked part time in a local hospital, in maternal and child health centers, and in school health services. In my years as a general practitioner I have used both paper patient records and several electronic patient record systems. At our medical centre we were all impressed when we could move from paper to electronic patient records after installation of the hardware and software on the weekend, receiving training on Sunday afternoon, and welcoming patients the following Monday morning on a nearly normal schedule. A general practitioner designed this electronic patient record. We were quite inexperienced with computers, and were glad to experience that use of the patient record represented a minor step from paper records. Every day we enjoyed having administrative work taken over by the computer, and our working day was eased. An update to a full Windows version several years later was a much bigger step. The many modules, keyboard combinations, and innumerable options lengthened the training process to 3 or 4 days. It took another 3 months to "reprogram" the operators' fingers. Step by step, we came to appreciate all the new possibilities. There were many initial problems with the new patient record software. Many failures were corrected, but new ones appeared. Our medical center was also involved in beta testing of new versions, and we experienced many failures due to problems that survived internal and external tests. Nevertheless, we ultimately became satisfied users of the system.

At that time I was leading a group of general practitioners and collaborating hospitals. The group gradually became interested in moving patient-related cooperation from paper to an electronic platform. As a result of this interest and our unified efforts, all colleagues in our county began receiving all medical information electronically within a period of some years. I am forever grateful to our local and regional hospitals for meeting this challenge. Failures related to incoming electronic health information, such as laboratory and X-ray reports as well as discharge letters, could themselves cause delays,

but the benefits far exceeded the problems. We also discovered that national standards either did not exist or weren't mandatory, and the solutions did not support electronic health communication outside the region.

My leadership of a national health communication project and my position as medical adviser of the national project on electronic prescription, plus being an adviser in several other IT projects, have given me additional insight into the use of electronic patient record systems in hospitals and primary care.

The interactions between general practitioners and patients and their next of kin can be rather complex. I believe that neither the deductive thinking of biomedicine nor the linear models of informatics can address the complexity of primary care. Knowledge gained from continuous study of various aspects of primary care may be used to improve the ability of electronic patient records to support clinical work. General practitioners work by experience, pattern recognition, and clinical hunch as well as by patient-adjusted, evidence-based knowledge. Hence, the electronic patient record must support these different approaches, and more studies are needed to achieve that goal.

General practitioners in Norway use electronic patient record systems as a tool to support clinical and administrative tasks, but the possibility of improving clinician performance and patient outcome has not yet been fully explored. When the University of Trondheim asked me to apply for a scholarship to explore physicians' opinions and further expectations of electronic patient records, I was very interested, but had to think twice. The hardest step was to leave my colleagues and patients at the medical center and my colleagues and friends in the local hospital and other parts of the health and social services. But my motivation and curiosity led me to apply and be accepted as a student. After starting the research, I realized that having a background similar to that of the respondents was an advantage in that it eased access to existing educational groups and medical practices for the collection of data, although I am aware that it might have led to possible blind spots as well. I hope the results of my research can contribute to further development of electronic patient record systems to provide better support of clinical work in primary care.

Acknowledgements

Prof. Anders Grimsmo at The Norwegian EHR center at NTNU in Trondheim has been my excellent supervisor, and I am very thankful for all his wise comments. I also thank Assoc. Professor Arild Faxvaag and Dr. Hallvard Lærum, for their contribution to one of the papers, and Faxvaag for his kind advice with regard to another paper and the thesis itself. I also wish to express my gratitude to Prof. Carl Fredrik Bassøe for his advice on two of the papers; to Prof. Eric Monteiro for his precise comments on the thesis, and to all my kind and supportive colleagues at the EHR center. My warm thanks to my previous colleagues at Sama Legesenter in Harstad for accepting my resignation so I could take up my studies, and for their support and understanding. I also thank my colleagues at Edda Legesenter in Trondheim, where I have been working part time to keep up my knowledge of primary care, and my friend and colleague Dr. Lasse Folkvord, for his supportive and optimistic comments in the process. I thank all my colleagues at the Department of Public Health and General Practice, especially Assoc. Professor Tom Ivar Nilsen and Assoc. Professor Pål Romunstad for statistical advice. I am also grateful to research fellow Ole Martin Winnem, who has given me kind advice on informatics and supported me in several approaches to the research as well as to Dr. Ole Andreas Bjordal and Yngve Nyheim for inspiring comments. I also thank Annebeth Askevold, Vigdis Heimly, Bjarte Aksnes, and Torbjørn Nystadnes at KITH–Norwegian Center for Informatics in Health and Social Care, and Souchef Ib Johansen from MedCom, Odense in Denmark for sharing their knowledge of standards in the health sector and their advice. I also thank Assoc. Professor Michael Klinkmann, Department of Family Medicine, University of Michigan, Professor Bob Bernstein, Institute of Family Medicine, University of Ottawa, and Dr. Marc Verbeke, Department of General Practice and Primary Health Care at the University of Ghent, Belgium for advice on electronic patient records oriented by problems and episodes. Finally, I must thank my wife Lillian and my children Andreas, Martin, Ingrid Marie, and Hilde for their patient and supportive attitudes throughout the duration of my research. Without their love and attention my work would have been less inspired.

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Christensen T, Grimsmo A. Instant availability of patient records, but diminished availability of information: a multi-method study of GPs use of electronic patient records. BMC Med Inform Decis Mak 2008; 8 (12).

PAPER 2

Christensen T, Faxvaag A, Lærum H, Grimsmo A. Norwegians GPs' use of electronic patient record systems. Submitted to *International Journal of Medical Informatics* July 21. 2008.

PAPER 3

Christensen T, Grimsmo A. Expectations for the next generation of electronic patient records in primary care: a triangulated study. Inform Prim Care 2008; 16 (1):21-8.

PAPER 4

Christensen T, Grimsmo A. Development of functional requirements for electronic health communication: preliminary results from the ELIN project. Inform Prim Care. 2005; 13 (3):203-8.

ABSTRACT

Aims

Four evaluation studies have been conducted in this thesis. The first study examined the Norwegian GPs´ use of EPR systems compared to previous use of paper patient records, the time spent on using the EPR systems, and the potential effects on the clinician-patient relationship. The second study evaluated how GPs judged the ability of the EPR systems to support important clinical tasks, the effect of the systems on the overall user satisfaction and success, as well as quality and efficiency of the work. In addition, differences of reported ability to support clinical tasks, software and hardware failures and user satisfaction between the systems were evaluated. Support of clinical tasks, user satisfaction and impact of quality of work were compared with results from a similar study of hospital physicians. The third study analyzed what kind of improvements GPs wanted in the next generation of EPR systems. The last study explored how GPs could be engaged to draw up the functional requirements they found necessary to achieve successful electronic collaboration in health care.

Methods

The methods used in this thesis were both quantitative and qualitative. A national questionnaire survey was conducted to collect representative quantitative data. The qualitative data was collected from focus group interviews and from observations in primary care medical practices. Two of the studies of the thesis were triangulated and collected and compared data from questionnaires, interviews and observations. One of the studies was quantitative and used data collected from the questionnaire. The last study collected the data from document analysis and methods from action research in a project to draw up functional requirements.

Results

We found that GPs in Norway prefer their always-available EPR systems compared to paper patient records, but the availability of the information within large EPRs was not satisfactory. The time used to register and document was shorter in the observation study

(88% ≤ 3min) compared to the questionnaire study (31% ≤ 3min). Use of EPR systems did not disturb the clinician–patient relationship in this study. The GPs reported to get assistance from their EPR systems while conducting 21 of 24 clinical tasks. The remaining three tasks were not supported by the system. 19 of the 21 tasks were used extensively. The GPs rated the overall satisfaction and the success of the systems to be good or excellent. They reported that their work had been easier to perform and that the quality of their work had increased. The GPs reported no differences between different EPR systems as to support of clinical tasks, but one of the systems was reported to have more hardware and software failures and less user satisfaction and success. GPs were significantly more satisfied with the electronic patient records than were their hospital colleagues, when comparing the results with a similar hospital study. They also judged the ability of the GP-oriented systems to support clinical tasks and the impact of clinical work to be better. The GPs wanted improvements in several areas, although they were overall satisfied with the electronic record systems. They missed decision support that could be adjusted to the individual patient. They wanted all communication to become electronic and to be able to consult specialists electronically. They also considered whether the electronic patient records should be integrated with personal health records. A method for the development of functional requirements was tried out. The participant GPs selected 67 requirements from the exciting EPR standard and formulated 197 new functional requirements to achieve successful electronic collaboration in health care.

Conclusion

The balance between time spent examining and talking to patients and time spent on reading and documentation in EPR systems is of great clinical importance. The observed and reported timesavings documented in this thesis are challenged by previous time studies, and more research is needed to describe how time is spent and how administrative workload on GPs can be reduced.

The clinician-patient relationship is of great concern for clinical practice, but the respondents of this thesis denied that use of computers disturbed this relationship. The clinical relevance of reduced overview in large EPRs should be studied more in depths. The respondents of this thesis suggest that a problem-oriented record might solve some of

these difficulties. Although the quality of the documentation in the records probably has increased, possible effects on the quality of the clinical work have to be studied further.

The ELIN-method represents user-driven bottom up organized national projects that are fully financed. The method has demonstrated a complete production line starting with user-developed requirements that are tested stepwise and end up implemented in routine clinical work and with revised standards and requirements. Later studies of GP use of the EPR systems after implementation of the requirements from this thesis can reveal if success is achieved in the field of interchange of health information. The tools from the ELIN-method can be used to realize the mandate from the responders of this thesis to develop problem-orientated EPRs with decision support adjusted to the individual patient, as well as integration of PHRs and consultations with specialists.

INFORMATICS IN PRIMARY CARE

The four studies presented in my thesis represent an empirical assessment to the development and use of EPR systems in primary care. My comprehension of the field has been that the development of the EPR systems has been an iterative process influenced by a mix of local organization, regulations, traditions, values, research and the development of the technology itself. There is a need for insight into the context and characteristics of general practice to fully understand and explain the empirical material put forward in this thesis. General practice diverges from other fields of medicine in many ways. Some authors even claim that informatics in primary care qualify as a field of its own.[1]

A framework for understanding the development and use of EPR in general practice

Primary care is the first point of contact with the health system, distinguished from other aspects of care by the clinical characteristics of the patients and their problems. Primary care practitioners are distinguished from colleagues in secondary and tertiary care by the variety of problems they encounter.

Several definitions of primary care have been proposed and discussed. The Starfield definition of primary care as “First contact, continuous, comprehensive and coordinated care provided to individuals and populations undifferentiated by age, gender,

disease or organ system;" has often been cited.[2] The Institute of Medicine defines primary care as "the provision of integrated, accessible, health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community."[3] The Medical Research Council of the United Kingdom defines primary care as health services which provide the first (primary) point of contact for individual members of the public (in contrast to secondary referral services), although it accepts that some of these services are provided by hospitals.[4] It also points out that primary care incorporates elements of social care, community care, and primary caring provided by families or unpaid individual members of the public. The definition from WONCA Europe is complex but can be simplified into three core activities:[5]

- Heuristic decision making (based on intelligent rules of thumb), rather than deductive reasoning (take a full history, examine and investigate the patient), is used in a context in which patients often have vague symptoms and unstructured problems.
- The more holistic, biopsychosocial model is used ahead of the more straightforward biomedical one. There is often a long-term relationship between individuals, families, and their primary care providers.
- Primary care has its own scientific body of knowledge whose application enhances practice delivered using a patient-centered consulting style.

Primary care services are characterized by attributes that include accessibility, comprehensiveness, co-ordination, continuity, and accountability.[6] Table 1 summarizes some of the most important characteristics of general practice that have implications for designing EPR systems that support the work of GPs. Table 1 also illustrates how these needs are different from specialist care.[7]

Primary care practitioners are distinguished from colleagues in secondary and tertiary care by the rapid shifts of patient consultations, on average 15 to 20 minutes per patient. Their income too is based on high turnover. GPs may accordingly be very

sensitive and thereby negative to software solutions that slow them down as shown in study one and four.

The GPs are fronted with a great variety of problems at the encounter. They also work independently without supervision or guidance by colleagues. This explains why GPs are interested in decision support (study three) and why it has been successful in general practice. On the other hand it has also been shown that the EPR functions as an aide memoire that helps the GP in this rapid and frequent change of topics to make patients feel continuity and personal commitment by the GP.[8]

As described in table 1 the patient-doctor relation in general practice is often continuous over many years, sometimes decades, and deals with many problems, some of them reappearing or chronic. This supports the need of a problem-oriented EPR and methods for better overview, expressed both directly and indirectly by the GPs that participated in the survey. This explains why the GP responders in this thesis said that even if each EPR was easily available, this was not always the case for the information needed within each patient record.

The face-to-face encounter with the patient and doctor alone is a situation based on great confidence to and empathy from the doctor. This gives an understanding of why the GPs were concerned if the computer on the desk might disturb the patient-doctor relationship as discussed in study one. This also explains why GPs more often than their hospital colleagues have expressed more skepticism to let others have access to their EPR systems and have supported strict regulations of confidentiality.

On the other hand table 1 state that GPs communicate with a broad number of other instances both inside and outside health care. The GPs in Norway have an extensive gatekeeper and coordinator role. This explains the GPs' great interest in the development of electronic communication expressed in study four.

It is also worthy to notice in table 1 that GPs in contrast with their colleagues in hospitals usually spend their time staying in one place having the patients come to them. This tells us that the context of general practice probably has more in common with ordinary office work than in specialist care where health personnel in hospital departments are highly mobile and running several tasks in parallel. This indicates that the experience that vendors have from other settings is easier to transfer to general

practice than to clinical departments, and this could explain some of the greater success of EPR systems in general practice compared to hospitals as shown in study two. The obstructions that logon procedures have caused in hospitals are an example that reflects some of the difference between general practice and specialist care when routines from office work are transformed to health care.

Table 1 Characteristics of business management and health problem assessment in general practice compared to specialist care

Business management	**General practice**	**Specialist care**
Organization	Decentralized, autonomous. Solo or in small groups	Governed, hierarchic. Large organizations. Dedicated ICT departments and personnel.
Economy	Piecework, self-employed. Per capita plus fee for service. Low costs	Fixed salary. Combination of fixed budget and prospective payment system. High costs.
Services	Broad/general Large volumes per doctor Short encounters	Segregated/specialized Small volumes Day and night
Collaboration with external partners	Many, medical and non-medical Gate-keeper, coordinator, advocate	Few and mainly with primary care Finalization
Patient-doctor relationships	Continuous – over years Personal, committed	Rare and short periods Large staff, shift work
Patient sharing information with the doctor	Often intimate information	Cautious information sharing
Health problem assessment		
Health problems	Most often several, in parallel Whole spectrum of diagnoses	Usually one, or one at the time Limited number of diagnosis
Mobility	One patient at the time, mainly in one spot (by doctor's desk)	Move from bed to bed (High mobility)
Disease development	Early, few and unspecific symptoms	Characteristic symptoms/signs
Prevalence	Low, not selected	High and selected
Diagnostics	Early pattern recognition Exploring probability Low predictability ICPC (symptom, process and disease classification)	Systematic, complete " Jig-saw puzzle " High predictability ICD10 (end point disease classification)
Tests	Few and simple	Many and advanced
Decision	GP single-handed. Adherent to patient preferences	Often by teams Adherent to guidelines
Treatment	ADL and relief-oriented Simple, exploring	Organ and cure oriented Advanced, based on reliable diagnosis

Informatics in primary care is then dependent on theory and concepts that support the patient-centered approach, and parts of these are already referred to in the definitions. The theory and concepts are described by de Lusignan in the following four sections.[1]

- **An Epistemology of knowledge and an Ontology for Primary care**

  Although evidence-based medicine is a cornerstone of patient treatment, it also has its limitations. According to Polyani and later Goldman and de Lusignan, only explicit knowledge is represented as evidence based, and we still lack an adequate framework to address and value the tacit knowledge gained in primary care.[9-11] One has to consider the relationship between clinical judgments based upon the knowledge, setting, and needs of the individual patient as well as the evidence-based advice from medical science at the patient group level. Hence, the clinical decisions should be adjusted to the individual patient when possible.[11, 12] The clinical judgments can possibly be devalued by the believers in evidence-based medicine.[13, 14]

  Whether terminologies such as SNOMED CT (Systematized Nomenclature of Medicine–Clinical Terms) and classifications such as ICPC (International Classification of Primary Care) are sufficient to describe the patient-centered primary care is still debatable.[15]

- **Heuristic instead of deductive reasoning in decision making in primary care**

  Although the analyzing methods of deductive reasoning are most important and successful in medicine as described by Musen,[16] primary care calls for supplementary methods such as 'intelligent rules of thumb' to adjust decision making to the full context of the individual patient.[17] Suchman concluded that set cognitive models in the computer interface may not be appropriate to address what is important and dominant for the patient in the consultation, and the common sense drawn from experience can be in conflict with decision support, even though the decision support is evidence-based.[18] Decision support is also used rather infrequently when available in the treatment of chronic diseases, a finding possible related to these aspects.[19]

Things are complicated further by Balint who showed that the clinician-patient relationship is in itself therapeutic.[20] According to Chapman, IT experts are extremely good at linear, reductionist, positivist thinking and not so good at constructing social solutions and appreciating other perspectives.[21] Complex adaptive systems should therefore be studied to achieve robust models of primary care.[22, 23]

- **Using the Biopsycosocial rather than the Biomedical model**

  More than medicine in general, primary care with its longitudinal information gathering is dependent on a model that includes more than a strict biomedical view: it has adopted a holistic approach, considering social, behavioral, and psychological as well as biomedical factors.[24, 25] Due to this complexity, modeling in primary care is a challenge and is not satisfactory reflected in the modeling of informatics.[26, 27] The modeling in primary care informatics should provide technology that supports the complexity of the consultation rather than expecting the consultation to adjust to inadequate technology.[28, 29]

- **Patient-centered rather than disease-centered consultations**

  Balint started the movement toward patient-centered consulting in the 1950s.[20] According to work by Byrne and Long in 1976 and 1984, the most frequent reason for patients to leave their consultation disappointed was that their agenda was not addressed.[30] Consultations in primary care are patient-centered more than disease-centered,[31] and according to Pendleton patients who explain their ideas and beliefs need to be understood for there to be agreement on medical advice and treatment plans.[32]

Primary care informatics can already be considered an established specialty or subdomain of health informatics in some jurisdictions, and specialist groups and specialized journals exist.[1, 33] Studies of the uptake and use of EPR and its possible effects on the clinician–patient relationship are included in this field. Studies of implementation in different primary care settings are also important in identifying factors important for success. Issues such as comparing paper-based with electronic patient

records, EPR uptake and adoption, data quality, and the secondary use of data also add to this potential medical informatics subspecialty. Clinical communication is important to support the patient's trajectory and to integrate clinical data in the EPR within and across health services, and requires a common architecture of interaction. Clinical coding and concepts, education and training, and patient access to medical records also add to this field.[6]

Electronic patient records in Norwegian primary care

I have chosen to use the concepts EPR and EPR systems in this thesis, and I find EPRs to be synonymous with computer-based records as well as electronic medical records, although there might be differences. Several definitions are known, and several concepts have been developed. According to Institute of Medicine (IOM) on page 55 and 56 in "The computer-based patient record: An Essential Technology for health care" from 1997; a computer-based patient record is defined as an electronic patient record that resides in a system specifically designed to support users through the availability of complete and accurate data, practitioner reminders and alerts, clinical decision support systems, links to bodies of medical knowledge, and other aids. A patient record system is the set of components that form the mechanism by which patient records are created, used, stored, and retrieved, and is usually located within a health care provider setting.[34] This definition from IOM is found most suitable for this thesis.

Functional descriptions by Weed and Shortliffe also are relevant to this thesis. According to Weed, EPR systems that are comprehensive should be oriented by problems and episodes where diagnostic and therapeutic plans should be linked to the medical problems.[35] As referred to by Shortliffe (*Medical Informatics*, page 333), they should include integrated views of patient data, clinical order entry and documentation, clinical process and decision support, and access to knowledge resources as well as integrated communication support. EPR systems should provide for practice organization and administration, patient care and statistical overviews, and research. They normally consist of a set of sections or functional modules such as basic, medical, pharmacy, scheduling, financial, communication, and possible research modules and should also have source and chronological views.[36]

In this thesis the concept electronic health records (EHR) is used when referring a few articles, and therefore should be defined. The Healthcare Information and Management Systems Society (HIMSS) define the EHR as a "longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting." It does more than store information: It "supports other care-related activities directly or indirectly, including evidence-based decision support, quality management and outcomes reporting.[37]

A personal health record (PHR) can be defined as "an electronic application that individuals can access, manage and share their health information, and that of others for whom they are authorized, in a private, secure and confidential environment".[38]

The development of Norwegian GP EPR systems

In Norway the development of computerized medical record started in the second half of the 1970s. At the University of Tromsø work was in progress on the Balsfjord system from 1976 and the systems was introduced in a medical practice in 1980. The requirement specification developed was given free of charge to other developers.[39] The development of the computerized medical record DOC110, claimed by some to be the first operative EPR in Scandinavia, followed in Bergen in the late seventies, and was later replaced by a system called PROMED.[40] At the same time, and partly in collaboration with the developer of PROMED, the EPR system Infodoc Dos was developed and introduced in medical practices.[41] It was later replaces by Infodoc Windows, and in 2007 a new system called Infodoc Plenario, was released. In the early 1980s a general practitioner developed another system called Profdoc Dos and this system was released in 1985.[42] In 1993 the EPR system WinMed was released, and in 1995 the first system with real windows functionality, Profdoc Vision, was released.

General practitioners designed all these pioneer systems inspired by the lack of overview and statistic possibilities in their paper records as well as by the upcoming new technology.[39] General practitioners themselves programmed Profdoc DOS and PROMED, and the other EPR systems were programmed in close cooperation with dedicated GPs and user groups, a process that may be labeled user-driven design.[42]

These early pioneers were possibly also inspired from European and US groups who developed EPR systems from the 1970s and a few of them are briefly referred to. The most famous of the US systems are Massachusetts general hospital Utility Multiprogramming System (MUMPS),[43] Technicon Medical Information System (TMIS) and HELP,[44] as well as the Regenstrief Medical Record System (RMRS).[45] A Problem-Oriented Medical Information system (PROMIS) was developed,[46, 47] as well as Computer Stored Ambulatory Record (COSTAR) [47, 48] that was followed by its Nordic variants SWEDESTAR,[49] NORSTAR and FINSTAR.[50] In Iceland the Egilsstadir Project started in 1975 with a problem oriented medical record system for primary health care,[51] and in a bit later it was described what kind of components a Danish EPR system should include.[52]

EPR systems in the Norwegian marked today

Three different EPR systems dominate the GP market in Norway today. The EPR systems are windows applications oriented by time and source only and don't provide research modules or integrated medical knowledge as decision support or medical procedures.[42] They support medical processes and can provide links to medical knowledge systems and are usually located within a health care provider setting. The systems are used in many specialist practices as well.

In the public health centers and in the company health services, modified GP-EPR systems are dominating the market, while the health service in schools is seldom supported by informatics. In nursing homes and home nursing care, three different systems are competing for contracts in a market yet to be developed in many communities. The systems in nursing homes mainly support nursing activity, but they are increasingly more supportive of the supervising physicians as well, who most often are GPs.

The hospital market for generalized EPRs has been divided between three vendors. One of them recently won large contracts at the expense of the other two, indicating a probable future one-vendor domination in the Norwegian market for hospital-wide EPR systems. Nursing systems are included in the hospital-wide EPR systems in Norway. Hospital EPR systems provide the same functions as the systems

used in primary care, but at the time of the hospital survey one of the systems did not provide a prescription module.[53] One of the systems has no patient administrative module, and is therefore integrated with such systems already installed in the hospitals. The hospital systems are oriented by time and source, but can to a certain degree represent problems from the diagnostic lists and episodes of hospitalization.[53] In large parts of the hospital sector in Norway, multiple clinical department systems still play an important role despite hospital-wide EPR systems introduced in most hospitals several years ago.[54] As of today, all hospitals in Norway have EPR systems.

Only a few hospitals, clinics and laboratories are private owned. Several specialist medical practices are private, as well as most of the GP medical offices with enlisted patients. Nearly all have some kind of public financial support or refunds.

The Norwegian EPR market early diminished into a few vendors. Many European countries still have a great number of vendors competing in the market. The few and sustainable vendors in the Norwegian market probably made it easier to implement common functionality and standards.

Evaluation of information systems in health care

Information and Communication Technology (ICT) is used in all parts of the health services, including administration, clinical departments, health communication, education, and teaching as well as research. ICT used in health services can influence the patient's life and health both directly and indirectly, and in this aspect the use of ICT in health care differs from many other areas in society. All systems have their own life cycle that starts with an idea or new possibilities, followed by an abstract information model. After this model is programmed, it will eventually be tested as an information system in clinical practice. The system then is implemented and used on a large scale. Figure 7 from Friedman and Wyatt on page 6 in their book *Evaluation Methods in Biomedical Medicine* demonstrates the field of evaluation in medical informatics related to evaluation methods, medicine and health care, and information systems.[55] Evaluation is important because errors and failures in the information systems can lead to unwanted consequences and health damage, just as can drugs and surgical procedures. According to Friedman and Wyatt, we also have promotional, scholarly, pragmatic, ethical, and

medico-legal reasons to evaluate information systems in health care. When demonstrating information systems to be effective and safe, evaluation promotes the systems among physicians, patients, educators, researchers, and health authorities. The scholarly reasons ensure continuous studies due to the establishment of medical informatics as a scientific field.[56] The pragmatic reasons ensure that developers can understand the results and effects of their systems, and allow others to learn from mistakes and successes. Ethical aspects of evaluation are related to the opportunity for health planners and others to understand and defend the choice of information systems as opposed to other innovations competing for the same budget.[57]

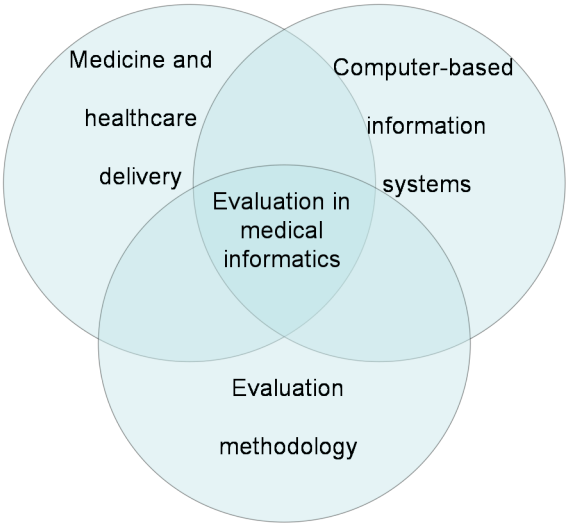

Figure 6. Evaluation in medical informatics

The medico-legal reasons reduce the risks of liability by giving the developers accurate information and users the opportunity to exercise their skills and judgment when using the systems.[58] There is a fine line of difference between evaluation and research, though the methods are the same. Evaluation is often related to assignments from authorities, leaders, organizations, and others, while research is most often driven by the goal of acquiring missing knowledge. The success of evaluation often is dependent on the problems to be answered being obvious and easy to understand.[59]

To evaluate health informatics, competence and methods from social science, medicine and informatics are used, often in parallel or in combination. Compared to medicine, informatics is a young and recently established science. Evaluation is important through every phase in the continuous development of IT systems, but requires different methods and qualifications.[26]

The four studies in this thesis deal with the evaluation of different parts of the life cycle.[59, 60] The first and the second study are evaluation studies in phase 5 when EPR are in use, while the third study is mainly related to ideas and requirements of phase 1 as well as phase 5. The fourth study suggests a method for engaging physicians to develop testable functional requirements related to phase 1, but also points to testing during programming in phase 3 and implementation in phase 4. Figure 7 summarizes the five phases of the life cycle and the different areas of evaluation. [59, 60]

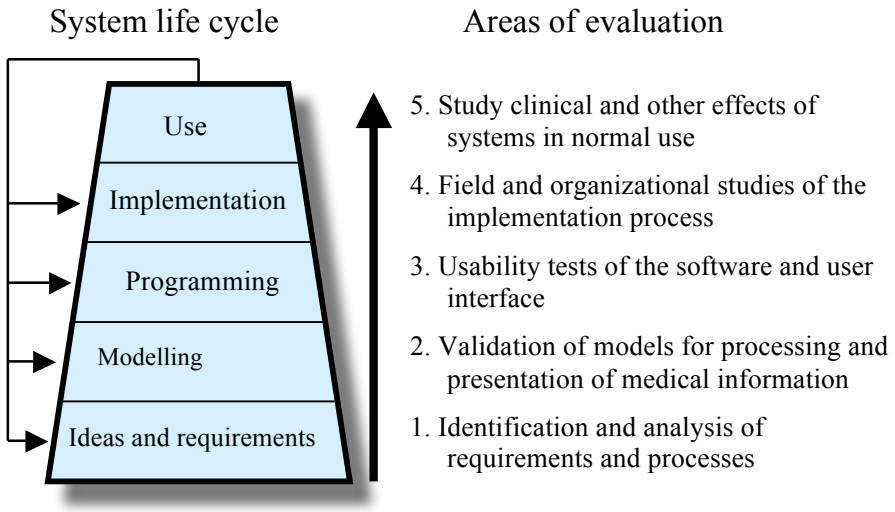

Figure 7 Phases in the development of new ICT-solutions

Quantitative methods like randomized controlled trials (RCT), before and after studies, and interrupted time series can measure the size of effects,[61] and questionnaires can rank evaluations.[56] Qualitative methods can illustrate what the effect means to those involved as well as wider outcomes.[62] Observations, individual or focus group interviews,

document analyses, and methods from action research are the most commonly used qualitative methods.[63, 64] The methods can be used at all phases in the life cycle, according to some authors.[65-67] Although quantitative methods are used for comparison in the second study of this thesis, qualitative methods are also used to compare health information systems.[68] Qualitative methods hold an important place among methods suitable for evaluating health information systems.[69]

The processes of the life cycle are iterative and include reprogramming and testing throughout the life cycle of the solutions. All phases are tightly connected and every new step depends on knowledge generated by previous phases. The model requires an interdisciplinary approach that can be challenging to carry out. A user-centered design with tests of user requirements in close collaboration with software vendors and researchers is another basic attribute of this model [70]

In many ICT projects in the health sector, users of the systems are best represented in the phases of ideas and analysis, and are often organized into user groups. The design process itself is iterative, including specification of the context of use, specification of requirements, and the development and evaluation of a design.[71] Involvement of health personnel in the idea phase as well as in the modeling and programming phases, ensures their contribution to the development of user requirements that can be tested in iterative processes.[72, 73] Complex contexts can easily be overseen or treated superficially both by medical staff and others, and medical requirements often are scarcely described. The identification of requirements and processes should preferably be organized and run like a research project using different methods, and many ICT projects fail for these reasons.[74] In the third study of this thesis ideas are suggested, and in the fourth study requirements are suggested and refined.

Phase 2, modeling, is dependent on functional requirements, processes, the possibilities of ICT, and the creativity required to suggest a dynamic reflection of reality.[75] Modeling as such has the qualities normally associated with research. Acting by intentions challenges the models and reduces their predictive value. When models are not satisfactory, they will be further developed in building new theories, and the effects of technology can be calculated.[76] In some cases this can be the only option, and effect

studies as RCTs cannot be performed. The expectations from paper 3 need to be converted to functional requirements before models and designs can be suggested.

Programming in phase 3 is a creative challenge, enabling computers to do what they have not done before. In this phase the requirements from paper 4 will be converted into testable solutions that can be used in clinical practice. Although innovation is not a science as such, it can include theory building and thus approach research. Software should be tested often in laboratories before pilot testing and clinical use.[77, 78] When systems are developed and tested, health personnel often are distant or not participating at all.[72] When system users are introduced to the programmed or implemented solutions too late for reprogramming or adjustments, intolerable extra costs and loss of time may be the result, and users may have to accept systems that are not sufficiently adjusted to their processes and medical needs.[79] Another consequence of insufficient requirements and user testing at an early stage is that systems and vendors can be rejected by users, in contrast to projects with careful and iterative testing throughout the development phase.[80] By following the development through iterations with subsequent updates of user requirements, the development of the systems can adapt to user needs.[81] Use cases often are local and often not developed by users and customers as national cases for all market vendors when relevant, but several international initiatives tries to establish common archetypes for EHR development.[82]

Study four also point to the implementation phase. Organizations need to adapt to new technology, and implementation in phase 4 must be done according to the best knowledge of the organizations and work environment. Although health personnel are commonly involved in the phase of piloting or implementation, the opportunity to do direct structured and systematic testing often are missing.[83] Barriers, adaptation, change of roles, patterns of interactions, and communications are interesting phenomena that can be studied if based upon theory and validated methods from process or formative evaluation.[84] Systems often have many unexpected failures in the implementation phase. Some are technical and some are functional. The sector could possibly profit from improvements in several aspects related to modern system development theory:[85, 86]

- The technical platform and architecture
- Collection of user experiences from earlier versions and systems

- User involvement and dynamic and testable user requirements
- User tests with fictive patient data in every iteration, and later on with real data
- Adjustments from few to many users during implementation and normal run
- Criteria and procedures for scientific evaluation

When systems are implemented and in use (phase 5), qualitative and quantitative methods can be used to collect data, and the first, the second and parts of the third study belong to this phase. When parts of the systems are finished, users will normally see new possibilities in cooperation with skilled programmers. When turning from few to several or many users, the systems often need to be adjusted. User groups may not have been representative of all user needs, and simultaneous use can stress the system and reveal unexpected failures. Reprogramming and new tests often must be done in the implementation phase as well as when in use.[72] In spite of improvements in recent years, too many failures and dysfunctions often survive into the next releases of the systems and defined methods could enhance EPR development, as well as to give advice on improvements.[59] The first and the second study of this thesis are related to phase 5.

Although effect studies are not included in these studies, it is important to emphasize that the evaluation of effects is possible when systems are implemented and in use. At this point RCTs can be performed. The method can be difficult to use in analyzing complex processes and organizations,[61] but have been successful to study reminders.[87] Endpoints that shall be measured are decided in advance through knowledge of possible outcomes. This is often difficult when studying health information systems, due to a wide spectrum of possible outcomes, which are often unknown.[61] EPR and electronic health communication deal with whole systems of IT solutions and changes affect all parts of the organization using the system. In such cases it will not be possible to randomize at the patient or user level, but at the levels of medical practices, nursing homes, and hospitals. When randomizing is difficult and changes are large and specific, before and after studies and interrupted time series often are preferred, although the risk of bias is increased.[59, 88] Through these methods it is possible to find effects in organizations using health information systems when compared with those not using them. Control groups often have the same confounders as the intervention groups.

Use of questionnaires in evaluation studies

Large amount of data from representative samples of a population can be collected by the use of self-administered questionnaires, and the conduction of the survey must be carefully planned.[89] The design of the questions is important, especially when the respondents are completing the questionnaires alone. Questions must be well formulated, reworded and tested in environments as similar to the intended responders as possible. Equal interpretation when reading the questions and completing the questionnaire is an important precondition when analyzing the results.[90] Low response rates may call into question if the results are representative, and eventual bias of non-responders must be excluded. [91] In studies achieving response rates lower than 70%, follow-up studies of the non-responders should be considered. [92] Development and use of the questionnaire in this thesis are described under the heading "Validation of the questionnaire" in the method chapter.

Selection of respondents in qualitative studies

It is not possible to generalize for whole populations in the same way as in quantitative studies, and the selection of respondents is crucial for the data material and the conclusions. A strategic selection of respondents account for a data material with the complexity needed to answer the research questions. It is important to consider a purposeful sampling according to problems, theoretical framework and pre-understandings in the group that is the subject of the study. [93] On the other hand, samples that are very homogenous sometimes can hinder diversity, variety of questions and new knowledge. Richness of the data can enhance the judgments of margins of error, as well as judgments of competitive results and conclusions. A strategic selection can strengthen the reliability of the results. [63] In qualitative research the data material from a strategic selection can represent knowledge relevant for other contexts than the study selection. In contrast to qualitative studies, data material from few units and selections can be of high transfer value if produced in accordance with high standards of research. [94] Transfer value is a way of addressing the external validity. Even though it is not possible to generalize results from qualitative research to the populations as a whole the way it is possible with results from studies with adequate quantitative design, the results can be of

great value in other contexts.[64] Selection of respondents to the studies of this thesis is described in the method chapter.

Aims

For more than four decades, EPR systems and other patient-centered information systems have been thought of as efficient remedies for a sector burdened with patient data archived on paper and corresponding labor-intensive, manual routines.[95] Since their inception in the 1960s, EPR systems have undergone continuous development and are increasingly being employed in hospitals and primary care facilities throughout the world.[36] Adoption of EPR systems may be profitable,[96] but in industrialized countries and regions their adoption show great variation, both in primary care and in hospital use.[97-99] Although several barriers against adoption have been described,[100, 101] several jurisdictions such as Denmark, The UK, Netherlands, Australia and NZ demonstrate high uptake of GP EPR systems,[97, 102] but not all of these are paperless.[103] The high uptake of EPR systems in primary care in several countries may seem like evidence of their value, but what constitutes the actual benefits and effects of the use of EPRs from the perspective of the GPs, patients, and healthcare processes has not been fully characterized.

Simultaneous access and better legibility compared to handwriting are obvious advantages. Other benefits are flexible visualization of patient data, automated collection of data from medtech devices, automated search, and the generation of reports in different formats, but estimation of benefits might be difficult.[104] Potential disadvantages can be numerous, such as cumbersome data entry, insufficient overview over the patient's data, non-intuitive interface layouts, and defects in software or hardware.[105] Regarding GPs' attitudes toward EPR systems compared with their paper-based ancestors, studies point at positive attitudes,[106] although one study showed that clinicians were far more positive about the quality of paper records than expected.[107] More should be known about the Norwegian GPs´ use of different EPR systems and how they evaluate this use compared to previous use of paper records.[42]

By being time efficient, the EPR system could possibly ease the burden of documentation and accounting, allowing the GP to spend more time in direct interaction

with the patient. Even though order entry can take longer time by computers than by paper, clerical errors are reduced, and use of computers may help to reduce total treatment time.[108, 109] Time studies on EPRs have failed to demonstrate any noticeable reduction in the time spent on clinician–patient encounters.[110, 111] Some studies have demonstrated an opposite effect; that is, that GPs spend more time.[109]

Patients may feel reassured by an impression of great technical and organizational support given by computers compared to paper folders.[112] On the other hand, the screen may act as a barrier between the clinician and patient,[113] and EPRs that do not present reliable or relevant data to clinicians when needed could detract from the relationship.[114] No Norwegian studies are found that describe the time spent on using the patient electronic records, and the potential effects on the clinician-patient relationships.

Having an EPR system gives no guarantee of comprehensive use, and reports from areas of relatively low adaption show variability in the functions available and in the extent to which physicians use them.[115] Clinical usability of configurable EPR systems have been studied in parts of hospital care,[116] and unraveling of the care process and the redistribution of tasks between professionals and the IT application can ensure better support of clinical tasks.[117] Quality and safety of health informatics systems are addressed in several studies,[58] and assessments of quality and efficiency of the systems as well as user satisfaction can be important contributions to the evaluation of the systems.[70, 106] At first glance, concerning hospital systems, it may seem like a paradox that some health care providers and organizations hesitate to implement a technology that many regard as sufficiently mature. However, establishing an EPR system entails large expenses and profound organizational changes must be made before return on investment is achieved. In some cases, employees have also failed to embrace the EPR system, impeding its adoption.[118, 119] Factors such as the size of the organization, its "change readiness," and properties of the EPR system and its implementation project are thought to influence the outcome of an EPR system implementation. Longer experience with EPR and less complexity in primary care may lead to expectations of variations in use and assessments of EPR systems among hospital physicians and GPs in some domains.[120] The ability of the Norwegian EPR systems to support important clinical tasks, the GPs opinions of the systems, and the effect of the EPR systems on the overall quality and

efficiency are understudied and should preferably be compared with results from studies of hospital physicians.[53]

Since implementation of the first EPR in Norwegian general practice in 1979, several systems have come to market.[41] The most recent EPR iteration in Norway emerged in the early 1990s [42]. Up until that time, the GP could expect new functionality with every upgrade. However, the basic structure and functionality of EPRs have changed relatively little in the last 10 years in the three EPR systems dominating the market at the time of the studies of this thesis. This could possibly indicate either the impending emergence of a new, more complete EPR system for GPs in Norway, or a lack of impetus for the further development of EPR systems. We know that almost all EPR systems in Norwegian general practices, in spite of their success, are time and source oriented and do not support medical decision making by being helpful in the sense of presenting medical procedures and guidelines. Some studies have suggested that decision support in patient records can be adjusted to the individual patient and improve clinical outcome.[121, 122] Although studies recommend that patient records should be oriented by problems and episodes,[35] few have actually evaluated such systems, and the potential for success is uncertain.[123, 124] Norwegian GPs expectations for the next generation of EPR systems have not been studied.

Few studies report representative user demands for further development of GP-EPR systems.[125, 126] Studies that describe functional requirements within the hospital sector often confine themselves to specific clinical domains of interest.[127-129] The distance between technology and the health disciplines is great, and can possibly explain some features of this scenario. The link between users and developers is based on a translation process wherein professional health information and knowledge must be operationalized and adapted to machine processing, and formulating the requirements of small and scattered health units can be difficult. In participatory design projects the work system (department with clinicians) and the IT system (providing IT functionality) must be considered when developing user requirements.[130] In this thesis the requirements to the EPR system is emphasized. Several authors have emphasized the call for user-centered design of EPRs,[131] and Hasman and Tang have described a method of combining research and prototyping to better understand and implement the user requirements of physicians

and nurses.[132] Prior to these suggestions, Rector emphasized a framework for modeling the EPR,[95] and Egyhazy suggested an object-oriented analysis and design.[133] Several surveys have been carried out to describe user needs and requirements,[128, 134] and some authors argue for methods suitable to meet the user needs of more rapid evolution of the systems.[135]

Electronic communication was identified as useful at an early stage.[136] The information needs of rural physicians have been described, but seldom fully realized on an electronic platform.[137] Although well adopted in some locations close to Norway,[138] electronic communication between rural physicians and other health personnel and patients is not yet fully implemented in all parts of Norway. Requirements for interoperability are dependent on a common architecture. Information architecture is dependent on standards and cannot be established by bilateral arrangements; resulting in standardization activities world wide.[139] Standards in health information systems reduce development costs, increase integration, and facilitate the collection of meaningful aggregate data for quality improvement and health policy development. [140] Even though it might be a tension between standards and flexibility,[141] standards are necessary to develop ICT solutions that support the patient trajectory, ensure that relevant and necessary health information is presented well, and follow the patient through different types of health care.[142] Leadership from stakeholders in health care is critical to achieving useful standards, which also requires the participation of governments, including legislative mandates.[143] National standards should adapt to national and local requirements, and the National Program of Standards should furthermore support user demands and laws and regulations, as well as satisfy international demands when necessary.[144] Even though EPR development in Norway has been user-driven, there have not been studies that engage GPs to express which national functional requirements they find relevant to achieve successful electronic collaboration in health care as well as to improve overall EPR functionality.

Research questions

The first study (Paper 1)

"Instant availability of patient records, but diminished availability of information: a multi-method study of GPs use of electronic patient records".

1. How do GPs describe their use of the EPR systems compared to previous use of paper records?
2. How much time do GPs spend on the EPR systems during consultations?
3. Does GPs' use of EPR systems disturb the patient-physician relationship?

The second study (Paper 2)

" Norwegian GPs' use of electronic patient record systems?"

4. How much do Norwegian GPs use their EPR systems while conducting clinical tasks, and how do they rate EPR systems' impact on the overall user satisfaction and success, as well as quality and efficiency of the work?
5. Does the reported ability to support clinical tasks; software and hardware failures, and user satisfactions differ between the various GP EPR systems?
6. Do GPs and hospital physicians report differences in support of clinical tasks, user satisfaction and impact of quality of work?

The third study (Paper 3)

"Expectations for the next generation of electronic patient records in primary care: a triangulated study"

7. What kind of improvements do Norwegians GPs want in the next generation of EPR systems?

The fourth study (Paper 4)

"Development of functional requirements for electronic health communication: preliminary results from the ELIN project"

8. How can GPs be engaged to draw up the functional EPR requirements they find necessary to achieve successful electronic collaboration in health care?

METHODS

In this thesis I have selected respondents for four different studies. In the first and the third study, triangulation of interviews, observations and questionnaires was used. The second study was a quantitative questionnaire study, and the last study was qualitative using document analyzes and methods from action research.

- In the first study use of EPR is compared to previous use of paper records, and the combination of quantitative and qualitative data was preferred to be able to generalize some of the results, as well as to explore possible new aspects concerning use of EPR systems.
- In the second study a validated questionnaire was used to evaluate GP use of ERP systems in a representative GP population. The results from the study were compared with the results from a similar hospital study.
- In the third study, triangulation of methods was used. Focus group interviews of users of EPR systems were conducted as well as observations followed by interviews to reveal and document ideas and requirements for the next generation of EPR systems. A validated questionnaire was used to rank actual use, as well as to judge suggested possible future functions of the EPR systems.
- The fourth study suggests a qualitative method for engaging physicians to develop testable functional requirements. According to the "ELIN-method" of this study, four different groups are used to find and document user requirements.

Selection of respondents

The studies in this thesis were conducted among users of the GP ERP systems Profdoc Vision, Profdoc WinMed, and Infodoc. The vast majority of Norwegian GPs use these three systems.

The selection of respondents to the questionnaire was randomly chosen to be representative for the population of Norwegian GPs as a whole, and the numbers high

enough to measure significance of the differences. Of all physicians in Norway, 97% are members of the Norwegian Medical Association. A database from the Norwegian Medical Association containing 4114 names and addresses of Norwegian GPs was paired with a list of 1988 practices using EPR systems obtained from the vendors. The GPs were grouped according to which of the three EPR systems they used, and a random sample of 408 participants, 136 from each EPR group, was selected according to calculations done by Lærum in his study. Data were collected between February and June 2003. Each participant was sent an information letter followed by the questionnaire one week later. The last questionnaires were collected 4 months later, after two written reminders followed by three reminders by telephone. The questionnaires were scanned using Teleform and the data analyzed with SPSS for Windows, Version 11.5.1.

In the qualitative studies it was important to find a strategic selection of respondents that could ensure collection of a material that was adequate in terms of relevance to answer the research questions and transfer value of the knowledge generated. [64]

Three focus groups were pragmatically selected among those participating in vocational and continuing GP specialist education programs in Mid Norway. The selected groups comprised 24 GPs, 5 of them female. The strategy of the selection was related to the fact that these groups are randomly put together after application from GPs participating in educational programs. The vocational group of consisted of GPs of younger age than in the continuing groups, and the groups were presumable big enough to ensure that sexes, different ages and all EPR systems were represented. Nevertheless, one of the systems was more poorly represented than the others in this part of Norway, and one of the group members represented a new system not accounted for in the questionnaire study.

The practices for observations were chosen according to a strategy to represent use of all EPR systems accounted for in the questionnaire study, different ages and sexes. Two of the observations were conducted in another region due to the poor representation of one of the systems in the mid region. Representation of sexes and different ages was part of the strategy of the observations. Experienced GPs represented a majority of the GPs studied, but computer skills and interest in IT solutions was not a selection criterion.

It was important to study as many GPs and consultations as necessary to discover a repeating pattern of use of EPR systems, and we don't think further observations would have added new knowledge. Two observers were used for internal validation and discussion.

All systems also were represented in the group of GPs that drew up the requirements in study four. The material in this study was collected through the creation of four groups: a panel of experts, a supplier group, a user group with practicing doctors, and an editorial committee. The panel of experts comprised 10 experienced GPs with long-term experience and interest in EPRs with respect to functionality and content. They had 10–20 years of experience as GPs and had taken part in user groups, conducted research, and been included in several types of IT–Health projects. Several GPs had also held key honorary offices.

A survey of suppliers' interest in study four was conducted by first searching for references to all appropriate suppliers in the Norwegian market by making enquiries to the authorities, universities, centers of expertise, and selected hospitals, as well as by asking the suppliers themselves. Only suppliers of software for electronic medical records were considered, since the project aims for standardized solutions from application to application. In this way a list of 24 appropriate suppliers in the area arrived. An information meeting was then held for these suppliers. They applied for participation after an invitation. The project management selected 10 of them according to given criteria, and these constituted the supplier group. A strategy was to provide each customer (GP or GP center) with one primary contact responsible for the EPR and communication systems, and the supplier of the EPR system was chosen to fill this role. This strategic selection from the whole group of suppliers included all major EPR systems dealing with communication, but excluded vendors or suppliers of pure communications modules. Another strategy was to include the suppliers of EPR systems communicating with GP systems. A third strategy was to only include suppliers being consolidated in the marked over several years. Suppliers to both public and private organizations were included.

Interest among practicing doctors in study four was investigated through a discussion and invitation on the home page of the Norwegian Medical Association, as

well as through an announcement in 'Eyr', a Norwegian mailing list for general practitioners. The project was also mentioned in the Journal of the Medical Association (Tidsskrift for Den norske lægeforening). The user group, subsequently termed the pilot practices, was selected by the project management after submission of applications and based on given criteria. A major strategy was to select pilot practices that represented all major systems, GPs of different ages and sexes, and localization in all Norwegian health regions.

To form the editorial committee in study four, the project manager included two doctors with special competence from the Norwegian Centre for Medical Informatics (KITH) and the Norwegian University of Science and Technology (NTNU), respectively. The project manager was a doctor specialized in general practice with several years of experience from collaborative health projects within the primary health service and across organizational levels. The strategy was to represent experience with use of systems, standardization and research in relevant fields to ensure a consistent documentation of requirements.

According to these strategic selections it was considered possible to collect data material of necessary width and depth in all qualitative studies to give relevant transfer value.

Validation of the questionnaire

To assess GP use of the EPR systems in the second study a questionnaire originally developed and validated by Lærum for evaluating physician use of computers within a hospital setting was used. Lærum validated the content of the questionnaire in an interview study (n = 10), and its reliability is investigated in a test-retest study (n = 37) and a scaling study (n = 31). The central part of the questionnaire builds upon information-related tasks essential to physician's work and interrogates on the respondents use of information systems while conducting 24 clinical tasks. According to content validity, Lærum found all of the 24 clinical tasks to be relevant except task eight, "Producing data reviews for specific patient groups," which was considered as administrative and time-consuming work. The accuracy of task interpretation was found to be high, but nine of the task questions were found difficult to answer by a minority of

the respondents. The compliance was high for all questions except in the column of use of other programs than EPR. Criterion validation was assessed in three ways, by correlating task-oriented EMR use to general EMR use, task performance to overall work performance, and task performance to user satisfaction; and was found to be satisfactory.[145]

The questionnaire was adjusted for primary care by removing the question concerning task 21, discharge reports that was irrelevant for GPs. This question was replaced by question 22, claim reimbursement, which was not accounted for in the hospital study. Hospital names and concepts as well as names of vendors were adjusted for primary care in cooperation with Lærum and another GP researcher. Observations studies in 2002 confirmed high use of the clinical tasks in question and minimal use of paper records, and were used for confirming content validation of primary care. The questionnaire was used in the second study of this thesis.

The questionnaire in the first and the third study of this thesis consisted of two sections and were developed through several iterations according to Morgan and Krueger.[146] The questions were developed in cooperation with general practitioners at four medical centers and with research colleagues, supported by the part of the observation study conducted in 2002. Different wordings were tested and discussed. Test-retest reliability of these two sections was examined in a pilot study of twenty randomly chosen GPs from nearby medical practices who filled in the questionnaire two times within 2 weeks, similar to the method described by Lærum.[145] The sections were then added to the questionnaire survey.

Interview guides and conduction of interviews and observations

The interview guide in the focus group study was developed using a method by Krueger described in Focus Group Kit 3, where questions were tested on GPs and research colleagues and subsequently revised and reworded.[146] According to permissions from the groups, regular meetings of each group were joined in 2002 and 2003. The interviews lasted approximately 3 h, and the interviews were recorded on a minidisk with subsequent transcription and later analysis in NUD*IST Vivo, version 1.1.127. Anders Grimsmo conducted the interviews. The questions from the interview guide were

explained and deepened when necessary, and new aspects and views were followed up during group discussions. When the answers given by the participants of the focus groups were quite consistent, it was decided that there was no need for further group interviews. A medical secretary familiar with medical terminology transcribed the interviews. Ambiguities were discussed and settled between the secretary and the author.

The observation study was conducted at various periods in 2002, 2003, and 2005. A total of 80 GP–patient encounters involving four female and seven male GPs were studied. The observed clinician obtained oral informed patient consents prior to each encounter. The author and a sociologist research assistant familiar with observations of health personnel conducted the observations. An observation guide that included a short interview of both patients and clinicians was used. The researcher, GPs from pilot practices, and the supervisor developed the guide and the questions. The guide was further developed through the observations due to new information revealed in the observations. Based upon this information time studies was added to the last observations. According to the themes of the study, actual use of EPR was noted with subsequent transcription.

Documentation analysis and methods from action research

The "Business-Oriented IT" (BIT) project model was chosen for implementation of the project.[126, 147] The model offers partial refunds of development costs of sector-specific IT solutions, and has been used successfully in other industries in a co-operative effort between users and suppliers of IT systems. This model had not been used in the Health sector earlier, and taken into account that it can be challenging to transfer such a method between sectors with success; we had to adjust the model. Care must be taken to make adjustments to the actual line of business. Normally the actual industry sector leads such projects, but there was no functioning organization for vendors of IT solutions in health in Norway for the time being. The small and independent medical practices had no common organization that took care of their interests in this matter, but 97% of the physicians were members of the Norwegian Medical Association. In his thesis, we therefore assumed that doctors in general- and specialist practices could represent a sector

and the Norwegian Medical Association (DNLF) the sector's professional organization. The project method was further adjusted to include testing of national standards and functional requirements, and some new types of agreements and binding contracts were developed as well. The method included a fully planned and financed project for developing, testing and implementing new or improved EPR functionality on a national basis.

The BIT program does not provide direct guidance about how an industry or sector should develop a user requirements specification. The panel of experts therefore had to establish a method for this purpose. Document analyses combined with methods from action research were used. The respondents were participants in this project which strategy was to include cooperation, context and values; this in contrast to experimental design where the research field is untouched.[148] The project was planned to produce results in terms of a method to engage GPs to find requirements for electronic health communication as well as to find and publish new knowledge. A number of actions such as identification of problems, summary of experiences, defining of goals, planning and development of requirements, and redefining of problems were conducted. At the same time research followed these actions by use of several methods. Literature and submitted documents were searched, and data were collected continuously through observations and minutes of meetings where notes were taken. A standard for electronic patient records was presented to the expert group. ICT standards in health care in Norway are developed by KITH according to the Standardization and Coordination Program, and is based on international standards.[149] The user requirements of the panel of experts were compared with messaging standards from KITH as well. The expert group was divided to deal with different themes in groups of two members, and then revised between the different strategically chosen groups of suppliers, pilot users and an editorial committee. Observer triangulation of this study is described in the chapter below.

The method of designing user requirements that ultimately was developed, tested and implemented in fully financed projects, was called the “ELIN-method”.

The researcher took part in the process as project manager and as a participant in the editorial committee.

Triangulation of methods

In the first and the third study three methods was used; interviews of GPs in focus groups, observations of the use of EPRs in GP medical practices followed by brief interviews, and a questionnaire consisting of two sections. Half of the questions were analyzed in the first study, and the second half of the questions were analyzed in the third study. Data material from focus groups and observations relevant to the research questions in each study were applied. The methods and respondents are described in more detail in the paper from the actual studies.

Triangulation methods were used to broaden the perspectives as well as to increase the precision of the results. Triangulation is seldom seen in health informatics, though highly recommended and said to be of equal importance to qualitative research as randomization is in quantitative research to make sound results.[64] Use of several methods made it possible to explore more questions on the same issues, and revealed new information not being found by one method alone. Contradictory and supportive findings were revealed, and unintended imbalance of the material could possibly be prevented. The material from the qualitative methods revealed knowledge about the content and character of the experiences and expectations of EPR use, while the questionnaire survey revealed knowledge of specific existing and future functions in the EPR systems representative for the population of GPs as a whole.

In the first and third study observer triangulation was also conducted. Two researchers from different research traditions collected and discussed the data material from the observation study, and the material from the focus groups was discussed with another researcher as well. Observer triangulation revealed knowledge and coherence that could have been missed by one researcher alone. Although triangulation of theories was not conducted, observer triangulation broadened the theoretic perspectives in the studies. Interviews and observations of GPs and patients contributed to some degree to triangulation of sources.

Triangulation was also used in the fourth study that combined document analyses and methods from action research. After meetings in plenary sessions, the doctors divided up into groups of two in this study. As their point of departure, the groups used the requirements from the national EPR standard that they found relevant to their part of the

work and developed the necessary additional requirements for the part for which they were responsible. A form of observer triangulation was used to evaluate the results, as the proposals for solutions were discussed in plenary sessions followed by new discussions, with resulting changes in the groups. The proposals were then swapped and evaluated between the groups. The editorial committee provided quality assurance for the requirements before the groups gave them final approval. These requirements were then validated by presenting them to the supplier group and the user group to investigate how willing they were to continue with these requirements in a principal project for developing and piloting new solutions.

Generalization from qualitative studies with relatively few respondents is challenging, although high transfer value is a goal of these studies. In the first and third studies comparison of qualitative against representative data from the questionnaire increase the possibility of generalization of the results to the GP population as a whole. The results from the fourth study were tried out and accepted in a user group of twenty medical practices to test the solutions and increase the transfer value of the study.

Summarized, triangulation contributed to broaden and widen the collected data material and to increase the transfer value.

Analysis of the collected data

The questionnaires were scanned using Teleform and the data were analyzed with SPSS for Windows, version 11.5. Non-responders were tested and did not seem to differ from the respondents. Results from use of different EPR systems were compared, and the overall results were compared to results from a similar hospital study.

The analysis of the qualitative material in the first and the third study was performed in four steps, after Giorgio and Malterud: establishment of a total impression of the material, identification of meaningful units, abstraction of these units, and finally establishment of the importance of the abstractions.[64] The author coded the transcripts after negotiations with co-authors and the sociologist researcher, with subsequent definition of the contents of the final categories. A perspective of GPs as being responsible for the medical care of enlisted patients supported the analysis.

Collected materials concerning informants' comparative notions of paper records and EPRs, time spent using EPRs during encounters, and effects on the clinician–patient relationship were identified and used for systematic text condensation in the first study. Results from the questionnaire relevant for the research questions were analyzed together with results from the qualitative studies.

Material concerning informants' notions of potential improvements to EPRs was identified, used for systematic text condensation, and analyzed in the third study together with relevant material from the questionnaire. Attention was drawn against helpful patient records that could be oriented by problems and episodes, electronic communication with the possibility of electronic consultations from specialists as well as integration with PHRs.

Document analysis and notes from group meetings collected the material in the fourth study, and the material was analyzed in several steps according to the actions in the project. An editorial committee revised the material several times according to the group meetings. Ambiguities were discussed and settled out between group members and finally in the committee. Final documentation of the relevance of the requirements cannot be studied until the implemented solutions have been used for a while.

SUMMARY OF RESULTS

All four papers represent work designed, performed, analyzed and interpreted by the author of this thesis. Professor Anders Grimsmo supervised the work. Paper 2 had contributions from Hallvard Lærum and Arild Faxvaag. The results from each study are published in the papers, but the main results are repeated here.

Different sections from a survey questionnaire were used in papers 1, 2, and 3. Of the 408 GPs invited, 70 were lost due to unknown address, leave of absence, or resignation. Of the 338 GPs who received an invitation, 247 (73%) completed the questionnaire; 18 of the respondents were excluded because they used an older version of the system, used other systems, or EPR system data were missing. Wherever the sample size in the results is other than 229, it is due to missing data.

GPs preferred EPR systems to paper records, and used their always-available EPR systems comprehensively and efficient. The availability of the information within large

patient records as well as the overview of information should be better. The time used to register and document during consultations was reported to be longer in the questionnaire (31% ≤ 3 min) than in the observations study (88% ≤ 3 min). In comparison the average consultation length was 18 minutes. Although reporting timesaving, they also reported administrative workloads previously done by secretaries. The use of EPR systems did not disturb clinician–patient relationships according to physicians and patients in this study.

The vast majority of the GPs reported extensive use of 19 of the 21 clinical tasks. Three of the 24 tasks in the questionnaire were not supported by the systems. The GPs strongly agreed that both the quality and efficiency of their work had improved after they started using EPR systems. The three most commonly used EPR systems in Norway support clinical tasks to the same degree, but one of the systems was reported to have more system errors and less user satisfaction and success compared to the other two systems. A comparison with another study of hospital physicians' use of hospital EPR systems revealed that GPs reported their EPR systems to support clinical tasks far better than what was reported from the hospital physicians. GPs also reported better overall user satisfaction and impact on the overall quality of the work.

The GPs reported that they in the future wanted the patient records to present medical knowledge and procedures related to the problems they were working on as well as relevant information for the patients. The medical knowledge should be easy to adapt to the individual patient. The traditional time and source orientation of the patient records should also be available, and they wanted the patient records to communicate fully electronically as well as to support an electronic dialogue function with specialists in secondary care. They also considered whether a personal health record should supplement the EPR.

A method was revealed that could engage GPs representing small and scattered units to express functional requirements for electronic communication. 69 requirements from the national EPR standard were selected after analysis by an expert panel, and a further 197 additional requirements were drawn up and presented in the same way as the requirements in the EPR standard that includes messaging standards. The majority of the requirements were summed up to cover requirements to ensure paperless communication, an electronic envelope for security reasons, helpful requisitions, and "The good referral"

and “The good discharge letter”. Support extended to the project from user groups and industry indicates that the method is valid and that it has created a forum where users and software suppliers work in closer and more binding cooperation.

GENERAL DISCUSSION

Discussion of methods

The second study was a questionnaire survey to find data from a randomized selection of GPs to describe overall use of EPR systems, user satisfaction and reported impact on the quality of the work. Results from use of different EPR systems were compared, and the overall data were compared to results from a hospital study as well. In the second and third study data material was collected from interviews and observations, and from other sections of the questionnaire survey in the second study. The data material in the fourth study was collected by document analysis and methods from action research that included the collection of material from group discussions.

Validity of the questionnaire survey

The internal validity of any demonstration study can be threatened by confounders, misclassification bias and selection bias,[55] and this chapter deals with the validity of the questionnaire study.

Confounding is sometimes referred to as the third major class of bias. It is a function of the complex interrelationships between various exposures and outcome. The strategy in this descriptive cross-sectional study was to prevent confounding by randomization, although nice p-values alone cannot protect against confounders.[150] There is a possibility that GPs of self-owned practices could defend their choice of EPR systems by evaluating them higher than GPs in community practices and hospital employed physicians. Assuming that the GPs’ EPR systems are equally distributed among community and self-owned practices, such possible confounders would not influence the comparison between GP systems. If such a confounder exists, it could possibly contribute to the differences between the evaluation between GP and hospital systems.

The questionnaire was previously validated through a measurement study among hospital physicians. Different scaling could represent a possible misclassification bias of this study.[55] Observation studies in primary care have demonstrated that GPs use all clinical tasks in question, except medical knowledge, medical procedures, and patient information which was retrieved from the Norwegian Electronic Medical Handbook in several practices.[151] Responses on these three tasks in the questionnaire were explained by the use of systems other than the EPR system. Hospital physicians and GPs have the same basic education, and hospital work is part of the GP specialist training. All hospital physicians have worked in primary care during internships, and many of them have previous careers as GPs. Results from interviews and pilot studies indicate that they interpret the measurement scales similar to hospital physicians. According to these considerations specific measurement studies in a GP population were not performed, and differences in scaling between the groups are not held to be a possible bias of any significance.

Excluding the pilot studies, the main questionnaire survey reached 238 respondents who answered a total of 17,850 questions. Assessment bias could threaten the results, and in an open study like this it is impossible to blind the respondents. We cannot rule out that those respondents who do not like EPR systems would evaluate them poorly out of these reasons alone. The high adoption of EPR systems among GPs make such an assumption unlikely, and the validation studies of the hospital physicians deal with this theme.[145] Checks against logs in the EPRs could be useful to find out if respondents actually do what they say they do,[59] but free text notes and actions of the user when not directly interacting with the computer would have been difficult to assess in logs. There is a question of potential impossible responses as well, but with the GPs in this study there was not found any responses that were not supported by the systems. End point studies of improvement of quality was beyond the purpose of this study, but could have strengthened the results from the questionnaire.[152] A broader approach could possibly have added more interesting results.[153, 154]

By randomizing from lists of GPs from the Medical Association and lists from the vendors, selection bias was avoided in the randomizing process. In cases of many non-responders, potential selection bias of non-responders could possibly influence the

results. In this study the response rate was 73%, and analysis of non-responders did not reveal any selection bias according to the distribution of the systems. Dropouts caused by incorrect or incomplete address lists should not cause any bias. The distribution of the three systems was practically similar in responder and non-responder groups, although there were slightly fewer users of Infodoc in the responder group. Data on age and sex showed no influence on the results. Altogether non-responders were not likely to cause bias. Only a follow-up study could truly reveal if for instance dissatisfied responders could be overrepresented in the non-responder group.[92] Such a study was not performed due to the high rate of responders.

Bias in data collection can affect results. Friedman and Wyatt have described the checklist effect where the measured effect of EPR systems could be related to the structure in the systems (page 212).[55] The Norwegian EPR systems are designed to resemble the structure of paper records according to the different modules as well as use of free text notes and copies of paper forms. This potential bias is therefore not likely to threaten the results of the first study of this thesis, which compares use of EPR systems to previous use of paper records.

It can be questioned if the questionnaire covers relevant tasks and issues. The original validation of the questionnaire was done in four separate studies that are described in a paper by Lærum.[145] When adapting the tasks to primary care, task 16, "Order treatment directly", could perhaps have been worded otherwise. Although hospital physicians probably could find this task misunderstood or poorly discriminated from task 17, "Write prescriptions," observations in primary care indicated that there was no overlap in interpretation. By accident, the task "electronic health communication" was not included. This task was indeed relevant, but was not included in the hospital study either. Planning is not supported by GP-EPRs and was excluded for this reason. The questionnaire was analyzed after the collection of data from interviews and observations. This was done to better understand why the GPs preferred using EPR to complete different tasks. The "why" answers were described in papers 1 and 3 concerning the two new sections. The results from interviews and observations also answered the "why" in paper 2, and this paper should preferably have been supplemented by results from the interviews.

Preparing questions according to the method from Morgan probably strengthened the reliability of the last two sections in the questionnaire.[146] Different wording was tried out by the GPs in the four pilot practices, and the understanding of the questions was consistent. In the test–retest pilot study among 20 GPs; only minor changes in two of the questions were necessary, indicating that the reliability was good. Looking back, these sections should have been supplied by more questions covering the themes in the observation study and in the interviews.

Validity and transferability of the qualitative material

Qualitative methods were used in three of the studies of this thesis because many of the original research questions could not be answered by quantitative methods alone. Another reason was to make it possible to discover effects not thought of ahead or undetectable in a questionnaire. Some of the research questions were also open ended.[155]Although qualitative methods are recommended for the evaluation of health informatics[63, 156, 157] and do not depend on the same comprehensive demands on theoretical frameworks as in the social sciences,[158] the study methods must be relevant and lead to valid answers to the research questions.[64, 159]

Validation in this study was a continuous process of examining the research questions, respondents and collected data material as well as the knowledge and background of the researcher.[160] It was relevant to question what kind of knowledge the respondents were sharing, as well as their previous beliefs. The respondents were continually asked to confirm the researchers' interpretation of their information. In the analyzing process alternative interpretations were considered as well as if the results were relevant answers to the research questions. The fact that the author's background was similar to that of the respondents could possibly lead to blind spots, but it also had the advantage of providing the access to existing educational groups and GP practices necessary for collecting the data. The background of the author and themes of the qualitative studies of this thesis were communicated to all respondents, and bias that could be caused by the researchers was taken into account. Common professional culture and terminology eased the communication. Technical approaches are sometimes introduced in medicine without thorough documentation or evaluation of the benefits or

possible limitations. An *a priori* understanding of the EPR as a positive innovation could possibly lead to an underestimation of the critical aspects of the results. The researcher's previous belief and experience of EPRs as challenging, but overall positive, was part of this self-reflection.

Selection of respondents in the focus groups was strategic to get information in depth to explore the research questions.[161] Miles and Huberman describe different typologies of sampling strategies from Kuzel and Patton (p 28).[162] The selection was done to create quite homogenous groups to meet some criteria. General criteria were to select GPs that were experienced in use of the major EPR systems and that represented both rural and urban practices. Criteria for choosing members of the expert groups were that they should have detailed knowledge of both EPR systems and medicine. Selection of focus groups among vocational and continuing GP specialist education programs in Mid Norway ensured a mixture of age and sex. One could have suspected that the low percentage of female GPs among the informants could have influenced the results, but later results from the questionnaire study did not relate to gender or age. One of the EPR systems was poorly distributed in this region and the evaluation of this system was therefore supplemented by observations in another region. The selection of users of the three EPR systems did not end up with equal numbers of respondents from each system. Instead, GPs of various ages were included to ensure users with a variation of computer experiences and the choice of one vocational group with members of younger age ensured such a variation. Participants of educational groups could be expected to be more dedicated to health issues compared to other GPs. But since the majority of GPs in Norway take postgraduate education to become specialists[163] , the risk of such possible bias is considered to be low. Most of the informants were familiar with paper records from the 1970s and 1980s, and an alternative design with control groups of clinicians using only paper records was no longer possible in Norway.

The user group from pilot practices in study four was chosen to represent all major EPR systems, and was from different geographic locations. This was done to represent potentially different experiences from different regions and systems, as well as to ease later implementation of the solutions on a national basis. The supplier group consisted of programmers and leaders that represented all major EPR systems to ensure

relevant feedback on the requirements. The editorial committee represented broad experience from medical practice, research and standardization to ensure precise interpretation and formulation of requirements.

Overall, the strategy of the selection of GPs for the focus groups and observations as well of the groups in study four was to achieve necessary depth and width of the collected material. It is not likely that another selection would have yielded more information.

When interviewing the focus groups, the questions were often repeated, and the respondents were asked to confirm that their statements were interpreted correctly. The use of already established groups made the respondents feel safe and willing to share their thoughts. The interview guide was supplemented with follow-up questions to fill out different themes when necessary. Follow-up member checking at different points after the interviews were not performed. Consistent answers at different points could have strengthened the results.[164]

It is likely that respondents try to perform as well as possible when observed by a colleague. It could be argued that use of EPR systems could be different during observations than in situations not observed, considering the "Hawthorne effect", when the mere act of studying human performance could change it.[165] But the respondents seemed relaxed and comfortable in the situations of observations. They seemed to easily forget being observed and gave the patient full attention. In the short interviews following the observations, there were no indications that respondents had used their EPR systems differently during observations.

Qualitative data based upon a strategic selection of informants cannot give answers to incidents, distribution and correlations as in quantitative materials.[166] In this context the observations of time use can be considered to be a form of quasi-statistical analysis. The number of observations is low, and the results are visualized to indicate that further time studies must be added to conclude on this matter.

The researchers' perspective of GPs being responsible for the medical care of enlisted patients supported the analysis, and indicates that EPR systems should support the GPs' medical care. The process of condensing and analyzing the transcriptions of interviews and observational data revealed interesting and sometimes surprising findings

we had not thought of when designing the questionnaire. [64] Focus group interviews seemed to be better suited for uncovering relevant new issues related to experiences with EPRs. Observations seemed to be preferable when uncovering real-time use of EPRs during encounters, actual use of different functional modules, use of search functions, reuse of information, use of mouse versus keyboard, use of the patient as an information source, use of supplementary sources of information, and eventual visible effects on the clinician–patient relationship. According to the studies of this thesis, the clinician–patient relationship is best explored through interviews combined with observations. Data from questionnaires to validate qualitative data has been supported in the other studies.[145] Moreover, the use of triangulation of quantitative and qualitative methods to strengthen validity, confirmability, and transferability of study results is well supported in litterature.[167, 168]

Observer triangulation was carried out to ensure that important or contradictory quotes related to the research questions were not left out. Camera monitoring of GPs and their mouse and keyboard usage would probably yield more objective observations that could be validated by several researchers, and perhaps more precise time estimates of patient record use.[153] Doing observations gave us additional information and more exact time estimates of time spent reading the patient record and were therefore preferred. The time aspect was discovered late in the observations, a finding that illustrates how observations can be useful in identifying unexpected findings. One of the validation strategies was for group interviews to require reflection upon opinions, with subsequent internal informant validation. Further validation strategies like negotiations and discussions between the author, co-author, and research assistants were implemented to avoid errors in the transcription from oral to written information and to inter-validate the findings in both focus groups and observations.

Involving people with in-depth theoretical and practical expertise in the area provided a sound professional foundation and was effective, but one must be cautious about generalizing the results before they have been tested with a representative sample.[59, 169, 170] The cross-evaluation between different parts of the expert group, the plenary assessment, and new approval in the panel of experts may not have provided optimal observer triangulation. The participants in the groups had fairly similar

backgrounds. Implementation of the project model was demanding, but in our opinion it increased precision and relevance. I also found that not all the requirements were completely unambiguous and suitable for subsequent programming and testing, although several of the experts had previously worked in close cooperation with programmers. The updating of the requirements throughout the iterations during development and piloting of the solutions could possibly increase quality and ease the implementation process. According to Edwards and Bushko other kinds of end-user development such as business modeling tools could be useful to increase the chance of producing successful solutions in the case of decision support for laboratory systems,[171] but user groups alone can be insufficient. Other research methods such as observations, interviews and modeling can reduce the conception-reality gap by exploring fields such as information, technology, processes, objectives and values, staffing and skills, as well as other resources.[74]

Transfer value and generalization

Although some of these aspects are previously discussed, a few new points will be emphasized. The selection of respondents in the questionnaire study is held to be representative of the Norwegian GP population as a whole, and the task-centered questionnaire have been validated in separate studies and during the observations in the first study of this thesis,[172] as well as used and accepted in other studies. [145, 173, 174] The significance level (α) in quantitative surveys is often 0.05, but what are relevant differences for the support of clinical and administrative work could be discussed. No previous studies were performed to determine the minimum "worthwhile differences", described by Friedman and Wyatt as just enough to lead to a change in practice.[55] According to our knowledge, very few GPs have replaced the system with the lowest score with other systems, but the system has failed to take a bigger share of the market. This possibly indicates that this difference is worthwhile and that the tolerance of systems with errors is low regardless of excellent support of clinical and administrative tasks.

Although I hold the results collected by the questionnaire to be valid for the GP population in Norway as a whole, it can be challenging to generalize over differences in use of EPR systems in different settings such as hospitals and general practice, and some aspects have been discussed in the second study.[175]The situation in hospitals is more

complex, and differences between primary care versus the hospital sector can be of importance to identify when experiences and results are considered used across these sectors.[176] Several considerations have to be made, and potential differences between public and private sector are among these.[74] Even though GPs mostly are self-employed, they are closely linked to agreements of public cost refunds, and clinical and administrative tasks have many similarities. Parallel use of paper records in hospitals may prolong the process of limited use of EPR systems.[174] In spite of these challenges, the method revealed differences of a size that defends generalization between primary care and the hospital sector over the issues in these studies. External validity with predictive and correlative values can be obtained when tasks are limited and use is defined by yes or no, such as in order-entry evaluation,[177, 178] but this was not the case in the studies of this thesis, and such values could not easily be predicted. The questions were confirmed to be relevant and expected elsewhere by the validation studies in hospital and primary care settings. None of the investigators had developed systems themselves, and this possible bias thereby was eliminated. The evaluation paradox of users being reluctant to use newly developed functionality until proven valuable[179] was not relevant in the second study of this thesis. The comparison hospital study demonstrated that the EPR systems were not always used as intended,[180] but all respondents were included in the study to prevent overestimation of the results.

In the first and the third triangulated studies, exploring observations studies and interviews ahead of the development of the questionnaire could have been done and thereby opened for complementary questions in the two sections. These two sections were originally planned to focus on knowledge associated with overview and problem orienting of EPRs. Looking back, time studies were not properly planned for in the questionnaire, and issues of clinician-patient relationships could have been explored as well. The discovery of new knowledge as you go when dealing with qualitative methods, challenges the development of questionnaires that must have a deadline. The use of closed questions and scaling was planned to validate some of the findings in interviews and observations against a selection of responders that were representative in a quantitative context. The careful planning, questioning and width and depth of the material held together with results from the questionnaire study increase the transfer

value of the results in these two studies. [181] The information collected by several methods was both supportive and contrasting, and contrasting information can be valuable and lead to further reflections.

In the fourth study of this thesis only qualitative methods were used, and a sort of triangulation was performed to increase the transfer value of the results.[182] Relevant documents from national EPR and messaging standards were analyzed to broaden the material and explore requirements for exchange of electronic patient information valuable and relevant for all GPs in Norway. A member from the standardization organization participated in the analysis to explain the documents and clear out ambiguities. The use of several user groups to validate the requirements was important to ensure a rich material that was valid among experts, programmers and pilot users, as well as to give relevant feedback to the organization responsible for EPR systems and messaging standards. Other studies support the approach of developing functional requirements through iterations that follow the life cycle of IT systems.[67] Results from later piloting of the solutions developed from these dynamic requirements will reveal the transfer value of the requirements in clinical practice. Overall, I hold the results collected by qualitative methods to be of high transfer value for GPs in Norway,

Although we claim the results from the second study to be representative for the Norwegian GP population and the qualitative results to be of high transfer value, generalization between countries is more challenging.[74] Clinical applications vary widely by country, and there is no single overwhelming benefit to prompt physicians to use computers for clinical care, this according to a Canadian study of use of EPR systems among GPs in 10 countries with a high rate of IT adoption: England, Scotland, Denmark, Sweden, Norway, the Netherlands, Austria, Germany, New Zealand and Australia.[183] However, the automation of medication prescriptions is the clinical application that provides one of the biggest benefits to general practitioners as it addresses legibility concerns, can be a significant time saver (particularly for repeat prescriptions) and offers the potential to make use of decision-support capabilities. The transmission of laboratory results is the most common electronic clinical communication application according to this study. Most of the results from all four studies can be of value to other countries of high adoption and quite similar situations for GPs,[97, 184] but can also be valuable for

countries of low adoption, such as the USA, if they implement strategies proved successful to adopt such systems.[183, 185]

Relating the findings to previous work

Use compared to paper patient records. Impacts on clinician-patient relationship

We found GPs in Norway to prefer EPR systems to paper records. Patient records had become easily available, but the availability of the information within each patient record was not satisfactory in large patient records. The time used to register and document was shorter in the observation study (88% $\leq$ 3min) compared to the questionnaire study (31% $\leq$ 3min). Use of EPR systems did not disturb the clinician–patient relationship in this selection.

The ability of EPRs to support administrative tasks and show benefits in patient registration and the production of practice profiles has been documented for as long as two decades.[186] A study in mental health centers show that EPRs have the potential to improve medication management for patients over traditional records.[187] The rapid implementation and complete use of EPRs in parts of western Europe and Australia is in itself a documentation of EPRs outperforming paper records,[106] although an Australian study from 2006 found that in spite of high adoption, GPs still are a bit reluctant to fully embrace the technology.[103] Not surprisingly, non-users of EMR from an area of low EPR adoption in USA still question their advantages.[188] We also found that GPs encouraged patients to read record notes during consultations, and a study from Israel shows that collaborative reading of the EMR can contribute to improved quality of care, enhance the decision-making process, and empower patients to participate in their own care.[189] Another study from USA indicated that the development of patient portals to view EPRs would likely result in improved EPR documentation, patient knowledge, and quality of care, provided that such tools support an efficient process for clinician review and incorporation of data into the EPR.[190]

The time spent on EPRs in the observation study was only half that found in the questionnaire survey, but the number of observations were few. According to a study of

primary care practices in UK, quality consultations may seem to last longer than they actually do.[191] Short computer interaction time could possibly indicate that more time is devoted to the patient, although an Israeli study of a primary care system from the mid-nineties have indicated that the physicians' work style changed from a 'conversational pattern' (continuous data recording) to a 'blocked pattern' (data entry at intervals).[192]. Another study in the mid-nineties from the USA has shown an initial increase in consultation length of between 1 and 2 min when EPRs are introduced to replace paper records in primary care, though this declines again after various time periods.[193] In the first study of this thesis, I did not compare EPR-associated consultation lengths with those involving paper records, but the mean consultation length of 18 min in the study was close to the length of 20 min found in previous studies in Norway.[194, 195] By comparison, the overall mean value in six other European countries is 10.7 min.[196] Even though previous studies showed that longer consultations might be associated with greater patient satisfaction and increased health education/prevention measures,[197] more recent review studies cannot confirm these results.[198]

Two American studies from late nine-tees, one of them randomized, support our finding that the clinician–patient relationship is not disturbed by computers.[199, 200] Another recent American study among patients visiting internists in a VA primary care clinic concluded that patients seen by residents more often agreed that examination room computers decreased the amount of interpersonal contact.[201] A longitudinal, qualitative study using videotapes of regularly scheduled visits in primary care from 3 points in time, 1 month before, 1 month after, and 7 months after introduction of computers into the examination room, showed that effects on clinician-patient communication may be dependent upon clinicians' baseline skills that are carried forward and are amplified, positively or negatively.[202] A British study showed that clinicians could use specific communication skills to manage the consultation, so that they are not called on to concentrate on the computer screen and the patient at the same time.[114] One of the studies of this thesis pointed out a shift in administrative workload from secretaries to physicians, and studies that support or argue against it have been difficult to find. A case study from a medical practice in London shows total cost savings on administrative and clerical tasks, indicating a possible shift in administrative workloads.[203]

Support of clinical tasks, user satisfaction and comparison with hospital systems

The GPs in the second study of this thesis reported to get assistance from their EPR systems while conducting 21 of 24 clinical tasks, and the remaining three tasks were not supported by the system. 19 of the 21 tasks were used extensively. They rated the overall satisfaction and the success of the systems to be good or excellent and they were significantly more satisfied with the electronic patient records than were their hospital colleagues. I have not found similar studies that compare use of EPR in general practice and hospitals.

A Dutch study claim that the redistribution of tasks between professionals and the IT application as well as adapting the IT application's demands to the needs of their work practices are crucial for support of the clinical work from EPR systems.[117] The finding that EPRs support clinical tasks and workflow with satisfied users in primary care was supported by studies from eight different European countries, Australia and New Zealand that also looked upon other factors of successful adoption.[183, 184] An American study from a region of relatively low adoption showed considerable variability of use and satisfaction for different systems and locations,[115] while two more recent American studies, one local concerning both a hospital and a primary care clinic and the other national, concludes that users of EPR are satisfied and find that the quality of work has increased.[106, 204]

Few studies have investigated effects on quality of care of EPR systems without decision support,[187] and positive effects can be questioned.[152] A review of 26 international articles between 2000 and 2003 found increased satisfaction among users in hospital and primary care and their patients, but the impact on medical practice and quality of care was not well demonstrated.[152] Overall, there is international support for users being satisfied with the use of EPR systems in primary care. A implementation study from Veterans Health Administrations (VHA) that compare the evaluation by GPs and hospital physicians concludes that IT clinical support was higher in urban hospitals ($p<0.05$) and those with cooperative cultures ($p<0.01$),[205] and a later Norwegian study have suggested that hospital physicians are more satisfied compared to the findings in the original comparative study.[145] A recent Danish study has documented positive effects of EPRs on three hospital clinical tasks.[206]

Decision support, electronic health communication and personal health records

Although overall satisfied with the EPR systems, the GPs wanted improvements in several areas, according to the results from the third study. They missed decision support that could be adjusted to the individual patient. They wanted all communication to become electronic and to be able to consult specialists electronically. They also considered whether the EPRs should be integrated with personal health records.

The findings are supported by a British study, suggesting that designers of decision support systems for use in primary care consultations must account for the practical needs of users when developing computerized support systems, and that the systems must be acceptable to the format of a consultation.[207] Medical decision-making requires combinatorial analysis to comprehend patients' uniqueness and avoid harmful and unnecessary trial and error. It is important to identify all individually relevant options and the pros and cons of each for the patient.[208] A British study support that designers of decision support systems for use in primary care consultations must account for the practical needs of users when developing computerized support systems.[207] Another review showed that systems developed by the authors were more successful than others, giving support to user-centered design based upon user recuirements.[209] On the other hand, a prospective study claim that medical decision support systems and other interventions designed to reduce medical errors cannot rely exclusively on clinicians' perceptions of their needs for such support.[210] The GPs in the third study of this thesis wanted reminders “at the fingertips”. Helpfulness in the forms of reminders can often be ignored when not congruent with workflow, and a systematic review of trials to identify features critical to success has shown that medical knowledge in EPRs can improve medical care only if presented at the time of decisions as recommendations rather than assessments.[211] GPs of this study also wanted support of prescriptions, and computer-based support of dosing and prescribing has also been proven to improve physician performance throughout; for example, increased prescription of generic drugs, reduced costs, and improved insulin dosing for outpatients.[212-214]

The respondents of this study reported that they wanted the patient records to sort out information by problems to increase the overview, and decreased availability of

information in large patient records not structured by problems has also been demonstrated to influence data collection in a study from primary care in Belgium. [215] Even though positive effects of sorting the information in the patient records by problems was documented in shared care as early as in the mid nine-tees in a region in Sweden,[49] a British study from the same time period indicated that problem-based patient records still have limitations.[123] EPRs oriented by problems and episodes have also been questioned in another study from Hong Kong.[216] A recent study from Belgium indicates that a problem-oriented conceptual model can be successfully implemented in many operational EPR systems at the international level.[217] Another Belgian study showed that some functions related to the problem-oriented patient record were spontaneously used by GPs in daily practice, and that this use increased during collaboration with the primary care research network.[218] Studies have demonstrated success in hospitals as well,[219] but other studies demonstrated failures unless the patients had few and simple problems and were hospitalized for a short time.[220]

Electronic interchange of health information is preferable, but challenging to achieve, according to an Austrian study of discharge letters.[221] In a recent American study in primary care, electronic messaging was an important component of improved care delivery according to 80% of the respondents.[106] Although a study from Geneva University Hospital as well as a study from Crete recommend interchange based upon XML standards as in Norway,[222, 223] studies from USA and Greece emphasize the additional need of a common service oriented architecture.[224, 225] According to an American study regional health information organizations and electronic health information exchange may have an important impact on the practice of emergency medicine,[226] and a Swedish study indicated benefits of shared printouts of emergency information at the respective care level for patients that frequently visited emergency care departments, although no decrease in overall healthcare utilization was yielded.[227] A Canadian randomized study showed that an electronic link between emergency and family physicians did not result in a significant reduction in resource utilization at either service point.[228] On the other hand another controlled clinical trial showed that the use of standardized communication systems between an emergency department and family physicians led to significant improvements in continuity of care by increasing the

usefulness of transferred information and by improving family physicians' perceived patient knowledge and patient management.[229]

The use of electronic dialogue functions has not been well described, and replacing the oral and immediate routines with electronic dialogue functions that can seldom be synchronous may be a challenge. Studies from Iowa and Boston support the notion that curbside consultations from specialists by e-mail can be efficient and improve communication and collaboration with acceptable response times, although security issues can be troublesome.[230, 231] A British study concludes that e-mail consultations can bridge the gap between research and practice and that they are mostly used when a rapid response is needed.[232] I have not found studies that include electronic dialogue functions integrated into the work process of EPRs.

This thesis demonstrates that GPs want to establish electronic dialogue functions with their patients as well and consider the possibility of using PHRs in this respect. This view as partially supported by an American study that summarize a college symposium discussion on PHR by describing PHR potentials like combination of data, knowledge, and software tools which help patients to become active participants in their own care.[233] A British study describes key challenges that include balancing security against utility and integrating diverse data sources.[234]

Functional requirements for electronic health communication

In the fourth study a method for the development of functional requirements was tried out. The participant GPs selected 67 requirements from the exciting EPR standard and formulated 197 new functional requirements to achieve successful electronic collaboration in health care.

IOM have defined five criteria for defining functional requirements for EPRs. These are improvement of patient safety, effectiveness of care, facilitation of the management of chronic conditions, improved efficiency, and feasible implementation. One of the core functionalities is communication and connectivity to provide secure and readily accessible communication among clinicians and patients,[235] and an American study identifies the design challenges in EHRs and explores the possibilities of a service-oriented architecture to ensure interoperability for intra-enterprise EHRs with regional databases.[224] All requirements to EPRs must support the workflow, and there is

considerable activity in the field in many countries, exemplified by the EuroRec and ProRec initiatives that establish different kinds of user requirements that can be adapted and adjusted to national conditions.[236] If analysis is confined to the primary issues of concern to GPs, an early Dutch study support the conclusions of our panel of experts that electronic communication between primary and secondary care providers is exchanged on a need to know basis under the responsibility of the care provider that generated the information.[237] According to a Dutch case study, user-friendliness is of greater concern for end-users in hospitals and general practice than for hospital and community administration and management staff. Balance between the bottom-up participatory design of end users and the more top-down approach from administration staff is suggested.[238] An early Dutch study supports the finding that it is vital that use of the systems provides immediate gains for those who use them, and that the systems provide great flexibility, adaptability, and communication with other systems to achieve optimal workflow.[239] It is support for the iterative approach from another study from the same author that emphasizes an iterative approach, in which the distinctions between 'analysis', 'design', 'implementation' and 'evaluation' blur. This study also underline that a sociotechnical approach sheds new light on the potential roles of IT applications in health care practices.[86] A hospital case study of a system in anesthesiology has shown that the system proved efficient and promising for enhancing users' involvement in the project, and for initiating the necessary re-engineering of the Human Computer Interface. [70]

This thesis has revealed that even systems that are judged as successes may have potential for further development when using different scientific methods to uncover user requirements and needs.[154, 240] Publications about the development of requirements specifications for EPRs in general show that many procedures have been used,[128, 241] and modern methods of agile and extreme programming indicate the possibility of rapid adjustment to user needs.[135, 242] Broad approaches using different scientific methods are often necessary to achieve success.[243, 244]

Future EPR systems

According to the respondents of this thesis, future EPR systems should be organized by problems as well as by source and time and integrate decision support that

can be adjusted to the individual patient. The responders preferred their EPR systems to be local and communicative.

A framework that enables representation of three prerequisite features for a future helpful patient record system: the primary care workflow process, the problem-oriented information model, and means to identify relevant information to the care process and medical decisions; could possibly meet these demands from Norwegian GPs.[8]

Several nations have projects for future EPR systems, and some of them deals with shared care. A British commentary claims that the development of integrated information systems shared between healthcare and social care in the controversial national programme for IT in the English National Health service (NHS) is an essential requirement in the modernization of our health and welfare systems. But that the absence of overall co-ordination of the different programmes presents a major risk not only to the strategy to develop integrated personal-care records but also to the Transformational Government Programme.[245] The study of the experiences of four "early adopter" primary care trusts in implementing the electronic summary care record finds fault with several aspects of the culture and methods, and criticizes the programme's "narrow and instrumental focus on implementing a technology" rather than on broader change.[246]

In Finland the shared record is a virtual EPR. The regional healthcare modules consist of an (1) eReferral network, (2) integrated EPR service between health care professionals and (3) PACS system. The eReferral between primary and secondary care not only speeds up the transfer, but also offers an option for communication in the form of eConsultation between general practitioners and hospital specialists.[247]

An Irish study suggests that the next generation of EHR will be a longitudinal cradle-to-the-grave active patient record readily accessible and available via the Internet, and which will be linked to clinical protocols and guidelines to drive the delivery of healthcare to the individual citizen.[248]

As for electronic future exchange of health information, a German hospital study recommend that an adequate architecture for shared electronic patient records is needed, which can use data for multiple purposes and which is extensible for new research questions.[249] The respondents of this thesis recommend separate systems within each

domain that integrates to communicate health information that is condensed and adequate and in accordance with patient consents.

There also are cases in which the future receiver of patient information is not known, and an English study discuss the challenges of accessible and centrally stored shared summary care records.[250]

Future systems may build upon some of these concepts, and they have to take in account results from studies, safety and confidentiality issues as well as the functional requirements from patients and users of the systems. Initiatives within the EU seem to support problem-orientation and decision support,[236] as well as openEHR and archetypes.[251, 252]

CONCLUSION

Implications for clinical practice

GPs manage many tasks through short encounters as described in table 1. The balance between time spent examining and talking with the patients and time spent on documentation is therefore of great clinical importance. The GPs report that they generally believe that using the computer save time, and they were observed to use less time than reported. On the other hand they also tell that the introduction of EPR has transferred workload from the secretary to the GP. In accordance with other time studies doctors spend more time using the computer than with previous paperwork. More research is therefore needed to get a better picture of how time is spent and how the administrative workload on the GP can be reduced.

The clinician-patient relationship is of great concern for the clinical practice among GPs, but they denied that using the computer disturbed this relationship. On the other hand they described that it had become more difficult to get the overview of the patients' earlier history. The studies of this thesis were not able to reveal if this finding has had clinical consequences, and this should be studied more in-depth. The GPs' and our proposal is that a problem-oriented record might solve some of these difficulties.

The respondents' opinions were that the quality of the work had improved by use of EPR systems. This is probably the case for the quality of the documentation in the records, but the effects on the quality of the clinical work have to be studied further.

Further development and use of the ELIN-method

The ELIN-method represents user-driven bottom-up organized national projects fully financed to develop IT solutions. Defined contracted milestones have been instrumental for accomplishing the projects. The solutions are tested and accepted by users; first in a usability laboratory and then by pilot users in practice followed by implementation. Publication of updated user requirements is a part of this method. The method has demonstrated a complete production line starting with user-developed requirements that are tested stepwise and end up implemented in routine clinical work, and with revised standards.

The ELIN-method has been used by the author in a national project for electronic prescriptions in primary and secondary care, and in addition to develop the user requirements of electronic health communication for this thesis. Validation of the requirements has been extended to include all parties participating in the interoperability chain. Test procedures were developed and attached to the requirements, not unlike use cases, and user tests were performed in the interoperability chain. Furthermore, the requirements and the test procedures were updated after each of the iterations in the different phases of development as well as the pilot phase to ensure updated documentation at the point of implementation. One pilot vendor developed and piloted the solution ahead of the other vendors in order to increase the quality of the requirements before the other vendors started the development phase. Later studies of GP use of the EPR systems after implementing the requirements can reveal if adequate and complete electronic health communication and successful electronic prescriptions are achieved.

The respondents in this thesis wanted the EPR systems to be further developed in terms of problem-orientation and decision support adjusted to the individual patient. The tools from the ELIN-method can be used to realize this mandate. Future studies of the

development and use of EPR systems can reveal if the adjusted ELIN-method is valid in other areas of EPR development and if acceptance from the users may be achieved.

Work that adds to the aims of the thesis

Countries with successful EPR adoption have reported several contributing factors. Research with possible prospective designs can reveal if these factors can contribute successfully to high adoption rates in other countries. The effect of helpful problem-oriented EPR systems on quality of care need to be further studied in well-designed RCTs. Integration of PHRs with EPR systems should be further studied in qualitative designs, and the usability and efficiency of consultations with specialists can be revealed by before and after studies with time series.

REFERENCES

1. de Lusignan S. What Is Primary Care Informatics? *J Am Med Inform Assoc.* 2003;10(4):304.

2. Starfield B. Is primary care essential? *Lancet.* 1994;344(8930):1129-1133.

3. Donaldson MS, Yordy KD, Vanselow NA. *Defining Primary Care: An Interim Report.* Washington DC: National Academy Press;1994.

4. MRC. Definition of Primary Care. 2003; http:// www.mrc.ac.uk/prn/index/strategy-strategy/strategy-science_strategy/strategy-strategic_implementation/strategy-highlight_notices/strategy-primary_care.htm. Accessed Oct, 2007.

5. Allen J, Gay B, Crebolder H, Heyrman J, Svab I, Ram P. The European definitions of the key features of the discipline of general practice: the role of the GP and core competencies. *Br J Gen Pract.* 2002;52(479):526-527.

6. Teasdale S. A review of Primary Care Informatics: past progress, present reality, future prospects. *Yearbook of Medical Informatics.* 2005:139-147.

7. Hunskår S. *Allmennmedisin: klinisk arbeid*. Oslo: Ad Notam Gyldendal; 1997.

8. Bayegan E, Tu S. The helpful patient record system: problem oriented and knowledge based. Paper presented at: Proc AMIA Symp2002.

9. Polanyi M. *The Tacit Dimension*. Gloucester: Peter Smith; 1983.

10. Goldman GM. The tacit dimension of clinical judgment. *Yale J Biol Med.* 1990;63(1):47-61.

11. de Lusignan S, Wells S, Singleton A. Why general practitioners do not implement evidence. Learning environments must be created that capitalise on teams' wealth of knowledge. *BMJ.* 2002;324(7338):674.
12. Greenhalgh T. Intuition and evidence-uneasy bedfellows? *Br J Gen Pract.* 2002;52(478):395-400.
13. Haynes RB. What kind of evidence is it that Evidence-Based Medicine advocates want health care providers and consumers to pay attention to? *BMC Health Serv Res.* 2002;2(1):3.
14. Haynes RB, Devereaux PJ, Guyatt GH. Clinical expertise in the era of evidence-based medicine and patient choice. *BMJ.* 2002;7(2):36.
15. Rector AL. Clinical terminology: why is it so hard. *Methods Inf Med.* 1999;38(4-5):239-252.
16. Musen MA. Medical informatics: searching for underlying components. *Methods Inf Med.* 2002;41(1):12-19.
17. Essex BJ. *Doctors, Dilemmas, Decisions*: Essex: BMJ Publishing Group; 1994.
18. Suchman LA. *Plans and Situated Actions: The Problem of Human-Machine Communication:* Cambrigde: Cambrigde University Press; 1987.
19. Rousseau N, McColl E, Newton J, Grimshaw J, Eccles M. Practice based, longitudinal, qualitative interview study of computerised evidence based guidelines in primary care. *BMJ.* 2003;326(7384):314.
20. Balint M. *The Doctor, His Patient And The Illness*. Second ed. Edinborough, London, Melbourne, New York: Churchill Livingstone; 2000.
21. Chapman J. A systems perspective on computing in the NHS. *Inform Prim Care.* 2002;10(4):197-199.
22. Griffiths F, Byrne D. General practice and the new science emerging from the theories of 'chaos' and complexity. *Br J Gen Pract.* 1998;48(435):1697-1699.
23. Miller WL, Crabtree BF, McDaniel R, Stange KC. Understanding change in primary care practice using complexity theory. *J Fam Pract.* 1998;46(5):369-376.
24. Engel GL. The need for a new medical model: a challenge for biomedicine. *Science.* 1977;196(4286):129.
25. Alonso Y. The biopsychosocial model in medical research: the evolution of the health concept over the last two decades. *Patient Educ Couns.* May 2004;53(2):239-244.
26. Friedman CP. Where's the science in medical informatics? *J Am Med Inform Assoc.* 1995;2(1):65-67.
27. Blois MS. *Information and Medicine: The Nature of Medical Descriptions*. Berkely, California: University of California Press; 1984.
28. de Lusignan S. Commentary: Improve the quality of the consultation. *BMJ.* 2003;326(7382):202-206.
29. Heath C, Luff P. Technology in Action. *Technology.* 2000.
30. Byrne P, Barrie E, Health GBDo, Security S. *Doctors Talking to Patients: A Study of the Verbal Behaviour of General Practitioners Consulting in Their Surgeries*. London: Royal College of General Practitioners; 1984.
31. Stewart M. *Patient-centered Medicine: Transforming the Clinical Method:* Thousand Oaks, California: Sage; 1995.

32. Pendleton D. *The Consultation: An Approach to Learning and Teaching*: Oxford University Press Oxford; 1984.
33. Primary Healthcare Specialist Group of the British Computer Society. 2007; http://www.phcsg.org.uk. Accessed oct 2007, 2007.
34. Dick RS, Steen EB, Detmer DE. *The computer-based patient record: an essential technology for health care*. Washington: National Academy Press; 1997.
35. Weed LJ. The problem oriented record as a basic tool in medical education, patient care and clinical research. *Ann Clin Res.* 1971;3(3):131-134.
36. Shortliffe EH, Perreault LE, Wiederhold G, Fagan LM. *Medical informatics: computer applications in health care and biomedicne*. Second ed. New York: Springer-Verlag; 2001.
37. Sidorov J. It Ain't Necessarily So: The Electronic Health Record And The Unlikely Prospect Of Reducing Health Care Costs. *Health Affairs.* Jul-Aug 2006;25(4):1079-1085.
38. Tang PC, Ash JS, Bates DW, Overhage JM, Sands DZ. Personal Health Records: Definitions, Benefits, and Strategies for Overcoming Barriers to Adoption. *J Am Med Inform Assoc.* Mar / apr 2006;13(2):121-126.
39. Hasvold T. A computerized medical record. "The Balsfjord system". *Scand J Prim Health Care.* September 1984;2(3):125-128.
40. Bassoe C. PROMED - A problem-orientated computerized medical record. *Utposten.* 1985;1:10-12.
41. Nilsen JF, Fosse S. [A computerized medical record system for primary health care]. *Tidsskr Nor Laegeforen.* September 10 1982;102(25):1285-1288.
42. Valnes KN, Aarseth HP. [A user evaluation of software programs in family practice]. *Tidsskr Nor Laegeforen.* January 20 1995;115(2):230-233.
43. Bowie J, Barnett G. MUMPS - an economical and efficient time-sharing system for information management. *Comput Programs Biomed.* Apr 1976;6(1):11-22.
44. Shortliffe E, Perreault L, Wiederhold G, Fagan L. *Medical informatics: computer applications in health care*. Boston: Addison-Wesley Longman Publishing Co.; 1990.
45. McDonald C, Overhage J, Tierney W, et al. The Regenstrief Medical Record System: a quarter century experience. *Int J Med Inf.* Jun 1999;54(3):225-253.
46. Wiederhold G, Perreault L. *Hospital information systems*. Boston: Addison-Wesley Longman Publishing Co; 1990.
47. Blum B, Duncan K. *A history of medical informatics*. New York: Addison-Wesley; 1990.
48. Barnett G, Justice N, Somand M, et al. COSTAR - A computer-based medical information system for ambulatory care. Paper presented at: Proceedings of the IEEE; 1979.
49. Linnarsson R, Nordgren K. A shared computer-based problem-oriented patient record for the primary care team. *Medinfo.* 1995;8(Pt 2):1663.
50. Hosia P. Finstar—A Comprehensive Information System for Primary Care. *Scand J Prim Health Care.* Nov 1984;2(4):163-166.
51. Sigurdsson G, Einarsson I, Josafatsson J, et al. A Medical Record and Information System for Primary Health Care in Iceland: The Egilsstadir Project. *Scand J Prim Health Care.* Nov 1984;2(4):159-161.

52. Krogh-Jensen P. Electronic records for general practice. The Danish system. *Scand J Prim Health Care.* Sep 1984;2(3):121-123.
53. Laerum H, Ellingsen G, Faxvaag A. Doctors' use of electronic medical records systems in hospitals: cross sectional survey. *BMJ.* 2001;323(7325):1344-1348.
54. Vedvik E, Faxvaag A. The fate of clinical department systems at the dawn of hospital-wide Electronic health records in a Norwegian university hospital. *Stud Health Technol Inform.* 2006;124:298-303.
55. Friedman CP, Wyatt J. *Evaluation Methods in Medical Informatics*. Second ed: New York: Springer Verlag; 2006.
56. Heathfield HA, Wyatt J. The road to professionalism in medical informatics: a proposal for debate. *Methods Inf Med.* 1995;34(5):426-433.
57. Friedman CP, Wyatt J. *Evaluation Methods in Medical Informatics*: New York; Springer Verlag; 1997.
58. Rigby M. Verifying quality and safety in health informatics services. *BMJ.* 2001;323(7312):552-556.
59. Wyatt JC, Wyatt SM. When and how to evaluate health information systems? *Int J Med Inf.* Mar 2003;69(2-3):251-259.
60. van Bemmel JH, Musen MA. *Handbook of Medical Informatics*. Heidelberg, Germany: Springer Verlag; 1997.
61. Mitchell E, Sullivan F. A descriptive feast but an evaluative famine: systematic review of published articles on primary care computing during 1980-97. *BMJ.* 2001;322(7281):279-282.
62. Ventres W, Kooienga S, Vuckovic N, Marlin R, Nygren P, Stewart V. Physicians, Patients, and the Electronic Health Record: An Ethnographic Analysis. *Ann Fam Med.* 2006;4(2):124-131.
63. Mays N, Pope C. Qualitative Research: Rigour and qualitative research. *BMJ.* 1995;311(6997):109-112.
64. Malterud K. Qualitative research: standards, challenges, and guidelines. *Lancet.* 2001;358(9280):483-488.
65. Brender J. Trends in assessment of IT-based solutions in healthcare and recommendations for the future. *Int J Med Inf.* Oct 1998;52(1-3):217-227.
66. Ammenwerth E, Brender J, Nykänen P, Prokosch HU, Rigby M, Talmon J. Visions and strategies to improve evaluation of health information systems Reflections and lessons based on the HIS-EVAL workshop in Innsbruck. *Int J Med Inform.* Jun 30 2004;73(6):479-491.
67. Brender J. Methodology for constructive assessment of IT-based systems in an organisational context. *Int J Med Inf.* Dec 1999;56(1-3):67-86.
68. Aarts J, Berg M. Same systems, different outcomes - comparing the implementation of computerized physician order entry in two Dutch hospitals. *Methods Inf Med.* 2006;45(1):53-61.
69. Heathfield H, Pitty D, Hanka R. Evaluating information technology in health care: barriers and challenges. *BMJ.* 1998;316(7149):1959-1961.
70. Beuscart-Zéphir M-C, Anceaux F, Menu H, Guerlinger S, Watbled L, Evrard F. User-centred, multidimensional assessment method of Clinical Information Systems: a case-study in anaesthesiology. *Int J Med Inform.* Mar 2005;74(2-4):179-189.

71. Jokela T, Iivari N, Matero J, Karukka M. The standard of user-centered design and the standard definition of usability: analyzing ISO 13407 against ISO 9241-11. Paper presented at: Proceedings of the Latin American conference on Human-computer interaction2003; Rio de Janeiro, Brasil.
72. Coble JM, Karat J, Orland MJ, Kahn MG. Iterative usability testing: ensuring a usable clinical workstation. Paper presented at: Proc AMIA Annu Fall Symp1997.
73. Kääriäinen J, Koskela J, Takalo J, Abrahamsson P, Kolehmainen K. Supporting Requirements Engineering in Extreme Programming: Managing User Stories. Paper presented at: ICSSEA2003; Paris, France.
74. Heeks R, Mundy D, Salazar A, Institute for Development Policy and M, University of M. *Why Health Care Information Systems Succeed Or Fail*: Institute for Development Policy and Management; 1999.
75. Coiera E. *Guide to Health Informatics*: Arnold London; 2003.
76. Anderson JG, Jay SJ, Anderson M, Hunt TJ. Evaluating the Capability of Information Technology to Prevent Adverse Drug Events: A Computer Simulation Approach. *J Am Med Inform Assoc.* 2002;9(5):479.
77. Myers GJ. *The Art of Software Testing*: John Wiley & Sons Inc; 2004.
78. Patel VL, Arocha JF, Kushniruk AW. Patients' and physicians' understanding of health and biomedical concepts: relationship to the design of EMR systems. *J Biomed Inform.* 2002;35(1):8-16.
79. Ellingsen G, Monteiro E. Big is beautiful: electronic patient records in large Norwegian hospitals 1980s-2001. *Methods Inf Med.* 2003;42(4):366-370.
80. Coble JM, Karat J, Kahn MG. Maintaining a focus on user requirements throughout the development of clinical workstation software. *Proceedings of the SIGCHI conference on Human factors in computing systems.* Atlanta, Georgia, United States; 1997:170-177.
81. Abrahamsson P, Salo O, Ronkainen J, Warsta J. *Agile software development methods. Review and Analysis.* Espoo, Finland: VTT Technical Research centre of Finland; 2002.
82. Blobel B. Advanced and secure architectural EHR approaches. *Int J Med Inf.* 2006;75(3-4):185-190.
83. Davis FD, Venkatesh V. Toward preprototype user acceptance testing of new information systems: implications for software project management. *Engineering Management, IEEE Transactions on.* 2004;51(1):31-46.
84. Finch T, May C, Mair F, Mort M, Gask L. Integrating service development with evaluation in telehealthcare: an ethnographic study. *BMJ.* Nov 22 2003;327(7425):1205-1209.
85. van Ginneken AM. The computerized patient record: balancing effort and benefit. *Int J Med Inf.* 2002;65(2):97-119.
86. Berg M. Patient care information systems and health care work: a sociotechnical approach. *Int J Med Inform.* Aug 1999;55(2):87-101.
87. Balas EA, Austin SM, Mitchell JA, Ewigman BG, Bopp KD, Brown GD. The clinical value of computerized information services. A review of 98 randomized clinical trials. *Arch Fam Med.* May 1996;5(5):271-278.

88. Harris AD, McGregor JC, Perencevich EN, et al. The Use and Interpretation of Quasi-Experimental Studies in Medical Informatics. *J Am Med Inform Assoc.* 2006;13(1):16-23.
89. Fink A. *How To Conduct Surveys: A Step-by-Step Guide*. Second ed: Sage; 2006.
90. Sheatsley PB. *Questionnaire construction and item writing:* In: Rossi PH, Wright JD, Anderson AB, editors. Handbook of survey research. New York: Academic Press; 1983.
91. Rossi PH, Wright JD, Anderson AB. *Handbook of survey research*. Orlando: Academic Press; 1983.
92. Haraldsen G. *Spørreskjemametodikk etter kokemetoden (Questionnaire methology)*. Oslo: Ad Notam Gyldendal; 1999.
93. Marshall C, Rossman GB. *Designing qualitative research*: Thousand Oaks, California: Sage Publications; 1999.
94. Patton MQ. *Qualitative evaluation and research methods*. Second ed. Newbury Park: Sage Publications; 1990.
95. Rector AL, Nowlan WA, Kay S. Foundations for an electronic medical record. *Methods Inf Med.* 1991;30(3):179-186.
96. Wang SJ, Middleton B, Prosser LA, et al. A cost-benefit analysis of electronic medical records in primary care. *Am J Med.* Apr 1 2003;114(5):397-403.
97. Jha AK, Doolan D, Grandt D, Scott T, Bates DW. The use of health information technology in seven nations. *Int J Med Inform.* Jul 24 2008;Epub ahead of print.
98. Berner E, Detmer D, Simborg D. Will the wave finally break?: A brief view of the adoption of electronic medical records in the United States. *J Am Med Inform Assoc.* Jan-Feb 2005;12(1):3-7.
99. Menachemi N, Brooks RG. EHR and other IT adoption among physicians: results of a large-scale statewide analysis. *J Healthc Inf Manag.* Summer 2006;20(3):79-87.
100. Sobol MG, Alverson M, Lei D. Barriers to the adoption of computerized technology in health care systems. *Top Health Inf Manage.* 1999;19(4):1-19.
101. Simon SR, McCarthy ML, Kaushal R, et al. Electronic health records: which practices have them, and how are clinicians using them? *J Eval Clin Pract.* 2008;14(1):43-47.
102. Nohr C, Andersen S, Vingtoft S, Bernstein K, Bruun-Rasmussen M. Development, implementation and diffusion of EHR systems in Denmark. *Int J Med Inform.* March 2005;74(2-4):229-234.
103. Henderson J, Britt H, Miller G. Extent and utilisation of computerisation in Australian general practice. *Med J Aust.* Jul 17 2006;185(2):84-87.
104. Wyatt JC. Clinical data systems, part III: developing and evaluating clinical data systems. *Lancet.* Dec 1994;344(8938):1682-1688.
105. Powsner S, Wyatt J, Wright P. Opportunities for and challenges of computerisation. *Lancet.* Nov 1998;352:6.
106. Joos D, Chen Q, Jirjis J, Johnson KB. An electronic medical record in primary care: impact on satisfaction, work efficiency and clinic processes. Paper presented at: AMIA Annu Symp Proc2006.
107. Tange H. The paper-based patient record: Is it really so bad? *Comput Methods Programs Biomed.* 1995;48(1):127-131.

108. Massaro TA. Introducing Physician Order Entry at a Major Academic Medical Center: I. Impact on Organizational Culture and Behavior. *Acad Med.* Jan 1993;68(1):20-25.
109. Sullivan F, Mitchell E. Has general practitioner computing made a difference to patient care? A systematic review of published reports. *BMJ.* 1995;311:848-852.
110. Pizziferri L, Kittler AF, Volk LA, et al. Primary care physician time utilization before and after implementation of an electronic health record: A time-motion study. *J Biomed Inform.* Jun 2005;38(3):176-188.
111. Lo H, Newmark L, Yoon C, et al. Electronic Health Records in Specialty Care: A Time-Motion Study. *J Am Med Inform Assoc.* June 28 2007;14(5):609-615.
112. Cruickshank PJ. Computers in medicine: patients' attitudes. *JR Coll Gen Pract.* 1984;34(259):77-80.
113. Ventres W, Kooienga S, Marlin R, Vuckovic N, Stewart V. Clinician style and examination room computers: a video ethnography. *Fam Med.* Apr 2005;37(4):276-281.
114. Booth N, Robinson P, Kohannejad J. Identification of high-quality consultation practice in primary care: the effects of computer use on doctor-patient rapport. *Inform Prim Care.* 2004;12(2):75-83.
115. Simon S, Kaushal R, Cleary P, et al. Physicians and electronic health records: a statewide survey. *Arc Intern Med.* Mar 12 2007;167(5):507-512.
116. Moller-Jensen J, Lund Pedersen I, Simonsen J. Measurement of the Clinical Usability of a Configurable EHR. *Stud Health Technol Inform.* 2006;124:356-361.
117. Berg M. The search for synergy: interrelating medical work and patient care information systems. *Methods Inf Med.* 2003;42(4):337-344.
118. Lium JT, Faxvaag A. Removal of paper-based health records from Norwegian hospitals: effects on clinical workflow. *Stud Health Technol Inform.* 2006;124:1031.
119. Ford E, Menachemi N, Phillips M. Predicting the adoption of electronic health records by physicians: when will health care be paperless? *J Am Med Inform Assoc.* 2006;13(1):106-112.
120. Benson T. Why general practitioners use computers and hospital doctors do not - Part 1: incentives. *BMJ.* Nov 9 2002;325(7372):1086-1089.
121. Morris AH. Decision support and safety of clinical environments. *Qual Saf Health Care.* 2002;11(1):69-75.
122. Bates DW, Kuperman GJ, Wang S, et al. Ten commandments for effective clinical decision support: making the practice of evidence-based medicine a reality. *J Am Med Inform Assoc.* Nov-Dec 2003;10(6):523-530.
123. Salmon P, Rappaport A, Bainbridge M, Hayes G, Williams J. Taking the problem oriented medical record forward. *Proc AMIA Annu Fall Symp.* 1996;463:7.
124. Lundsgaarde HP. *Human problems in computerized medicine*: University of Kansas Lawrence, Kan; 1981.
125. Kounalakis D, Lionis C, Okkes I, Lamberts H. Developing an appropriate EPR system for the Greek primary care setting. *J Med Syst.* June 2003;27(3):239-246.

126. Christensen T, Grimsmo A. Development of functional requirements for electronic health communication: preliminary results from the ELIN project. *Inform Prim Care.* 2005;13(3):203-208.
127. Meijer S, Hoopen A, van der Maas A, Kamphuis H. Pain clinic EPR: requirements determination & configuration. *Stud Health Technol Inform.* 2002;93:111-118.
128. Dumont R, van der Loo R, van Merode F, Tange H. User needs and demands of a computer-based patient record. *Medinfo.* 1998;9(Pt 1):64-69.
129. Hellesoe R, Ruland C. Developing a module for nursing documentation integrated in the electronic patient record. *J Clin Nurs.* Nov 2001;10(6):799-805.
130. Bodker K, Kensing F, Simonsen J. *Participatory IT Design: Designing for Business and Workplace Realities*: MIT Press; 2004.
131. Bevan N, Curson I. Planning and implementing user-centred design. Paper presented at: Conference on Human Factors in Computing Systems1999; Pittsburgh, Pennsylvania.
132. Hasman A. *Education and Training in Health Informatics in Europe: State of the Art, Guidelines, Applications*: IOS Press; 1995.
133. Egyhazy CJ, Eyestone SM, Martino J, Hodgson CL. Object-oriented analysis and design: a methodology for modeling the computer-based patient record. *Top Health Inf Manage.* 1998;19(1):48-65.
134. Strasberg HR, Tudiver F, Holbrook AM, Geiger G, Keshavjee KK, Troyan S. Moving towards an electronic patient record: a survey to assess the needs of community family physicians. *Proc AMIA Symp.* 1998:230-234.
135. Kane DW, Hohman MM, Cerami EG, McCormick MW, Kuhlmman KF, Byrd JA. Agile methods in biomedical software development: a multi-site experience report. *BMC Bioinformatics.* May 30 2006;7(1):273.
136. Branger PJ, van der Wouden JC, Schudel BR, et al. Electronic communication between providers of primary and secondary care. *BMJ.* Oct 31 1992;305(6861):1068-1070.
137. References S, Dee C, Blazek R. Information needs of the rural physician: a descriptive study. *Bull Med Libr Assoc.* 1993;81(3):259-264.
138. Protti DJ, Johansen I. Further Lessons from Denmark about Computer Systems in Physician Offices. *Int J Electron Healthc.* 2003;2(2):36-43.
139. Kokolakis S, Gritzalis D, Katsikas S, Ottes F. Overview on security standards for Healthcare information systems. *Stud Health Technol Inform.* 2002;69:13-21.
140. Klein GO. Standardization of Health Informatics-Results and Challenges. *Methods Inf Med.* 2002;41(4):261-270.
141. Hanseth O, Monteiro E, Hatling M. Developing Information Infrastructure: The Tension Between Standardization and Flexibility. *Sci Technol Human Values.* 1996;21(4):407.
142. McDonald CJ. The Barriers to Electronic Medical Record Systems and How to Overcome Them. *J Am Med Inform Assoc.* 1997;4:213-221.
143. Anderson JG. Social, ethical and legal barriers to E-health. *Int J Med Inf.* May-Jun 2007;76(5-6):480-483.
144. Klein GO. ISO and CEN standards for health informatics - synergy or competition. *Stud Health Technol Inform.* 2003;96:259-265.

145. Laerum H, Faxvaag A. Task-oriented evaluation of electronic medical records systems: development and validation of a questionnaire for physicians. *BMC Med Inform Decis Mak.* 2004;4:1.
146. Morgan DL, Krueger RA. *Focus group kit*: Thousand Oaks, California: Sage; 1998.
147. Johannessen R. The BIT Programme. 2007; http://www.innovasjonnorge.no/Tjenester/Kompetanse/Kompetanseutvikling/BIT-programmet/?locationId=,53427. Accessed aug 3, 2008.
148. Malterud K. Action research-a strategy for evaluation of medical interventions. *Family Practice.* 1995;12(4):476-481.
149. KITH. Standards of Norwegian EPR systems. 2008; http://www.kith.no/templates/kith_WebPage____894.aspx. Accessed 3. aug. 2008.
150. Smith GD, Ebrahim S. Data dredging, bias, or confounding They can all get you into the BMJ and the Friday papers. *BMJ.* Dec 21 2002;325(7378):1437-1438.
151. Johannessen T. The Norwegian Electronic Medical Handbook. 2008; www.legehandboka.no. Accessed 3. aug. 2008
152. Delpierre C, Cuzin L, Fillaux J, Alvarez M, Massip P, Lang T. A systematic review of computer-based patient record systems and quality of care: more randomized clinical trials or a broader approach? *Int J Qual Health Care.* Oct 2004;16(5):407-416.
153. Kushniruk AW, Patel VL. Cognitive and usability engineering methods for the evaluation of clinical information systems. *J Biomed Inform.* 2004;37(1):56-76.
154. Scandurra I, Hägglund M, Koch S. From user needs to system specifications: Multi-disciplinary thematic seminars as a collaborative design method for development of health information systems. *J Biomed Inform.* Aug 2008;41(4):557-569.
155. Lincoln YS. Emerging Criteria for Quality in Qualitative and Interpretive Research. *Qualitative Inquiry.* 1995;1(3):275.
156. Kaplan B. Evaluating informatics applications-some alternative approaches: theory, social interactionism, and call for methodological pluralism. *Int J Med Inform.* 2001;64(1):39-56.
157. Kaplan B, Shaw NT. Future directions in evaluation research: people, organizational, and social issues. *Methods Inf Med.* 2004;43(3):215-231.
158. Chapple A. Explicit guidelines for qualitative research: a step in the right direction, a defence of the'soft' option, or a form of sociological imperialism? *Fam Pract.* 1998;15(6):556-561.
159. Kvale S. Interviews: An Introduction to Qualitative Research Writing. Thousand Oaks, California: Sage Publications; 1996.
160. Kvale S. To validate is to question. *Issues of Validity in Qualitative Research*. Lund: Studentlitteratur; 1989:73-92.
161. Kuzel AJ. Sampling in qualitative inquiry. In: Crabtree BF, Miller WI, eds. *Doing qualitative research.* Vol 3. Newbury Park: Sage Publications; 1992:31-44.
162. Miles MB, Huberman AM. *Qualitative Data Analysis: An Expanded Sourcebook*: Sage; 1994.

163. Taraldset A. Active physicians < 70 years in Norway by position as of 11th of August 2008. 2008; Number of primary care specialists by sep 1. 2008. Available at: http://www.legeforeningen.no/index.gan?id=146439. Accessed oct 25, 2008.
164. Crabtree B, Miller W. *Doing Qualitative Research*. CA: Sage; 1999.
165. Roethlisberger FJ, Dickson WJ. *Management and the worker*: Harvard University Press Cambridge, Mass; 1949.
166. Miller W, Crabtree B. Primary care research: a multimethod typology and qualitative road map. In: Crabtree BF, Miller WI, eds. *Doing qualitative research.* Vol 3. Newbury Park: Sage Publications; 1992:3-28.
167. Kaplan B, Duchon D. Combining Qualitative and Quantitative Methods in Information Systems Research: A Case Study. *MIS Quarterly.* Dec 1988;12(4):571-586.
168. Mingers J. Combining IS Research Methods: Towards a Pluralist Methodology. *Information Systems Research.* 2001;12(3):240-259.
169. Baskerville RL. Investigating information systems with action research. *Communications of the AIS.* Oct 1999;2(3es):1-32.
170. McKernan J. *Curriculum Action Research: A Handbook of Methods and Resources for the Reflective Practitioner*: Routledge; 1996.
171. Edwards G, Bushko R. Business modeling tools for managing decision support systems. *Medinfo.* 1995;8(Pt 2):1005-1008.
172. Christensen T, Grimsmo A. Instant availability of patient records, but diminished availability of information: a multi-method study of GPs use of electronic patient records. *BMC Med Inform Decis Mak.* 28 march 2008;8(12).
173. Laerum H, Ellingsen G, Faxvaag A. [Electronic medical records in somatic hospitals--availability and clinical use]. *Tidsskrift for den Norske laegeforening.* October 30 2002;122(26):2540-2543.
174. Lium JT, Lærum H, Schulz T, Faxvaag A. From the Front Line, Report from a Near Paperless Hospital: Mixed Reception Among Health Care Professionals. *J Am Med Inform Assoc.* 2006;13(6):668-675.
175. Ammenwerth E, Gräber S, Herrmann G, Bürkle T, König J. Evaluation of health information systems - problems and challenges. *Int J Med Inform.* Sep 2003;71(2-3):125-135.
176. Benson T. Why general practitioners use computers and hospital doctors do not-Part 2: scalability. *BMJ.* Nov 9 2002;325(7372):1090-1093.
177. Lee F, Teich JM, Spurr CD, Bates DW. Implementation of physician order entry: user satisfaction and self-reported usage patterns. *J Am Med Inform Assoc.* 1996;3(1):42-55.
178. Staggers N, Kobus D. Comparing Response Time, Errors, and Satisfaction Between Text-based and Graphical User Interfaces During Nursing Order Tasks. *J Am Med Inform Assoc.* 2000;7(2):164.
179. Hart A, Wyatt J. Evaluating black-boxes as medical decision aids: issues arising from a study of neural networks. *Med Inform (Lond).* Jul-Sep 1990;15(3):229-236.
180. Wellwood J, Johannessen S, Spiegelhalter D. How does computer-aided diagnosis improve the management of acute abdominal pain? *Ann R Coll Surg Engl.* Jan 1992;74(1):40-46.

181. Jick T. Mixing Qualitative and Quantitative Methods: Triangulation in Action. *ASQ.* 1979;24(4):602-611.
182. Kaplan B, Maxwell JA. Qualitative research methods for evaluating computer information systems. *Evaluating Health Care Information Systems: Methods and Applications*. Second ed. New York: Springer; 2006:30-55.
183. Protti D. Comparison of Information Technology in General Practice in 10 Countries. *Healthc Q.* 2007;10(2):107-116.
184. Protti D, Wright G, Treweek S, Johansen I. Primary care computing in England and Scotland: a comparison with Denmark. *Inform Prim Care.* 2006;14(2):93-99.
185. Yasnoff WA, Humphreys BL, Marc Overhage J, et al. A consensus action agenda for achieving the national health information infrastructure. *J Am Med Inform Assoc.* May 22 2004;11(4):332-338.
186. Barnett GO. The application of computer-based medical-record systems in ambulatory practice. *N Engl J Med.* 1984;310(25):1643-1650.
187. Tsai J, Bond G. A comparison of electronic records to paper records in mental health centers. *Int J Qual Health Care.* Apr 2008;20(2):136-143.
188. Loomis G, Ries J, Saywell JR, Thakker N. If electronic medical records are so great, why aren't family physicians using them? *J Fam Pract.* Jul 2002;51(7):636-641.
189. Margalit RS, Roter D, Dunevant MA, Larson S, Reis S. Electronic medical record use and physician–patient communication: An observational study of Israeli primary care encounters. *Patient Educ Couns.* Apr 2006;61(1):134-141.
190. Siteman E, Businger A, Gandhi T, et al. Clinicians Recognize Value of Patient Review of their Electronic Health Record Data. *AMIA Annu Symp Proc.* 2006;2006:1101.
191. Cape J. Consultation length, patient-estimated consultation length, and satisfaction with the consultation. *Br J Gen Pract.* Des 2002;52(485):1004-1006.
192. Warshawsky SS, Pliskin JS, Urkin J, et al. Physician use of a computerized medical record system during the patient encounter: a descriptive study. *Comput Methods Programs Biomed.* Jun 1994;43(3-4):269-273.
193. Krall MA. Acceptance and performance by clinicians using an ambulatory electronic medical record in an HMO. *Proc Annu Symp Comput Appl Med Care.* 1995;708:11.
194. Hasvold T. Tabel 1 Notations of factors to estimate lenght of patients lists corresponding to year long assignment. *Tidsskr Nor Lægeforen.* 2000;120:786-787.
195. Johnsen R, Holtedal KA. Working hours and production of clinical services i Norwegian general practice in 1993. *Tidsskr Nor Lægeforen.* 1997;117:1489-1492.
196. Deveugele M, Derese A, van den Brink-Muinen A, Bensing J, De Maeseneer J. Consultation length in general practice: cross sectional study in six European countries. *BMJ.* Aug 31 2002;325(7362):472.
197. Wilson A. Consultation length in general practice: a review. *Br J Gen Pract.* 1991;41(344):119-122.

198. Wilson A, Childs S. The effect of interventions to alter the consultation length of family physicians: a systematic review. *Br J Gen Pract.* Nov 2006;56(532):876-882.
199. Aydin CE, Anderson JG, Rosen PN, Felitti VJ, Weng HC. Computers in the consulting room: a case study of clinician and patient perspectives. *Health Care Manag Sci.* Sep 1998;1(1):61-74.
200. Solomon GL, Dechter M. Are patients pleased with computer use in the examination room. *J Fam Pract.* Sep 1995;41(3):241-244.
201. Rouf E, Whittle J, Lu N, Schwartz MD. Computers in the Exam Room: Differences in Physician–Patient Interaction May Be Due to Physician Experience. *J Gen Intern Med.* Jan 2007;22(1):43-48.
202. Frankel R, Altschuler A, George S, et al. Effects of Exam-Room Computing on Clinician–Patient Communication. *J Gen Intern Med.* Aug 2005;20(8):677-682.
203. Dobbing C. Paperless practice - electronic medical records at Island health. *Comput Methods Programs Biomed.* Mar 2001;64(3):197-199.
204. DesRoches CM, Campbell EG, Rao SR, et al. Electronic health records in ambulatory care--a national survey of physicians. *N Engl J Med.* Jul 3 2008;359(1):50-60.
205. Doebbeling BN, Vaughn TE, McCoy KD, Glassman P. Informatics Implementation in the Veterans Health Administration (VHA) Healthcare System to Improve Quality of Care. Paper presented at: AMIA Annu Symp Proc2006.
206. Herzum M, Simonsen J. Positive effects of electronic patient records on three clinical activities. *Int J Med Inform.* May 3 2008;Epub ahead of print.
207. Short D, Frischer M, Bashford J. Barriers to the adoption of computerised decision support systems in general practice consultations: a qualitative study of GPs' perspectives. *Int J Med Inform.* May 2004;73(4):357-362.
208. Weed LL, Weed L. Opening the black box of clinical judgment - an overview. *BMJ.* Nov 13 1999;319(7220):1279.
209. Garg AX, Adhikari NKJ, McDonald H, et al. Effects of Computerized Clinical Decision Support Systems on Practitioner Performance and Patient Outcomes A Systematic Review. *JAMA.* Mar 9 2005;293(10):1223-1238.
210. Friedman CP, Gatti GG, Franz TM, et al. Do physicians know when their diagnoses are correct? Implications for decision support and error reduction. *J Gen Intern Med.* Apr 2005;20(4):334-339.
211. Kawamoto K, Houlihan CA, Balas EA, Lobach DF. Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success. *BMJ.* 2005;330(7494):765.
212. Jones DL, Kroenke K, Landry FJ, Tomich DJ, Ferrel RJ. Cost savings using a stepped-care prescribing protocol for nonsteroidal anti-inflammatory drugs. *JAMA.* 1996;275(12):926-930.
213. Ryff-de Leche A, Engler H, Nutzi E, Berger M, Berger W. Clinical application of two computerized diabetes management systems: comparison with the log-book method. *Diabetes Res.* 1992;19(3):97-105.
214. Bennet JW, Glasziou PP. Computerised reminders and feedback in medication management: a systematic review of randomised controlled trials. *Med J Aust.* 2003;178(5):217-222.

215. De Clercq E, Vandenberghe H, Jonckheer P, Bastiaens H, Lafontaine MF, Van Casteren V. Assessment of a Three-Year Experience with a Belgian Primary Care Data Network. *Stud Health Technol Inform.* 2002;93:163-169.
216. Ho LM, McGhee SM, Hedley AJ, Leong JCY. The application of a computerized problem-oriented medical record system and its impact on patient care. *Int J Med Inf.* Jul 1999;55(1):47-59.
217. De Clercq E. From a conceptual problem-oriented electronic patient record model to running systems: A nationwide assessment. *Int J Med Inform.* May 2008;77(5):346-353.
218. De Clercq E, Van Casteren V, Jonckheer P, et al. Are problem-oriented medial records (POMR) suitable for use in GPs' daily practice? *Stud Health Technol Inform.* 2007;129(Pt 1):68-72.
219. Okuhara Y, Kitazoe Y, Narita Y, et al. New approach to the medical information system for quality management in patient care: development of Problem Mapping System. *J Med Syst.* 1999;23(5):377-387.
220. Bossen C. Evaluation of a computerized problem-oriented medical record in a hospital department: does it support daily clinical practice? *Int J Med Inform.* Aug 2007;76(8):592-600.
221. Schabetsberger T, Ammenwerth E, Andreatta S, et al. From a paper-based transmission of discharge summaries to electronic communication in health care regions. *Int J Med Inf.* 2006;75(3-4):209-215.
222. Rassinoux A, Lovis C, Baud R, Geissbuhler A. XML as standard for communicating in a document-based electronic patient record: a three years experiment. *Stud Health Technol Inform.* 2002;90:673-678.
223. Katehakis DG, Sfakianakis S, Tsiknakis M, Orphanoudakis SC. An Infrastructure for Integrated Electronic Health Record Services: The Role of XML (Extensible Markup Language). *J Med Internet Res.* Jan-Mar 2001;3(1):E7.
224. Raghupathi W, Kesh S. Interoperable Electronic Health Records Design: Towards a Service-Oriented Architecture. *e-Service Journal.* 2007;5(3):39-57.
225. Katehakis DG, Sfakianakis SG, Kavlentakis G, Anthoulakis DN, Tsiknakis M. Delivering a Lifelong Integrated Electronic Health Record Based on a Service Oriented Architecture. *IEEE Trans Inf Technol Biomed.* Nov 2007;11(6):639-650.
226. Shapiro JS, Kannry J, Lipton M, et al. Approaches to Patient Health Information Exchange and Their Impact on Emergency Medicine. *Ann Emerg Med.* Oct 2006;48(4):426-432.
227. Hansagi H, Olsson M, Hussain A, Öhlén G. Is information sharing between the emergency department and primary care useful to the care of frequent emergency department users? *Eur J Emerg Med.* Feb 2008;15(1):34-39.
228. Lang E, Afilalo M, Vandal AC, et al. Impact of an electronic link between the emergency department and family physicians: a randomized controlled trial. *CMAJ.* Jan 31 2006;174(3):313-318.
229. Afilalo M, Lang E, Leger R, et al. Impact of a standardized communication system on continuity of care between family physicians and the emergency department. *CJEM.* Mar 2007;9(2):79-86.
230. Bergus GR, Sinift SD, Randall CS, Rosenthal DM. Use of an E-mail curbside consultation service by family physicians. *J Fam Pract.* Nov 1998;47(5):357-360.

231. Safran C, Jones PC, Rind D, Bush B, Cytryn KN, Patel VL. Electronic communication and collaboration in a health care practice. *Artif Intell Med.* 1998;12(2):137-151.
232. Russell J, Greenhalgh T, Boynton P, Rigby M. Soft networks for bridging the gap between research and practice: illuminative evaluation of CHAIN. *BMJ.* 2004;328(7449):1174.
233. Tang PC, Ash JS, Bates DW, Overhage JM, Sands DZ. Personal Health Records: Definition, Benefits, and Strategies for Overcoming Barriers to Adoption. *J Am Med Inform Assoc.* Mar-Apr 2005;13(2):121-126.
234. Pagliari C, Detmer D, Singleton P. Potential of electronic personal health records. *BMJ.* Aug 18 2007;335(7615):330-333.
235. IOM. Key Capabilities of an Electronic Health Record System: Letter report; 2003.
236. EuroRec Services. http://www.eurorec.org/services/archetypes.cfm?selection=archetypes&actief=services. Accessed Jul 31.2008
237. Kinkhorst OM, Lalleman AW, Hasman A. From medical record to patient record through electronic data interchange (EDI). *Int J Biomed Comput.* Jul 1996;42(1-2):151-155.
238. Faber M. Design and introduction of an electronic patient record: how to involve users? *Methods Inf Med.* 2003;42(4):371-375.
239. Berg M, Langenberg C, vd Berg I, Kwakkernaat J. Experiences with an electronic patient record in a clinical context: considerations for design. *Stud Health Technol Inform.* 1997;43(Pt B):811-815.
240. Chiasson M, Reddy M, Kaplan B, Davidson E. Expanding multi-disciplinary approaches to healthcare information technologies: What does information systems offer medical informatics? *Int J Med Inf.* 2006;76(Supplement 1): S89-97.
241. van der Meijden MJ, Tange HJ, Boiten J, Troost J, Hasman A. The user in the design process of an EPR. *Stud Health Technol Inform.* 2000;77:224-228.
242. Kaariainen J, Koskela J, Abrahamsson P, Takalo J. Improving requirements management in extreme programming with tool support-an improvement attempt that failed. Paper presented at: Euromicro Conference, 2004. Proceedings 30th; Aug 31, 2004; Rennes, France.
243. Koch S. Designing Clinically Useful Systems: Examples from Medicine and Dentistry. *Adv Dent Res.* 2003;17(1):65-68.
244. Scandurra I, Hägglund M, Johansson N, Sandblad B, Koch S. User needs for development of context dependent devices in mobile home care. Paper presented at: 5th International Symposium, Mobile HCI; Sept 8-11, 2003; Udine Italy.
245. Johnstone D. The challenge of making healthcare and socialcare information systems interoperable. *Br J Healthcare Comput Info Manage.* 2007;24(2):16-17.
246. Cross M. Electronic sharing of patients' data requires their explicit consent, report says. *BMJ.* May 17 2008;336(7653):1090-1091.
247. Harno K, Ruotsalainen P. Sharable EHR Systems in Finland. *Stud Health Technol Inform.* 2006;121:364-370.

248. Grimson J. Delivering the electronic healthcare record for the 21st century. *Int J Med Inf.* Dec 2001;64(2-3):111-127.
249. Knaup P, Garde S, Merzweiler A, et al. Towards shared patient records: An architecture for using routine data for nationwide research. *Int J Med Inf.* Mar-Apr 2006;75(3-4):191-200.
250. Greenhalgh T, Stramer K, Bratan T, Byrne E, Mohammad Y, Russell J. Introduction of shared electronic records: multi-site case study using diffusion of innovation theory. *BMJ.* 2008;337(a1786).
251. Chen R, Klein G. The openEHR Java Reference Implementation Project. *Stud Health Technol Inform.* 2007;12(Pt 1):58-62.
252. Chen R, Garde S, Beale T, et al. An Archetype-based Testing Framework. *Stud Health Technol Inform.* 2008;136:401-406.

APPENDIX A

The pilot questionnaire pilot study, Norwegian

0033177821 EPJ Evalueringsskjema for Primærleger v.02a
Tom Christensen (tlf. 73598781) og Hallvard Lærum (tlf. 73869748) 1 IDnr

A. Alder, kjønn og klinisk stilling

Alder	Kjønn	Klinisk Stilling	Journalsystem
☐ <35	☐ Kvinne	☐ Turnuslege	☐ Profdoc WinMed
☐ 35-50	☐ Mann	☐ Fastlege	☐ Profdoc Vision
☐ >50		☐ Vikar	☐ Profdoc DOS
		☐ Annet	☐ Infodoc Windows
			☐ Infodoc DOS
			☐ Annet

Kryss av slik: ☒
Ikke slik: ☒

B. Om din erfaring med bruk av datamaskin

		Ja	Nei
1	Eier du en datamaskin?	☐	☐
2	Hvor mange fingre bruker du når du skriver på maskin? ☐ To ☐ Tre eller flere ☐ Alle (evt. touch)		
3	Har du brukt en datamaskin til	Ja	Nei
	a Å lete etter et labresultat eller svar på andre supplerende undersøkelser?	☐	☐
	b Litteratursøk	☐	☐
	c Tekstbehandling	☐	☐
	d Skrive inn kliniske pasientopplysninger (eks. et poliklinisk notat)	☐	☐
	e Innhente kliniske pasientopplysninger (eks. en tidligere epikrise)	☐	☐

		Aldri	Sjeldnere enn månedlig	Månedlig	Ukentlig	Daglig
4	Hva er den høyeste hyppigheten du har brukt datamaskin tidligere?	☐	☐	☐	☐	☐

		Lavest		Middels		Høyest
5	Hvordan vil du rangere dine dataferdigheter?	☐	☐	☐	☐	☐

C. Om tilgjengelighet av datamaskiner på din arbeidsplass på sykehuset

		Ja	Nei
1	Har du en datamaskin på kontoret ditt?	☐	☐
2	Vedrørende øvrige rom du benytter ved klinisk arbeid (eks. skiftestue, akuttstue, undersøkelsesrom)		
	a Finnes det datamaskiner som er tilgjengelig for deg her?	☐	☐
	b Hvis ja, bruker du denne eller disse datamaskinen(e)?	☐	☐

Hvis du svarte nei på både spørsmål 1 og 2a, trenger du ikke fylle ut resten av skjemaet

		Aldri	Sjeldnere enn månedlig	Månedlig	Ukentlig	Daglig
3	Angående datamaskinen(e) som er installert på skiftestue, akuttstue, undersøkelsesrom,o.l. Hvor ofte hindres du i å bruke datamaskin fordi den er i bruk av andre?	☐	☐	☐	☐	☐
4	Hvor ofte hindres du i å gjøre det du skal pga. datafeil, systemhavari eller andre maskinavhengige problemer?	☐	☐	☐	☐	☐
5	Hvor ofte hindres du i å gjøre det du skal fordi systemet arbeider for langsomt?	☐	☐	☐	☐	☐

1

D. Om din bruk av datamaskin (PC) til arbeidsoppgaver innen klinisk arbeid

Hvor ofte bruker du datamaskin (PC) til å hjelpe deg med følgende arbeidsoppgave....	...og...					...hvilke(t) dataprogram bruker du evt. til denne arbeidsoppgaven?	
	Aldri/ nesten aldri	Sjelden	Omtrent halvparten av tiden[1]	Som regel	Alltid/ nesten alltid	Bruker EPJ[2]	Bruker annet dataprogram[3] enn EPJ
1 Få oversikt over pasientens problemstilling	☐	☐	☐	☐	☐	☐	☐
2 Lete frem enkeltopplysninger fra pasientjournalen	☐	☐	☐	☐	☐	☐	☐
3 Følge resultatene av en bestemt prøve eller undersøkelse over tid	☐	☐	☐	☐	☐	☐	☐
4 Slå opp svar på nye prøver eller undersøkelser	☐	☐	☐	☐	☐	☐	☐
5 Føre daglige og/eller forefallende journalnotater	☐	☐	☐	☐	☐	☐	☐
6 Få tak i opplysninger om prosedyre for utredning eller behandling	☐	☐	☐	☐	☐	☐	☐
7 Få svar på spørsmål om generell medisinsk-faglig kunnskap, eks. vedr. behandling, symptomer, komplikasjoner, o.l.	☐	☐	☐	☐	☐	☐	☐
8 Få ut samledata for en gruppe pasienter, eks. komplikasjonsrate, diagnosefordeling	☐	☐	☐	☐	☐	☐	☐
9 Rekvirere klinisk-kjemiske laboratorieanalyser	☐	☐	☐	☐	☐	☐	☐
10 Slå opp svar på klinisk-kjemiske lab.-analyser	☐	☐	☐	☐	☐	☐	☐
11 Rekvirere røntgenundersøkelser, UL eller CT	☐	☐	☐	☐	☐	☐	☐
12 Slå opp svar på røntgen, UL eller CT	☐	☐	☐	☐	☐	☐	☐
13 Rekvirere andre supplerende undersøkelser	☐	☐	☐	☐	☐	☐	☐
14 Slå opp svar på andre suppl. undersøkelser	☐	☐	☐	☐	☐	☐	☐
15 Henvise pasienten til sykehus eller privatpraktiserende spesialist	☐	☐	☐	☐	☐	☐	☐
16 Ordinere behandling direkte (medikamentell, operativ eller annen)	☐	☐	☐	☐	☐	☐	☐
17 Skrive resept	☐	☐	☐	☐	☐	☐	☐
18 Skrive sykmelding	☐	☐	☐	☐	☐	☐	☐
19 Samle inn pasientopplysninger til ulike lege-erklæringer (eks. uførepensjon)	☐	☐	☐	☐	☐	☐	☐
20 Gi skriftlig individuell informasjon til pasienten (eks. sykdommens status, medikamenter, m.m.)	☐	☐	☐	☐	☐	☐	☐
21 Gi skriftlig generell medisinsk-faglig informasjon til pasienten	☐	☐	☐	☐	☐	☐	☐
22 Samle inn opplysninger til epikrise	☐	☐	☐	☐	☐	☐	☐
23 Kontrollere og signere ferdig skrevne notater	☐	☐	☐	☐	☐	☐	☐

24 Annet (spesifiser)

[1] Tiden man bruker på denne arbeidsoppgaven
[2] EPJ = Elektronisk pasientjournal, f.eks. Profdoc, Infodoc m.fl.
[3] F.eks. Norsk Elektronisk Legehåndbok, Helsenett, Elektroniske prosedyrebøker m.fl.

E. Generelt om praksis og bruk av EPJ

		<=1	2	3	4	5	>=6
1	Hvor mange minutter bruker du i gjennomsnitt til registrering og dokumentasjon per konsultasjon?	☐	☐	☐	☐	☐	☐

		<=2	3	4	5	6	>=7
2	Hvor mange pasienter har du i gjennomsnitt på kontoret per klokketime?	☐	☐	☐	☐	☐	☐

		Aldri/ nesten aldri	Sjelden	Omtrent halvparten av tilfellene	Som regel	Alltid/ nesten alltid
3	Hvor ofte føler du behov for å slå opp riktig punkt under paragraf 9 når du fyller ut en blå resept?	☐	☐	☐	☐	☐
4	Hvor ofte benytter du import- og klipp og lim funksjoner i det daglige journalarbeidet?	☐	☐	☐	☐	☐

F. Om din oppfatning av den elektroniske pasientjournalen (EPJ[1]) som brukes på ditt kontor

		Aldri/ nesten aldri	Sjelden	Omtrent halvparten av tiden[3]	Som regel	Alltid/ nesten alltid
1	Innhold					
	a Hvor ofte gir systemet deg akkurat den informasjonen du trenger?	☐	☐	☐	☐	☐
	b Hvor ofte er informasjonsinnholdet nok for ditt behov?	☐	☐	☐	☐	☐
	c Hvor ofte klarer systemet å lage rapporter som ser ut til å passe akkurat for deg?	☐	☐	☐	☐	☐
	d Hvor ofte gir systemet tilstrekkelig informasjon?	☐	☐	☐	☐	☐
2	Nøyaktighet[2]					
	a Hvor ofte er systemet nøyaktig?	☐	☐	☐	☐	☐
	b Hvor ofte er du fornøyd med nøyaktigheten i systemet?	☐	☐	☐	☐	☐
3	Format					
	a Hvor ofte synes du svarene fra systemet presenteres på en nyttig måte?	☐	☐	☐	☐	☐
	b Hvor ofte er informasjonen klar og tydelig?	☐	☐	☐	☐	☐
4	Brukervennlighet					
	a Hvor ofte er systemet brukervennlig?	☐	☐	☐	☐	☐
	b Hvor ofte er systemet enkelt å bruke?	☐	☐	☐	☐	☐
5	Betimelighet					
	a Hvor ofte får du den informasjonen du trenger i tide?	☐	☐	☐	☐	☐
	b Hvor ofte gir systemet deg oppdatert informasjon?	☐	☐	☐	☐	☐

[1] F.eks. Infodoc, WinMed, Vision

[2] F.eks. at rett journal, rett pasient og rett dokumenttype finnes frem; at informasjonen (eks. blodtrykk) presenteres med rett navn; at informasjonen som presenteres er relevant; at samledata i rapporter er korrekte, m.m.

[3] Tiden man bruker med datasystemet

G. Samlet vurdering av den elektroniske pasientjournalen (EPJ) ved ditt kontor

	Svært uenig	Uenig	Litt uenig	Både og	Litt enig	Enig	Svært enig
1 Hvor enig eller uenig er du i følgende utsagn: EPJ er verdt den tid og de krefter det tar å bruke det	☐	☐	☐	☐	☐	☐	☐

	Ikke i det hele tatt	Lite	Noe	Godt	Svært godt
2 Alt i alt, hvor fornøyd er du med den EPJ du bruker på ditt kontor?	☐	☐	☐	☐	☐

3 Alt i alt, hvordan synes du EPJ har endret følgende to aspekter ved ditt kontor?

	Betydelig vanske-ligere	Vanske-ligere	Litt vanske-ligere	Ingen endring	Litt lettere	Lettere	Betydelig lettere
a Gjennomføringen av arbeidet ved vårt kontor er blitt:	☐	☐	☐	☐	☐	☐	☐

	Betydelig dårligere	Dårligere	Litt dårligere	Ingen endring	Litt bedre	Bedre	Betydelig bedre
b Kvaliteten på arbeidet ved vårt kontor er blitt:	☐	☐	☐	☐	☐	☐	☐

	Ikke i det hele tatt	Lite	Noe	Godt	Svært godt
4 Hvor vellykket er den EPJ du bruker på ditt kontor?	☐	☐	☐	☐	☐

H. Din oppfatning om noen funksjoner i elektronisk pasientjournal

Denne delen av spørreskjemaet gjelder funksjoner som vil være mest aktuelle å benytte ved gjentatte kontakter i et forbigående sykdomsforløp, samt ved kontroll av kronisk sykdom. (gjelder fra 50-70% av konsultasjonene i allmennpraksis).

1. Journalnotater

Notatene i den elektroniske journal utgjør en stor del av journalopplysningene. Nedenfor kommer noen påstander knytter til journalnotatene der du skal angi grad av enighet.

	Helt uenig	Litt uenig	Verken enig eller uenig	Litt enig	Helt enig
a. Det er generelt nyttig å se over tidligere notater når jeg arbeider med en pasient.	☐	☐	☐	☐	☐
b. I et skjermbilde er det bare plass til noen få notater. Dette hemmer meg i å få en oversikt.	☐	☐	☐	☐	☐
c. Det hender at jeg lar være, eller gir opp å lete etter tidligere notater fordi det tar for mye tid.	☐	☐	☐	☐	☐
d. Det kan være raskere å spørre eller undersøke pasienten på nytt i stedet for å lete i journalen.	☐	☐	☐	☐	☐

2. Sortering av notater

Tenk deg at du fikk et system som i tillegg til kronologisk rekkefølge av journalnotatene, også kunne sortere dem etter problem. Du kunne enkelt skifte mellom problemene etter behov. Du kunne for eksempel velge/peke på en tidligere diagnose og få frem informasjonen tilhørende dette problemet på skjermen. Ta stilling til påstandene nedenfor gitt at journalsystemet hadde en slik funksjon?

	Helt uenig	Litt uenig	Verken enig eller uenig	Litt enig	Helt enig
a. Jeg ville få bedre oversikt over tidligere notater	☐	☐	☐	☐	☐
b. Jeg ville spare tid	☐	☐	☐	☐	☐
c. Det ville bli færre unødvendige gjentagelser	☐	☐	☐	☐	☐
d. Det ville bli lettere å samle sammen informasjon ved utarbeiding av henvisninger, legeerklæringer og lignende.	☐	☐	☐	☐	☐

3. Oppdeling av notater

For å få fullt utbytte av en slik organisering av journalopplysningene ville det i større grad kreve at du deler opp notater, for eksempel skriver to forskjellige notater når pasienten kommer for to forskjellige problemer.

	Usannsynlig	Lite sannsynlig	Noe sannsynlig	Ganske sannsynlig	Svært sannsynlig
a. Tror du at du ville gjennomføre dette i praksis?	☐	☐	☐	☐	☐
b. Tror du dine kolleger ville gjennomføre dette i praksis?	☐	☐	☐	☐	☐

4. Sortering av annen informasjon enn notater

Sortering av informasjon kan også gjennomføres for andre deler av journalen enn notatene. Når du har oppgitt eller valgt ut en tidligere diagnose/problem hos en pasient, hvor nyttig vil det da være at programmet også kan sortere ut:

	Unyttig	Lite nyttig	Noe nyttig	Ganske nyttig	Svært nyttig
a. Legemidlene som er skrevet ut for denne diagnosen tidligere når du skal skaffe deg oversikt eller skrive ut en resept.	☐	☐	☐	☐	☐
b. Hvilke laboratorieprøver som er blitt tatt tidligere for dette problemet når du skal skaffe deg oversikt elle rekvirere nye prøver?	☐	☐	☐	☐	☐
c. Henvisninger og epikriser som er skrevet i samband med dette problemet når du skal skaffe deg oversikt eller skrive nytt notat eller henvisning	☐	☐	☐	☐	☐

I. Eventuelle kommentarer

1. Er det noen funksjoner i din EPJ du synes fungerer spesielt godt? I så fall forklar:

2. Er det noen funksjoner i din EPJ du synes fungerer mindre godt? I så fall forklar:

3. Er det noen funksjoner i din EPJ du savner spesielt? I så fall forklar:

4. Var deler av spørreskjemaet uklart eller tvetydig? Andre kommentarer?

The main questionnaire study, Norwegian (Paper 1, 2 and 3)

4230212093 EPJ Evalueringsskjema for Primærleger v.05
Tom Christensen (tlf. 73598781) og Hallvard Lærum (tlf. 73598826) 1 IDnr

A. Alder, kjønn og klinisk stilling

Alder	Kjønn	Klinisk Stilling	Journalsystem	Versjon (nummer) av journalsystem
☐ <35	☐ Kvinne	☐ Turnuslege	☐ Profdoc WinMed	
☐ 35-50	☐ Mann	☐ Fastlege	☐ Profdoc Vision	
☐ >50		☐ Vikar	☐ Profdoc DOS	
		☐ Annet	☐ Infodoc Windows	
			☐ Infodoc DOS	
			☐ Annet	

Kryss av slik: ☒
Ikke slik: ☒

B. Om din erfaring med bruk av datamaskin

		Ja	Nei
1	Har du en datamaskin hjemme?	☐	☐
2	Hvor mange fingre bruker du når du skriver på maskin? ☐ To ☐ Tre eller flere ☐ Alle (evt. touch)		
3	Har du tidligere på annen arbeidsplass brukt en datamaskin til	Ja	Nei
	a Å lete etter et labresultat eller svar på andre supplerende undersøkelser?	☐	☐
	b Litteratursøk	☐	☐
	c Tekstbehandling	☐	☐
	d Skrive inn kliniske pasientopplysninger (eks. et konsultasjonsnotat)	☐	☐
	e Innhente kliniske pasientopplysninger (eks. en tidligere epikrise)	☐	☐

		Aldri	Sjeldnere enn månedlig	Månedlig	Ukentlig	Daglig
4	Hva er den høyeste hyppigheten du har brukt datamaskin tidligere?	☐	☐	☐	☐	☐

		Lavest		Middels		Høyest
5	Hvordan vil du rangere dine dataferdigheter?	☐	☐	☐	☐	☐

C. Om tilgjengelighet av datamaskiner på din arbeidsplass

		Ja	Nei
1	Har du en datamaskin på kontoret ditt?	☐	☐
2	Vedrørende øvrige rom du benytter ved klinisk arbeid (eks. skiftestue, akuttstue, undersøkelsesrom)		
	a Finnes det datamaskiner som er tilgjengelig for deg her?	☐	☐
	b Hvis ja, bruker du denne eller disse datamaskinen(e)?	☐	☐

		Aldri	Sjeldnere enn månedlig	Månedlig	Ukentlig	Daglig
3	Angående datamaskinen(e) som er installert på skiftestue, akuttstue, undersøkelsesrom,o.l. Hvor ofte hindres du i å bruke datamaskin fordi den er i bruk av andre?	☐	☐	☐	☐	☐
4	Hvor ofte hindres du i å gjøre det du skal pga. datafeil, systemhavari eller andre maskinavhengige problemer?	☐	☐	☐	☐	☐
5	Hvor ofte hindres du i å gjøre det du skal fordi systemet arbeider for langsomt?	☐	☐	☐	☐	☐

1

D. Om din bruk av datamaskin (PC) til arbeidsoppgaver innen klinisk arbeid

Hvor ofte bruker du datamaskin (PC) til å hjelpe deg med følgende arbeidsoppgaver, og hvilke(t) dataprogram bruker du i så fall?	Kryss av et alternativ i hver linje					Kryss av et eller to alternativer i hver linje	
	Aldri/ nesten aldri	Sjelden	Omtrent halvparten av tiden[1]	Som regel	Alltid/ nesten alltid	Bruker EPJ[2]	Bruker annet dataprogram enn EPJ[3]
1 Få oversikt over pasientens problemstilling	☐	☐	☐	☐	☐	☐	☐
2 Lete frem enkeltopplysninger fra pasientjournalen	☐	☐	☐	☐	☐	☐	☐
3 Følge resultatene av en bestemt prøve eller undersøkelse over tid	☐	☐	☐	☐	☐	☐	☐
4 Slå opp svar på nye prøver eller undersøkelser	☐	☐	☐	☐	☐	☐	☐
5 Føre daglige og/eller forefallende journalnotater	☐	☐	☐	☐	☐	☐	☐
6 Få tak i opplysninger om prosedyre for utredning eller behandling	☐	☐	☐	☐	☐	☐	☐
7 Få svar på spørsmål om generell medisinsk-faglig kunnskap, eks. vedr. behandling, symptomer, komplikasjoner, o.l.	☐	☐	☐	☐	☐	☐	☐
8 Få ut samledata for en gruppe pasienter, eks. komplikasjonsrate, diagnosefordeling	☐	☐	☐	☐	☐	☐	☐
9 Rekvirere klinisk-kjemiske laboratorieanalyser	☐	☐	☐	☐	☐	☐	☐
10 Slå opp svar på klinisk-kjemiske lab.-analyser	☐	☐	☐	☐	☐	☐	☐
11 Rekvirere røntgenundersøkelser, UL eller CT	☐	☐	☐	☐	☐	☐	☐
12 Slå opp svar på røntgen, UL eller CT	☐	☐	☐	☐	☐	☐	☐
13 Rekvirere andre supplerende undersøkelser	☐	☐	☐	☐	☐	☐	☐
14 Slå opp svar på andre suppl. undersøkelser	☐	☐	☐	☐	☐	☐	☐
15 Henvise pasienten til sykehus eller privatpraktiserende spesialist	☐	☐	☐	☐	☐	☐	☐
16 Ordinere behandling direkte (medikamentell, operativ eller annen)	☐	☐	☐	☐	☐	☐	☐
17 Skrive resept	☐	☐	☐	☐	☐	☐	☐
18 Skrive sykmelding	☐	☐	☐	☐	☐	☐	☐
19 Samle inn pasientopplysninger til ulike lege-erklæringer (eks. uførepensjon)	☐	☐	☐	☐	☐	☐	☐
20 Gi skriftlig individuell informasjon til pasienten (eks. sykdommens status, medikamenter, m.m.)	☐	☐	☐	☐	☐	☐	☐
21 Gi skriftlig generell medisinsk-faglig informasjon til pasienten	☐	☐	☐	☐	☐	☐	☐
22 Registrere takster	☐	☐	☐	☐	☐	☐	☐
23 Kontrollere og signere ferdig skrevne notater	☐	☐	☐	☐	☐	☐	☐
23 Annet (spesifiser)							

[1] Tiden man bruker på denne arbeidsoppgaven
[2] EPJ = Elektronisk pasientjournal, f.eks. Profdoc, Infodoc m.fl.
[3] F.eks. Norsk Elektronisk Legehåndbok, Helsenett, Elektroniske prosedyrebøker m.fl.

E. Generelt om praksis og bruk av EPJ

		<=1	2-3	4-5	>=6
1	Hvor mange minutter bruker du i gjennomsnitt til registrering og dokumentasjon per konsultasjon?	☐	☐	☐	☐
		<=10	11-15	16-20	>=21
2	Hvor mange minutter bruker du vanligvis på en kontorkonsultasjon?	☐	☐	☐	☐
		<=14	15-19	20-24	>=25
3	Hvor mange kontorkonsultasjoner har du vanligvis i løpet av en arbeidsdag?	☐	☐	☐	☐

		Aldri/ nesten aldri	Sjelden	Omtrent halvparten av tilfellene	Som regel	Alltid/ nesten alltid
4	Hvor ofte føler du behov for å slå opp riktig punkt under paragraf 9 når du fyller ut en blå resept?	☐	☐	☐	☐	☐
5	Hvor ofte benytter du import- og klipp og lim funksjoner i det daglige journalarbeidet?	☐	☐	☐	☐	☐

F. Om din oppfatning av den elektroniske pasientjournalen (EPJ [1]) som brukes på din arbeidsplass

		Aldri/ nesten aldri	Sjelden	Omtrent halvparten av tiden[3]	Som regel	Alltid/ nesten alltid
1	Innhold					
	a Hvor ofte gir systemet deg akkurat den informasjonen du trenger?	☐	☐	☐	☐	☐
	b Hvor ofte er informasjonsinnholdet nok for ditt behov?	☐	☐	☐	☐	☐
	c Hvor ofte klarer systemet å lage rapporter som ser ut til å passe akkurat for deg?	☐	☐	☐	☐	☐
	d Hvor ofte gir systemet tilstrekkelig informasjon?	☐	☐	☐	☐	☐
2	Nøyaktighet [2]					
	a Hvor ofte er systemet nøyaktig?	☐	☐	☐	☐	☐
	b Hvor ofte er du fornøyd med nøyaktigheten i systemet?	☐	☐	☐	☐	☐
3	Format					
	a Hvor ofte synes du svarene fra systemet presenteres på en nyttig måte?	☐	☐	☐	☐	☐
	b Hvor ofte er informasjonen klar og tydelig?	☐	☐	☐	☐	☐
4	Brukervennlighet					
	a Hvor ofte er systemet brukervennlig?	☐	☐	☐	☐	☐
	b Hvor ofte er systemet enkelt å bruke?	☐	☐	☐	☐	☐
5	Betimelighet					
	a Hvor ofte får du den informasjonen du trenger i tide?	☐	☐	☐	☐	☐
	b Hvor ofte gir systemet deg oppdatert informasjon?	☐	☐	☐	☐	☐

[1] F.eks. Infodoc, WinMed, Vision

[2] F.eks. at rett journal, rett pasient og rett dokumenttype finnes frem; at informasjonen (eks. blodtrykk) presenteres med rett navn; at informasjonen som presenteres er relevant; at samledata i rapporter er korrekte, m.m.

[3] Tiden man bruker med datasystemet

G. Samlet vurdering av den elektroniske pasientjournalen (EPJ) på din arbeidsplass

	Svært uenig	Uenig	Litt uenig	Både og	Litt enig	Enig	Svært enig
1 Hvor enig eller uenig er du i følgende utsagn: EPJ er verdt den tid og de krefter det tar å bruke det	☐	☐	☐	☐	☐	☐	☐

	Ikke i det hele tatt	Lite	Noe	Godt	Svært godt
2 Alt i alt, hvor fornøyd er du med den EPJ du bruker på din arbeidsplass	☐	☐	☐	☐	☐

3 Alt i alt, hvordan synes du EPJ har endret følgende to aspekter på din arbeidsplass

	Betydelig vanske-ligere	Vanske-ligere	Litt vanske-ligere	Ingen endring	Litt lettere	Lettere	Betydelig lettere
a Gjennomføringen av arbeidet ved vår arbeidsplass er blitt:	☐	☐	☐	☐	☐	☐	☐

	Betydelig dårligere	Dårligere	Litt dårligere	Ingen endring	Litt bedre	Bedre	Betydelig bedre
b Kvaliteten på arbeidet ved vår arbeidsplass er blitt:	☐	☐	☐	☐	☐	☐	☐

	Ikke i det hele tatt	Lite	Noe	Godt	Svært godt
4 Hvor vellykket er den EPJ du bruker på din arbeidsplass?	☐	☐	☐	☐	☐

H. Din oppfatning om noen funksjoner i elektronisk pasientjournal

Denne delen av spørreskjemaet gjelder funksjoner som vil være mest aktuelle å benytte ved gjentatte kontakter i et forbigående sykdomsforløp, samt ved kontroll av kronisk sykdom. (gjelder fra 50-70% av konsultasjonene i allmennpraksis).

1. Journalnotater

Notatene i den elektroniske journal utgjør en stor del av journalopplysningene. Nedenfor kommer noen påstander knytter til journalnotatene der du skal angi grad av enighet.

	Helt uenig	Litt uenig	Verken enig eller uenig	Litt enig	Helt enig
a. Det er generelt nyttig å se over tidligere notater når jeg arbeider med en pasient.	☐	☐	☐	☐	☐
b. Slik notatene er organisert i dag er det ofte vanskelig å få en oversikt over aktuelle notater i ett skjermbilde	☐	☐	☐	☐	☐
c. Det hender at jeg må gi opp å lete etter notater fordi det tar for lang tid	☐	☐	☐	☐	☐
d. Det hender at jeg lar være å lete etter notater fordi jeg tror det tar for lang tid	☐	☐	☐	☐	☐
e. Det kan være raskere å spørre eller undersøke pasienten på nytt i stedet for å lete i journalen.	☐	☐	☐	☐	☐

2. Sortering av notater
Tenk deg at du fikk et system som i tillegg til kronologisk rekkefølge av journalnotatene, også kunne sortere dem etter problem eller diagnose på en enkel måte.

Ta stilling til påstandene nedenfor gitt at journalsystemet hadde en slik funksjon:

	Helt uenig	Litt uenig	Verken enig eller uenig	Litt enig	Helt enig
a. Jeg ville få bedre oversikt over tidligere notater	☐	☐	☐	☐	☐
b. Det ville være enklere å finne relevante notater	☐	☐	☐	☐	☐
c. Det ville bli lettere å gjenbruke informasjon om pasienten	☐	☐	☐	☐	☐

3. Oppdeling av notater
For å få fullt utbytte av en slik organisering av journalopplysningene ville det i større grad kreve at du deler opp notater, for eksempel skriver to forskjellige notater når pasienten kommer for to forskjellige problemer.

Hvor sannsynlig er det at du ville gjennomføre dette i praksis hvis...

	Usannsynlig	Lite sannsynlig	Noe sannsynlig	Ganske sannsynlig	Svært sannsynlig
a. ...journalarbeidet totalt sett ikke tar mer tid enn nå	☐	☐	☐	☐	☐
b. ...journalarbeidet totalt sett tar mindre tid enn nå	☐	☐	☐	☐	☐
c. ...journalarbeidet totalt sett tar litt mer tid enn nå (inntil et minutt mer per pasient)	☐	☐	☐	☐	☐

4. Sortering av annen informasjon enn notater
Sortering av informasjon kan også gjennomføres for andre deler av journalen enn notatene. Når du arbeider med en bestemt diagnose eller et bestemt problem hos en pasient, hvor nyttig vil det da være at programmet også kan sortere ut...

	Unyttig	Lite nyttig	Noe nyttig	Ganske nyttig	Svært nyttig
a. ...hvilke legemidler som tidligere er skrevet ut for denne diagnosen/dette problemet	☐	☐	☐	☐	☐
b. ...hvilke laboratorieprøver som tidligere er tatt for denne diagnosen/dette problemet	☐	☐	☐	☐	☐
c. ...hvilke røntgenundersøkelser som tidligere er gjort denne diagnosen/dette problemet	☐	☐	☐	☐	☐
d. ...hvilke henvisninger eller epikriser som er knyttet til denne diagnosen/dette problemet	☐	☐	☐	☐	☐

I. Eventuelle kommentarer

1. Er det noen funksjoner i din EPJ du synes fungerer spesielt godt? I så fall forklar:

2. Er det noen funksjoner i din EPJ du synes fungerer mindre godt? I så fall forklar:

3. Er det noen funksjoner i din EPJ du savner spesielt? I så fall forklar:

4. Var deler av spørreskjemaet uklart eller tvetydig? Andre kommentarer?

The main questionnaire study, English (Paper 1, 2 and 3)

A. Age, gender, and work position

Version (number) of EPR system:.....

Age	Gender	Work position	EPR System	
☐ <35	☐ Female	☐ Intern	☐ Profdoc WinMed	*Check like this:* ☒
☐ 35-50	☐ Male	☐ GP with patient list	☐ Profdoc Vision	*not like this:* ☒
☐ >50		☐ Substitute	☐ Profdoc DOS	☐ Infodoc DOS
		☐ Other	☐ Infodoc Windows	☐ Other systems

B. Your experience with computers

		Yes	No
1	Do you own a computer?	☐	☐

2 How many fingers do you use when typing? ☐ Two ☐ Three or more ☐ All (or touch)

		Yes	No
3	Have you used a computer for		
	a Test result retrieval	☐	☐
	b Literature search	☐	☐
	c Word processing	☐	☐
	d Entering patient info	☐	☐
	e Retrieving patient info	☐	☐

		Never	Rarely	Monthly	Weekly	Daily
4	In the past, what is the most frequently you have used a computer?	☐	☐	☐	☐	☐

		Lowest		Average		Highest
5	How would you rate your computer skills?	☐	☐	☐	☐	☐

C. The availability of computers at your work place

		Yes	No
1	Do you have a computer in your office?	☐	☐
2	Concerning other rooms you use for clinical work (e.g. ward, emergency room, investigation rooms)		
	a Are there computers available for you here?	☐	☐
	b If yes, do you use these computers?	☐	☐

		Never	Rarely	Montly	Weekly	Daily
3	About the computers installed in the ward, at the outpatient clinic offices, investigation rooms, etc. How often are you prevented from using them because.others are using them?	☐	☐	☐	☐	☐
4	How often are you prevented from using them due to computer errors or other machine-related problems?	☐	☐	☐	☐	☐
5	How often are you prevented from doing your work because the system is working too slowly?	☐	☐	☐	☐	☐

D. Your use of personal computers for clinical tasks in your clinical work

How often do you use a personal computer (PC) to assist you with the following tasks, and what kind of computer program do you use?	Never/ almost never	Seldom	About half of thetime [1]	Most of the time	Always/ almost always	What computer program do you use for this task? EMR[2]	Other than EMR
1 Review the patient's problems	☐	☐	☐	☐	☐	☐	☐
2 Seek out specific information from patient records	☐	☐	☐	☐	☐	☐	☐
3 Follow the results of a particular test or investigation over time	☐	☐	☐	☐	☐	☐	☐
4 Obtain the results from new tests or investigations	☐	☐	☐	☐	☐	☐	☐
5 Enter daily and/or continuing notes	☐	☐	☐	☐	☐	☐	☐
6 Obtain information on investigation or treatment procedures	☐	☐	☐	☐	☐	☐	☐
7 Answer questions concerning general medical knowledge (e.g., concerning treatment, symptoms, complications)	☐	☐	☐	☐	☐	☐	☐
8 Produce data reviews for specific patient groups, e.g. complication rate, diagnoses	☐	☐	☐	☐	☐	☐	☐
9 Order clinical biochemical laboratory analyses	☐	☐	☐	☐	☐	☐	☐
10 Look up results from clinical biochemical laboratory analyses	☐	☐	☐	☐	☐	☐	☐
11 Order X-ray, ultrasound, or CT investigations	☐	☐	☐	☐	☐	☐	☐
12 Look up the results from X-ray, ultrasound or, CT investigations	☐	☐	☐	☐	☐	☐	☐
13 Order other supplementary investigations	☐	☐	☐	☐	☐	☐	☐
14 Look up the results from other supplementary investigations	☐	☐	☐	☐	☐	☐	☐
15 Refer the patient to hospitalss or specialists in private medical practices	☐	☐	☐	☐	☐	☐	☐
16 Order treatment directly (e.g. medicines, operations or other)	☐	☐	☐	☐	☐	☐	☐
17 Write prescriptions	☐	☐	☐	☐	☐	☐	☐
18 Write sick-leave notes	☐	☐	☐	☐	☐	☐	☐
19 Collect patient information for various medical declarations	☐	☐	☐	☐	☐	☐	☐
20 Give written individual information to patients, e.g., about medications, disease status	☐	☐	☐	☐	☐	☐	☐
21 Give written general medical information to patients	☐	☐	☐	☐	☐	☐	☐
22 Claim reimbursement	☐	☐	☐	☐	☐	☐	☐
23 Check and sign previous record notes	☐	☐	☐	☐	☐	☐	☐

24 Other (specify)

[1] The time normally spent on this task

[2] Profdoc WinMed, Profdoc Vision, Infodoc Windows

Remember to fill in this column, too....

E. Generally about praxis and use of EPR

		<=1	2-3	4-5	>=6
1	How many minutes in average do you use on data entery and documentation in each consultation?	☐	☐	☐	☐

		<=10	11-15	16-20	>=21
2	How many minutes does a normal consultation last?	☐	☐	☐	☐

		<=14	15-19	20-24	>=25
3	How many patient encounters is normal in one working day?	☐	☐	☐	☐

		Never/ almost never	Seldom	About half of the time	Most of the time	Always/ almost always
4	How often do you need to look up the right refund code when you fill out a refundable prescription?	☐	☐	☐	☐	☐
5	How often do you use cut and paste functions in your daily work in the EPR?	☐	☐	☐	☐	☐

F. About your satisfaction with the EPR installed in your working place

		Never/ almost never	Seldom	About half of the time	Most of the time	Always/ almost always
1	Content					
	a How often does the system provide the precise information you need?	☐	☐	☐	☐	☐
	b How often does the information content meet your needs?	☐	☐	☐	☐	☐
	c How often does the system provide reports that seem to be exactly what you need?	☐	☐	☐	☐	☐
	d How often does the system provide sufficient information?	☐	☐	☐	☐	☐
2	Accuracy					
	a How often is the system accurate?	☐	☐	☐	☐	☐
	b How often are you satisfied with the accuracy of the system?	☐	☐	☐	☐	☐
3	Format					
	a How often do you think the output is presented in a useful format?	☐	☐	☐	☐	☐
	b How often is the information adequate and easy to understand?	☐	☐	☐	☐	☐
4	User-friendliness					
	a How often is the system user-friendly?	☐	☐	☐	☐	☐
	b How often is the system easy to use?	☐	☐	☐	☐	☐
5	Timeliness					
	a How often do you get the information you need in time?	☐	☐	☐	☐	☐
	b How often does the system provide up-to-dated information?	☐	☐	☐	☐	☐

[1] Profdoc WinMed, Profdoc Vision, Infodoc Windows

[2] E.g. right journal, right patient and right document types are located; the information (e.g. blood pressure) is labelled correctly, The information presented is relevant; the aggregated data in overviews are correct.

G. Global assessment of the EPR installed in your place of work

1 How much do you agree with the following statement about the system:	Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly disagree
The EPR system is worth the time and effort required to use it	☐	☐	☐	☐	☐	☐	☐

2 All things considered, how would you rate your satisfaction with the EMR installed in your place of work?	non-existent	poor	fair	good	excellent
	☐	☐	☐	☐	☐

3 All things considered, to what extent has the system changed these two aspects of your own department?

	Signifi-cantly decreased	Decreased	Slightly decreased	No change	Slightly increased	Increased	Signifi-cantly increased
a The ease of performing the work at our workplace has been	☐	☐	☐	☐	☐	☐	☐
b the quality of the work at our workplace has been	☐	☐	☐	☐	☐	☐	☐

4 All things considered, how would you rate the success of the EMR system installed in your place of work?	non-existent	poor	fair	good	excellent
	☐	☐	☐	☐	☐

H. Your opinion of some functions in the EPR

This part ofthe questionnaire deals with the functions that would be adequate to use in to repeating visis related to temoorary disease , and related to control of chronically ill patients (50-70% of encounters in primary care)

1. Record notes

The record notes constitutes a major part of the information in the EPR. In the following you shall report how much you can agree to some statements.

	Disagree	Partly disagree	Indifferent	Partly agree	Agree
a. It is generally useful to look over previous notes while owrking with a patient?	☐	☐	☐	☐	☐
b. It is often difficult to get an overview of relevant record notes in one screenshot	☐	☐	☐	☐	☐
c. It happens that I must give in looking for relevant record notes because it is too time consuming	☐	☐	☐	☐	☐
d. It happens that I don`t look up relevant record notes because I think it will be to time consuming	☐	☐	☐	☐	☐
e It could be easier to ask or examine the patient one more time than to look up the information in the EPR	☐	☐	☐	☐	☐

2. Sort out record notes
Consider that you had an EPR system that could arrange the record notes by problems or diagnosis in a user-friendly way in addition to the usal chronoligical view.

Rank the following statements given that the EPR system had such a function

	Disagree	Partly diagree	Indifferent	Partly agree	Agree
a. Iwould get a better overvies of the record notes	☐	☐	☐	☐	☐
b. It would be easier to find relevant record notes	☐	☐	☐	☐	☐
c. I would be easier to reuse patient information	☐	☐	☐	☐	☐

3. Separate recod notes
To utilize such an organisation of the information in the EPR it would some times probably be necessary to write separate record notes, i.e. write two different record notes when the patient presents two different problems

Is What is the chance that you would do this if....

	Improable	A bit probalbe	Some probable	Quite probable	Highly probable.
a. The work related to use of EPR would not take any more time than by the routines oftodag?	☐	☐	☐	☐	☐
b. The work related to the use of EPR would take l less time than the work of today	☐	☐	☐	☐	☐
c. The work related to use of the EPR would tak a bit more time than today (up to one minute more)	☐	☐	☐	☐	☐

4. Sort out other informastion than record notes
Sorting out information kan be done for other information than the record notes. When you work with a certain diagnosis or problem when a patient is consulting you, how useful woould it be if the EPR also could sort out....

	Unuseful	**A bit useful**	**Some useful**	**Quite useful**	**Most useful**
a. what kind of medication that was prescribed reltated to the actual diagnosis or prlblem	☐	☐	☐	☐	☐
b. what kind of laboratory tests that was taken for this diagnosis or problem	☐	☐	☐	☐	☐
c. what kind of x-rays that woas conducted for this diagnosis or proglem	☐	☐	☐	☐	☐
d. what kind of refrrals or discharge letters that where related to this diagnosis or problem	☐	☐	☐	☐	☐

I. Comments

1. Are thrre any functions in the EPR that works extraordinary well? In that case, pleasse explain:

2. Are there any functions in the EPR that work badly? In that case, please explain:

3. Do you miss some functions in the EPR? In that case, please explain:

4. Did you find some parts of the questionnaire ambiguous or difficult to understand? Other vomments:

Questionnaire sections, main study, Norwegian (Paper 1 and 3)

0204177821 EPJ Evalueringsskjema for Primærleger v.02a
Tom Christensen (tlf. 73598781) og Hallvard Lærum (tlf. 73869748) 3 IDnr ☐☐☐☐

E. Generelt om praksis og bruk av EPJ

1	Hvor mange minutter bruker du i gjennomsnitt til registrering og dokumentasjon per konsultasjon?	<=1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	>=6 ☐
2	Hvor mange pasienter har du i gjennomsnitt på kontoret per klokketime?	<=2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	>=7 ☐

		Aldri/ nesten aldri	Sjelden	Omtrent halvparten av tilfellene	Som regel	Alltid/ nesten alltid
3	Hvor ofte føler du behov for å slå opp riktig punkt under paragraf 9 når du fyller ut en blå resept?	☐	☐	☐	☐	☐
4	Hvor ofte benytter du import- og klipp og lim funksjoner i det daglige journalarbeidet?	☐	☐	☐	☐	☐

H. Din oppfatning om noen funksjoner i elektronisk pasientjournal

Denne delen av spørreskjemaet gjelder funksjoner som vil være mest aktuelle å benytte ved gjentatte kontakter i et forbigående sykdomsforløp, samt ved kontroll av kronisk sykdom. (gjelder fra 50-70% av konsultasjonene i allmennpraksis).

1. Journalnotater

Notatene i den elektroniske journal utgjør en stor del av journalopplysningene. Nedenfor kommer noen påstander knytter til journalnotatene der du skal angi grad av enighet.

		Helt uenig	Litt uenig	Verken enig eller uenig	Litt enig	Helt enig
a.	Det er generelt nyttig å se over tidligere notater når jeg arbeider med en pasient.	☐	☐	☐	☐	☐
b.	I et skjermbilde er det bare plass til noen få notater. Dette hemmer meg i å få en oversikt.	☐	☐	☐	☐	☐
c.	Det hender at jeg lar være, eller gir opp å lete etter tidligere notater fordi det tar for mye tid.	☐	☐	☐	☐	☐
d.	Det kan være raskere å spørre eller undersøke pasienten på nytt i stedet for å lete i journalen.	☐	☐	☐	☐	☐

2. Sortering av notater

Tenk deg at du fikk et system som i tillegg til kronologisk rekkefølge av journalnotatene, også kunne sortere dem etter problem. Du kunne enkelt skifte mellom problemene etter behov. Du kunne for eksempel velge/peke på en tidligere diagnose og få frem informasjonen tilhørende dette problemet på skjermen. Ta stilling til påstandene nedenfor gitt at journalsystemet hadde en slik funksjon?

	Helt uenig	Litt uenig	Verken enig eller uenig	Litt enig	Helt enig
a. Jeg ville få bedre oversikt over tidligere notater	☐	☐	☐	☐	☐
b. Jeg ville spare tid	☐	☐	☐	☐	☐
c. Det ville bli færre unødvendige gjentagelser	☐	☐	☐	☐	☐
d. Det ville bli lettere å samle sammen informasjon ved utarbeiding av henvisninger, legeerklæringer og lignende.	☐	☐	☐	☐	☐

3. Oppdeling av notater

For å få fullt utbytte av en slik organisering av journalopplysningene ville det i større grad kreve at du deler opp notater, for eksempel skriver to forskjellige notater når pasienten kommer for to forskjellige problemer.

	Usannsynlig	Lite sannsynlig	Noe sannsynlig	Ganske sannsynlig	Svært sannsynlig
a. Tror du at du ville gjennomføre dette i praksis?	☐	☐	☐	☐	☐
b. Tror du dine kolleger ville gjennomføre dette i praksis?	☐	☐	☐	☐	☐

4. Sortering av annen informasjon enn notater

Sortering av informasjon kan også gjennomføres for andre deler av journalen enn notatene. Når du har oppgitt eller valgt ut en tidligere diagnose/problem hos en pasient, hvor nyttig vil det da være at programmet også kan sortere ut:

	Unyttig	Lite nyttig	Noe nyttig	Ganske nyttig	Svært nyttig
a. Legemidlene som er skrevet ut for denne diagnosen tidligere når du skal skaffe deg oversikt eller skrive ut en resept.	☐	☐	☐	☐	☐
b. Hvilke laboratorieprøver som er blitt tatt tidligere for dette problemet når du skal skaffe deg oversikt elle rekvirere nye prøver?	☐	☐	☐	☐	☐
c. Henvisninger og epikriser som er skrevet i samband med dette problemet når du skal skaffe deg oversikt eller skrive nytt notat eller henvisning	☐	☐	☐	☐	☐

Questionnaire sections, main study, English (Paper 1 and 3)

EPJ evaluating questionnaire for Primary care physicians v. 02a
Tom Christensen and Hallvard Lærum ☐☐☐☐

E. General about praxis and use of the electronic patient record (EPR) in your office

1 How many minutes do you approximately use to register and document in each patient encounter?

≤ 1	2	3	4	5	6
☐	☐	☐	☐	☐	☐

2 How many patients to you in your office see every one hour?

≤ 2	3	4	5	6	≥ 7
☐	☐	☐	☐	☐	☐

	Never/ Almost Never	Rarely	About half of the time	Most of the time	Always almost
3 How often do you need to search for information about prescription reimbursement regulations?	☐	☐	☐	☐	☐
4 How often do you use cut and paste functions in your daily work with the EPR?	☐	☐	☐	☐	☐

H. Your meaning about some functions in the EPR

This part of the questionnaire deals about functions that are mostly used with multiple contacts in a temporary patient trajectory, and in chronically ill patients. (50-70% of the encounters in primary care praxis).

1 *Record notes*

The record notes form a major part of the information in the EPR. You will now be presented some statements related to the record notes and you shall mark your degree of agreement.

	Disagree	Slightly disagree	Neutral	Slightly agree	Agree
a It is generally useful to look into previous record notes when I work with a patient.	☐	☐	☐	☐	☐
b In one screen shot only a few record notes can be presented. This prevents me from having a good overview of the notes.	☐	☐	☐	☐	☐
c It happens that I either don't look at all or give up looking for previous record notes because it is to time consuming	☐	☐	☐	☐	☐
d It might be faster to ask the patient for information or do a physical examination rather than to search in the EPR	☐	☐	☐	☐	☐

2 *Sort out record notes*

Imagine you got a system that in addition to the chronological view also could sort them by problems. You could easily alternate between the views. If you by example point choose/point on a diagnosis and then be presented all information connected to this problem. Mark how you agree with the statements assuming the EPR had such a functionality.

	Disagree	Slightly disagree	Neutral	Slightly agree	Agree
a I would have a better overview of previous record notes.	☐	☐	☐	☐	☐
b I would spare time	☐	☐	☐	☐	☐
c I would have been fewer unnecessary repetitions in the EPR	☐	☐	☐	☐	☐
d I would be easier to collect information when working with referral letters, medical certificates and such	☐	☐	☐	☐	☐

3 *Take down separate record notes*

To achieve full advantage of such an organization of the information in the EPR you would have to take down separate record notes more often. For instance write two separate record notes when two separate problems are presented or defined.

	Unlikely	Not much likely	Little likely	Quit likely	Very likely
a Do you think you would do so in your praxis?	☐	☐	☐	☐	☐
b Do you think your colleagues would do so in praxis?	☐	☐	☐	☐	☐

4 Sort out other information than the record notes

Other parts of the information in the records then the record notes can sorted out as well. How useful would you find it to be if the application could sort out the following information when you have chosen a problem or a diagnose:

	Useless	Almost useless	Some useful	Quite useful	Very useful
a Drugs that have been prescribed earlier when you want an prescription overview or like to do a prescription.	☐	☐	☐	☐	☐
b Previous laboratory results related to the problem you are working with when you want an overview or are about to take new samples	☐	☐	☐	☐	☐
c Referral letters and case reports related to the problem you are working with when you need an overview or want to take down a new record note or a referral letter	☐	☐	☐	☐	☐

APPENDIX B

Interview guide focus groups, Norwegian

FOKUSGRUPPESPØRSMÅL Endelig versjon

Oppsummering av fokusgruppespørsmålene.

Hva vil du si er det mest positive ved EPJ?

Hva er det mest negative?

Hva tenker du og hva skjer når du skal hente inn en ny pasient?

Hva tenker du og hva skjer når pasienten har kommet inn på kontoret?

Hvordan bruker du journalen i konsultasjonsarbeidet?

Er det noen forandringer dere kunne tenke dere i den elektroniske pasientjournalen?

Hvilke forandringer vil dere prioritere som de mest viktige?

Felles tema for alle samtaleområder:

1. **Oversikt**
2. **Gjenbruk av informasjon**
3. **Påminnere**
4. **Beslutningsstøtte**
5. **Arbeidsflyt**

Presentasjon (ved Anders Grimsmo)

Vi må først få takke for at vi fikk komme. Dere lurer sikkert på hva vi skal, men det skal jeg forklare etter at vi først har presentert oss.

Vi driver altså forskning, så godt som på heltid alle og temaet vårt er den elektroniske pasientjournalen.

Formålet: Hvordan kan den elektroniske journalen bli bedre?

Det finnes mange måter å finne ut hvordan EPJ kan bli bedre.
Det finnes spørreskjema, intervju, observasjon av leger i arbeid, men det forutsetter helst at man på forhånd vet nøyaktig hva man skal spørre om og se etter.

Vi har valgt en metode som kalles Fokusgruppe intervju. Det er fordi vi ikke er riktig sikre på hva som er viktig i denne sammenhengen, men håper det vil komme frem underveis når dere begynner å fortelle oss hvordan dere bruker EPJ i konsultasjonsarbeidet. Og i tillegg så kan man i en gruppe som utveksler synspunkter og erfaringer kanskje der og da få gode tips om hvordan problemer kan løses.

Tom og jeg har våre meninger om pasientjournalen og hvordan den bør bli, men jeg har en mistanke om at så opptatt som vi har vært av EPJ, så er det en fare for at våre synspunkter kan bli litt sære. Og min erfaring er at man tenker så mye bedre når en fører en dialog.

Dette blir altså en slags gruppediskusjon. Min rolle er å være ordstyrer. Jeg kommer til å lede dette ved å stille dere spørsmål. Men det er like mye dere som skal snakke dere i mellom. Hører du noe som du gjerne vil supplere, evt. noe du selv vil følge opp med spørsmål, så gi meg et tegn. Dermed unngår en lettere at en snakker i munnen på hverandre. Jeg vil også be dere slå av mobiltelefonene.

Jeg har en liste over 4-5 temaer som vi vil at vi skal komme innom. Derfor kommer jeg kanskje noen ganger til å bryte en diskusjon som er i gang.

Dere vil merke at ikke spørsmålene dreier seg om pasientjournalen. Det er fordi at vi på noen områder heller vil vite hvordan dere tenker enn hvordan dere bruker EPJ. Ideelt sett kunne vi ønsket oss å starte helt på scratch. Vi har en tendens til å tenke ut i fra hva vi er vant med og kjenner. Derfor en utfordring til dere: T e n k f r i t t !

Jeg skal også passe på at flere meninger kommer frem – dvs. jeg ser gjerne at dere er uenige og står frem med det. Her det ikke ”rette” eller ”gale” svar, - bare ulike synspunkter.

Vi tar opp dette på bånd. Selv om Tom noterer underveis, så er det umulig å få med seg alt, og i verste fall så kan Tom og jeg etterpå bli uenig om hva som egentlig ble sagt. Vi

hører helst det vi liker å høre. Men navn og evt. synspunkter sol lett kan bli knyttet til person, vil ikke under noen omstendigheter bli brukt når vi skal publisere resultatene. For analysen sin del er det likevel viktig at navnet på den som snakker fremkommer ved at jeg gir ordet til hver som har noe på hjertet ved å si navnet.

Første spørsmål:

Hva vil du si er det mest positive ved EPJ og hva er det mest negative?

Vi skal starte denne fokusgruppen med først å gå i vårt eget lønnkammer og tenke litt. Dere har fått et skjema. Øverst er det noen person- og bakgrunnsopplysninger som vi gjerne vil ha når vi senere skal studere det dere sier.

Under er arket delt i to spalter. I den ene skal dere ramse opp hva dere synes er mest positivt med elektronisk pasientjournal. I den andre hva dere synes er mest negativt.

Dette gjelder både generelt og som arbeidsverktøy i allmennpraksis. Hvis dere greier å sette opp 4-5 momenter i hver kategori blir vi godt fornøyd, uten at det skal være noe mål at det blir like mange av hver.

Dere får 10min stillhet. Etterpå tar vi opp i plenum det som dere har skrevet opp.

Stillhet

Det første jeg vil dere skal gjøre, er å sette en strek under det som dere har ført opp på begge sider. Hvis dere under den videre diskusjonen i gruppen plutselig kommer på noe som dere synes er minst like viktig som det dere allerede har ført opp, så føy det til under.

Vi begynner med de positive er faringene med EPJ. Kan du (navn) fortelle hva du har skrevet opp?

Hva tenker du på og hva skjer når du skal hente inn en ny pasient? (oversikt)

For å få litt systematikk i diskusjonen, skal vi videre gå gjennom de ulike trinnene i en pasientkonsultasjon på kontoret. La oss starte med at du akkurat har gjort deg ferdig med en pasient. Du sitter enda i stolen. Du er ferdig med det du skal skrive, og forrige pasient er gått ut.

Hva er vanligvis det første du gjør når du skal fortsette?

Momenter:

Oppslag i timeboka
Tidspunkt for åpning av pasientjournalen
Undersøke tidligere informasjon.

Jeg vil gjerne ha noen flere synspunkter på det med å få oversikt over informasjonen om pasienten. Er det viktig med oversikt? (Har du noen eksempler på slike situasjoner?)

Fører du noen form for oversikt i EPJ?

Hva tenker du og hva skjer når pasienten har kommet inn på kontoret?
(Problemorientering)

Vi fortsetter med trinnene i en konsultasjon. Først et spørsmål: Når pasienten og du har kommet inn på kontoret, hvor lang tid tar det før du har begynt å tenke på hva pasienten kommer for og hva som feiler han?

Når det ikke er en kontroll, men en pasient som henvender seg for noe nytt, skal vi normalt finne frem til en diagnose. Kanskje et litt vanskelig spørsmål: Når du aner hva slags problem eller diagnose du har med å gjøre, hva er det da som har kommet på plass?

Momenter:

Reduksjonistisk problemorientert versus systematisk og bred
Mønstergjenkjenning
Sannsynlighet

Hender det at du står fast? Hva gjør du vanligvis da? (Hvis det ikke er en opplagt sak for henvisning).

Momenter:

Beslutningstøtte
Informasjonskilder
Brukes journalen?

Aller leger har felleskatalogen på bordet. Mange også Norsk legemiddelhåndbok, og noen har Norsk elektronisk legehåndbok.
Er det noe av informasjonen i disse oppslagsverkene som burde vært tilgjengelig direkte i EPJ, og i så fall på hvilken måte?

Kunne du tenkt deg felleskatalogen i elektronisk form, i stedet for den du har nå? Hvorfor ikke?

Hvor mye bruker dere NEL? Hva er grunnen til at mange bruker den så lite?

Hvordan bruker du journalen i konsultasjonsarbeidet?
(Dokumentasjon, episoder notater)

Så over til en konsultasjon der det ikke dreier som om et nytt tilfelle, men om en pasient som går jevnlig til kontroll.

Ser du etter hva som står i forrige notat ved en kontroll – alltid? Bruker du å bla i journalen mens du undersøker og snakker med pasienten? Hvor mange notater eller skjermbilder bakover bruker du vanligvis å kikke før du synes det går med for mye tid?

Skriver du vanligvis uavhengige og frittstående notater som gir en rimelig mening helt av seg selv, eller skriver du bare supplerende opplysninger som det var en fortsettelse av forrige notat om dette problemet?

Bruker du å skrive noe om hva du skal gjøre neste gang?

I løpet av en pasientkontakt, - når skriver du helst eller vanligvis journalnotatet? Skriver du alt i ett notat eller deler du opp i problemer/diagnoser?

Hender det at du glemmer noe som du skulle har gjort, og hva er det vanligvis tror du?

Når fører du inn diagnosen?

Momenter:

Bruk av tidligere informasjon
Skille mellom problemer
Påminninger

(Tiltak)
Når du i hovedsak er ferdig med undersøkelse og samtale og skal iverksette tiltak, - for eksempel skrive resept, bestille prøver, lage henvisning, - gjør du det med pasienten til stede eller hvordan gjør du det?

Ser du får deg at det kunne vært en kobling mellom diagnosen som du har satt, og iverksettingen av tiltak, - når du skrev resept eller bestilte prøver?

Når det er et kjent problem, kunne du tenkt deg at det hadde vært praktisk å sette diagnosen først og at alt du hadde skrevet og gjort tidligere omkring dette problemet ble filtrert frem?

Om dere tenker fritt; er det noen forandringer dere kunne tenke dere i den elektroniske pasientjournalen?

Vi vet at leger ofte har sin helt bestemte måte å arbeide på, noe som også gjenspeiler seg i måten de bruker journalen på. Selv når jeg viser mine kollegaer hvordan de kan gjøre ting både enklere og raskere, så fortsette de på samme ofte tungvinte måte som tidligere, samtidig som de klager over hardt tidspress. Har noen mening om hvorfor det er så vanskelig å legge om arbeidsmønstre, og hva må egentlig til?

Nå vil jeg ha en stille stund igjen. Dere skal tenke på det vi har snakket om til nå i denne gruppen og så skal dere sette opp en liste på hva dere ville ha ønsket dere i samband med pasientjournalen. Det skriver dere ned på arket.

Når dere setter opp denne listen, så prøv om dere kan glemme de journalsystemer som dere kjenner. Tenk helt fritt og at det ikke finnes begrensninger på hva man kan få til, - det gjelder både funksjoner og innhold.

Så avslutter vi med dette i plenum.

Stillhet

Hvilke av disse forandringene synes dere er de viktigste?

Nå vil jeg gjerne høre hvordan dere alle ønsker at et journalsystem skal fungere for å være mest mulig optimalt?

Hva vil du prioritere høyest på ønskelisten? Sett et 1-tall med ring rundt for det med høyest prioritet og så videre nedover, og gjør det samme med listen over det positive og det negative som vi startet med.

Fokusgruppe (dato)

Navn…….

Kvinne:___ Mann:___ Alder:_____ Tid i praksis:_____ år

Hvilket journalsystem bruker du nå?

WinMed___ Vision___ Profdoc Dos___ Infodoc___ Annet___

Hvilket journalsystem har du erfaring med fra tidligere?

WinMed___ Vision___ Profdoc Dos___ Infodoc___ Annet___

Har du jobbet i allmennpraksis uten tilgang på elektronisk pasientjournal, - bare brukt papirjournal?

Ja___ Nei___

Erfaringer og synspunkter på den elektroniske pasientjournalen

De mest positive

De mest negative

Spørsmål for eventuell stimulering av debatten:

Taler:
Kan du utdype dette nærmere?
Vil du beskrive hva du mener?
Kan du gi et eksempel?
Er det mer du vil si?
Hvilke erfaringer har du gjort som gjør at du er kommet fram til dette?
Hvis……? Hva……..?

De andre i gruppen:
Er det noen som har noe å tilføye?
Dere ser ut til å være enige, noen innvendinger?
Vi vil gjerne ha alle synspunkter. Er det noen som ser annerledes på dette
Har noen gjort seg andre erfaringer?
Er det flere som kan stadfeste det som blir sagt?)

Interview guide focus groups, English

Focus group questions summarized

Final version

What is best about EPR systems?

What is worst about EPR systems?

What do you think about and what happens before you are about to call the patient in to your office?

What do you think about and what happens when the patient has arrived in your office?

How do you use the EPR in the work with patients?

Thinking freely, are there any changes in the EPR you would recommend?

Which of these changes do you hold to be most important?

Common themes in all subjects:

1. **Overview**
2. **Reuse of information**
3. **Reminders**
4. **Decision support**
5. **Work flow congruence**

Presentation (By Anders Grimsmo)

First we have to thank you for permitting us to come. You must be wondering about details of what to do, and I will explain after the presentation.

All of us do research at full time and the theme of today is the electronic patient record EPR).

The purpose of our study is to find out how the EPR can be better. There are several methods to study this subject, and questionnaires, interviews and observations are among these, and all of these methods are eased if we know what to look for. The method we are using today is called focus group interviews. We use this method because we are not sure what subjects is important in this context, but hope this will be clarified during the interviews when you tell us how you are using the EPR related to patient encounters. When we discuss this in a group exchanging experiences and views, all of us might find relevant suggestions of how to solve problems and challenges.

Tom and I have our opinions of the EPR and how it should be further developed, but I suspect us to be perhaps as dedicated to improvement of EPR that our opinions might be odd. After my experience we all think better when having a dialogue with colleagues.

This will be kind of a group discussion and my task is to be moderator. I will lead this by asking questions. You must feel free to discuss all subjects in the group. If you hear anything you like to comment, or if you like to ask follow up questions, don't hesitate to give me a sign. Then we can avoid interrupting anyone. I also will ask you to turn of your cellphones.

I have a list over 4-5 themes I want us to discuss, and therefore I might interrupt ongoing discussions to make sure we have time to discuss all themes.

You will find out that not all the questions are related to the EPR. This is due to our interest in exploring the way you are thinking more than how you are using the EPR in some cases. Ideally we could thing of starting on scratch, because we all have a tendency to think out of what we are used to and know. Therefore we challenge you to think as freely as possible.

I will ensure that all meanings can be spoken, but hope you disagree on several subjects. No meanings are right or wrong, just different viewpoints.

We are taping this. Even if Tom takes notes along the way, it is impossible to take notes about everything you are saying, and in worst case Tom and I can disagree about what was noted. We often hear what we like most to hear. Names and viewpoints that can be connected to specific persons will not be used when the results are published. On behalf of the analyzes it is important that the name of the one speaking can be recorded due to my saying of the name when letting him speak.

First question:

What would you say is the most positive aspects of EPR; and what is the most negative?

We will start this focus group by doing a little thinking of our own. You have got a form, and at the top of this form you shall fill in some personal information we need when we will study the results later. You will furthermore find two columns to fill in information of what is positive and what is negative of EPR. This is related to EPR in general and as a working tool in primary care. If you can fill in up to 4 or 5 viewpoints in each category we will be satisfied. After 10 minutes we will collect the forms, and discuss them in plenum.

10 minutes quietness

The first thing I want you to do now is to draw a line under your viewpoints. If anything comes up in the discussion that you find as important as what you already have noticed, I will ask you to add this below the line.

We will start with the positive experiences. Can you (name) tell us what you have taken down?

What are you thinking about and what happens when you are about to call a patient in to your office?
(Overview)

To bring some systematic into the discussion, we will go through the different steps in the clinician-patient encounter. Let us say you just have finished a consultation. You are still in your chair, have finished your records notes and the patient have left.

What do you regularly do to continue?

Elements to consider:

When do they open the next patient record?
Do they open the schedule module?
Do they search for historical information in the EPR?

I would like to know if you have other viewpoints on overview of the patient information.
Is this overview important?
Do you have any examples of situations where overview is important?
Do you try to increase the overview of the patient information in the EPR?

What are you thinking about and what happens when the patient has arrived in your office?
(Problem oriented)

We continue with the steps in the encounter.

When the patient have arrived in your office, how long will it take before you start to think about the reason for the encounter, and what the patient is suffering from?

When it is a new problem, we normally try to explore if the criteria's of a diagnosis are positive. This might be a difficult question:
When you have a hunch of what is the problem or the diagnosis, what is it that has actually happened?

> *Elements to consider:*
> *Reductionist problem oriented versus broad and systematic*
> *Pattern recognition. Probability.*

If not an obvious case to refer and you need some kind of support; what do you do?

> *Elements to consider:*
> *Decision support*
> *Source of information*
> *Do you use the EPR?*

All doctors have books of reference according to medication on their desk.
Would you like it these to be in electronic versions as well?
Should it be integrated with the EPR?
If so, how should it be integrated?

Do you use 'The Norwegian Electronic Medical Handbook'?
If so, how often do you use it?
What could be the reason why many of us don't use it much?

How do you use the EPR in the work with patients?
(Documentation, episodes, record notes)

We now will discuss follow up encounters concerning chronic diseases.
Do you check the last record note in these follow up encounters?
Always?
Do you do information search in the EPR while you are talking to the patient?
How many screen shots and record notes do you regularly look into before you stop because it is being to time consuming?

Do you regular take down independent and free record notes that imply a medical meaning in itself, or do you take down record notes that contain only supplementary information?

Do you write anything about what to do in the next follow up encounter?

During the encounter; when do you regularly take down the record notes?
Do you take it all down in one record note, and if the case, do you separate the problems within his note if several problems?
Do you take separate notes for separate problems?

Does it happen that you forget something you should have done, and if the case, what is most often forgotten?

At what point of the encounter do you register the diagnosis?

> *Elements to consider*
> *Use of historical information within the EPR*
> *Separation of problems*
> *Reminders*

(*Medical work/actions*)
When you have finished the interview and the physical examination of the patient and will take down record notes, perform order entry and prescriptions or write referral letters; do you prefer to do so while the patient is still with you, or do you wait until you are alone?

Would you profit from a connection between the diagnosis and the medical actions trigged by the problem or diagnosis?

When working with previous patient problems, would it be practical if all previous clinical work and actions could be sorted out when you chose the specific problem in the EPR?

Thinking freely, are there any changes in the EPR that you would recommend?

We know that physicians have adapted to individual working routines, and this is the case for the use of the EPR as well. Even though I can show my colleagues smart and faster use of the EPR to support clinical and administrative work, many of them continue to work in cumbersome ways complaining about the general time pressure.

Do you have opinions about why it often is difficult to change patterns of work, and how we could be able to do it?

Now I want some quiet again. You should think of what we have talked about in this group, and then form a list of what you want from the EPR. Write it down and try to forget all you know about EPR systems. Think completely independent without limitations in terms of functions and content. When you have finished, we will have our last plenum discussion.

Quiet (10-15 min)

Which of these changes do you hold to be most important?

Now I would like to hear all your wishes and expectations for an EPR to function optimally?

What would you give the highest priority? Number your list from 1 and so forth.

We also want you to number your previous list of the most positive and the most negative aspects of EPR of today that filled out at the beginning of the interview.

Focus group from (date)

Name…….

Woman:___ Man:___ Age:_____ Years in praxis:_____

Name of EPR system you are using now?

WinMed___ Vision___ Profdoc Dos___ Infodoc___ Other___

Name of EPR system you have used earlier?

WinMed___ Vision___ Profdoc Dos___ Infodoc___ Other___

Have you been working in primary care earlier using paper records only?

Yes___ No___

Experiences and viewpoints towards the EPR

Positive Negative

Notes for the moderator:

Follow up questions to the speaker:

Do you want to elaborate this viewpoint?
Can you describe what you mean?
Can you give an example?
Anything more?
What experiences make you think like this?
If.....?
What.....?

Follow up questions to the others in the group:

Anyone want to ads something?
You look like you agree / disagree?
We want to have all views?
Other meanings?
Anyone experienced anything else?
Can someone confirm these views?

Guide for observations, Norwegian

Intervju guide og stikkord for observasjon av pasient konsultasjoner i allmenn praksis.

Siste versjon

Konsultasjon nr ____ Kjønn _____ Alder _____

Hvordan brukes EPJ?

Registrere hvordan EPJ er brukt, og hvilke moduler som brukes.
Registrere om historisk informasjon in journalnotater søkes etter eller ikke
Registrere om historisk informasjon in journalnotater søkes etter, men ikke synes å bli funnet.

Hvordan brukes EPJ før pasienten kalles inn?

Hvordan brukes EPJ under konsultasjonen?

Hvordan brukes EPJ etter når pasienten har forlatt kontoret?

Søk etter medisinsk informasjon andre steder enn i EPJ?

Litteratur? Elektroniske kilder?

Pasient problemer under konsultasjon?

Nytt problem / Nye problemer

Gammelt problem / Gamle problemer

Antall problemer

Observators vurderinger

Gjenbrukte klinikeren informasjon i EPJ?

Var det noen tegn til pasient reaksjoner når legen brukte EPJ?

Fritekst (aktuelle andre observasjoner)

Tids studier (lagt til underveis)

Registre tid brukt på EPJ during i hver konsultasjon. (14 av konsultasjonene).

Intervju guide

Til pasient

Hvordan opplevde du legens bruk av EPJ i løpet av konsultasjonen?
(Ble kontakten forstyrret av dette?)

Til legen

Hvordan opplevde du din egen bruk av EPJ i forhold til pasienten i løpet av konsultasjonen?
(Ble kontakten forstyrret av dette?)

Hvilken informasjon lette du etter i EPJ?

Fant du all informasjon du søkte etter?

Guide for observations, English

Interview guide and key words for observation of patient encounters in primary care

Final version

Encounter nr ____ Sex _____ Age _____

How is the EPR used?

Register how it is used and which modules
Register if historical information in record notes is searched for or not
Register if historical information in record notes is searched for but not seem to be found.

How is the EPR used before the patient is called in?

How is the EPR used during the encounter?

How is the EPR used after the patient left the office?

Search for medical knowledge elsewhere?

Literature? Electronic sources?

Patient problems in the encounter?

New problem(s)

Old problem (s)

Number of problems

Observer judgments

Did the clinician reuse information in the EPR?

Was there any sign of patient reactions against use of the computer?

Time studies

Register time used on EPR during the encounter. (14 of the encounters).

Interview guide

To the patient

How did you experience the use of the computer during the encounter?

To the physician

How did you experience the use of the computer during the encounter?

What kind of information were you looking for in the EPR?

Did you find all the information needed in the EPR?

APPENDIX C

PAPER 1

BMC Medical Informatics and Decision Making

BioMed Central

Research article

Open Access

Instant availability of patient records, but diminished availability of patient information: A multi-method study of GP's use of electronic patient records

Tom Christensen* and Anders Grimsmo

Address: Norwegian EHR Research Centre, Faculty of Medicine, Norwegian University of Science and Technology in Trondheim, MTFS, 7489 Trondheim, Norway

Email: Tom Christensen* - tom.christensen@ntnu.no; Anders Grimsmo - anders.grimsmo@ntnu.no

* Corresponding author

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Abstract

Background: In spite of succesful adoption of electronic patient records (EPR) by Norwegian GPs, what constitutes the actual benefits and effects of the use of EPRs in the perspective of the GPs and patients has not been fully characterized. We wanted to study primary care physicians' use of electronic patient record (EPR) systems in terms of use of different EPR functions and the time spent on using the records, as well as the potential effects of EPR systems on the clinician-patient relationship.

Methods: A combined qualitative and quantitative study that uses data collected from focus groups, observations of primary care encounters and a questionnaire survey of a random sample of general practitioners to describe their use of EPR in primary care.

Results: The overall availability of individual patient records had improved, but the availability of the information within each EPR was not satisfactory. GPs' use of EPRs were efficient and comprehensive, but have resulted in transfer of administrative work from secretaries to physicians. We found no indications of disturbance of the clinician-patient relationship by use of computers in this study.

Conclusion: Although GPs are generally satisfied with their EPRs systems, there are still unmet needs and functionality to be covered. It is urgent to find methods that can make a better representation of information in large patient records as well as prevent EPRs from contributing to increased administrative workload of physicians.

Background

Norwegian GPs started to move their clinical documentation work from paper to EPR systems in the beginning of the 1980's. In the last decade more than 95% of Norwegian GPs have been using an EPR system (personal communication). The high uptake of EPR systems may be looked upon as a proof of their value, but what constitutes the actual benefits and effects of the use of EPRs for GPs and patients have not been fully characterized. Evaluation of EPRs can provide developers, clinicians, and administrators with important information about success and failure [1]. Simultaneous access for multiple users and improved readability compared to handwriting are obvious advantages. Other benefits are flexible visualization of

patient data, automated collection of data from accessory medical equipment, automated search, and the generation of reports in different formats. Potential disadvantages can be numerous, such as cumbersome data entry, insufficient overview over the patient's data, nonintuitive interface layouts and erroneous software or hardware [2].

Efficient EPR systems support the workflow and may ease the burden of documentation and accounting, possibly allowing the GP to spend more time in direct interaction with the patient. However, time studies on physician use of EPRs have failed to demonstrate any noticeable reduction in the time spent on clinician-patient encounters [3-5]. Regarding GPs' attitudes toward EPR systems compared with their paper-based ancestors studies show positive attitudes [6,7], although one study showed clinicians to be far more positive about the quality of paper records than expected [8].

Use of computers may influence the clinician-patient relationship. Some patients may feel reassured by an impression of a greater technical, medical and organizational support given by computers compared to paper folders. On the other hand, the screen may act as a barrier between clinicians and patients. EPRs that do not present reliable or relevant data to clinicians when needed could distract the relationship [9].

In this report we have applied three different methods to study GPs' use of EPR: through focus group interviews, observations of clinical practice, and with use of a questionnaire survey. We have inquired about GPs' use of electronic patient records, measured the actual time spent interacting with the EPRs, and observed and interviewed patients and GPs about the impact of computers on the clinician-patient relationship to find out more about the rapid adoption of Norwegian GP EPR systems.

Methods

Setting

Most Norwegian GPs are self-employed and organized in medical practices of an average of 3–4 physicians in a system with enlisted patients. Three different EPR systems offered by two vendors dominate the market (personal communication). Different sections or modules for basic data, medical data, scheduling, financial functions, communications, statistics and other functions build up the EPR systems, but the information is also accessible from a common chronological view of all documentation in the record. The EPR supports most clinical tasks such as free text progress notes, computerized physician order entry, drug prescription, electronic communication, as well as facilitate other functions needed to be independent of paper records. The EPR systems in Norway do not include decision support or instructions on medical procedures.

Study design

Data was gathered from interviews of GPs in focus groups, from observations of the use of EPR during encounters in clinical practice, and from a questionnaire sent to a random sample of GPs.

Selection of respondents, data gathering, and analysis

Focus groups

Vocational and continuing GP specialist education programs from the Norwegian Medical Association include participation in approved educational groups. We identified some of the groups in the middle of Norway, and invited ourselves to three of them. We chose two continuing groups in the city of Trondheim, and one in the countryside outside Trondheim. The groups represented both GPs with experience with use of paper records and younger physicians with no such experience. There were 23 GPs all together in these groups representing 20 different medical practices. We joined one regular meeting of each of the three groups in 2002 and 2003. The interviews lasted approximately 3 hours. We used an interview guide previously validated by GPs from four different practices and two professors of family medicine. The interviews were recorded on a minidisc with subsequent transcription and later analyzed using NUD*IST Vivo, version 1.1.127. A health secretary familiar with medical terminology transcribed the interviews. Ambiguities were discussed and settled between the secretary, the author (TC) and the co-author (AG). The views expressed across the chosen focus groups were quite consistent and it was considered that more focus groups would not add much additional information.

Observations

The observation study was conducted at various periods in 2002, 2003, and 2005. The functions in the EPR systems did not change in this period. A total of 80 GP-patient encounters involving four female and seven male GPs in five medical practices were studied. The practices were strategically chosen to represent all EPR systems. One of the GPs observed had participated in the focus group study. The observed clinicians obtained patient consents prior to each encounter and no patients declined to consent. The observer was situated out of the way behind the patient not to disturb the encounter. Use of different modules or sections in the EPR and time spent on EPR related to some of the encounters were recorded. TC and a sociologist research assistant familiar with observations of health personnel conducted the observations. An observation guide that included a short interview of both patients and clinicians was used after being validated by the researcher, GPs from pilot practices and the supervisor. According to the themes of the study, actual use of EPR was noted with subsequent transcription.

Questionnaire

The questionnaire consisted of two major sections and was validated by 20 randomly chosen GPs in a test-retest pilot study in 2002. The respondents in the main study were selected from a database with names and addresses of all GP members of the Norwegian Medical Association and matched with vendor lists of GPs using specific EPR systems. An electronic software program randomly extracted a group of 136 participants from each of the EPR system users. An information letter was sent on February 6th 2003 to all 408 selected GPs, followed by the questionnaire one week later. We collected the last questionnaires in June 2003 after two written reminders followed by three reminders by telephone.

Analysis of the collected data

The completed questionnaires were scanned using Teleform and the data were analyzed with SPSS for Windows, version 11.5. Collected material concerning informants' comparative notions of paper records and EPRs, time spent using EPRs during encounters, and effects on clinician-patient relationship was identified and used for systematic text condensation. The analysis of the qualitative material was deductive and the themes and the quotes were derived from the data in four steps: Establishment of a total impression of the material, identification of meaningful units, abstraction of these units, and establishment of the importance of the abstractions [10]. TC coded the transcripts after negotiations with AG and the sociologist researcher, with subsequent definition of the contents of the final categories. The authors' perspective of GPs being responsible for the medical care of enlisted patients supported the analysis. Attention was drawn to the function of EPRs as a tool to support GP medical work, time spent on the EPR, and possible effects on the clinician-patient relationship. Results from the focus groups, observations, and questionnaire survey were compared in the analysis.

Results

The results from the focus group interviews and the observation study are presented together with relevant data from the questionnaire. Of the 408 GPs invited, 70 were lost due to unknown address, leave of absence, or resignation. Of the 338 GPs who received an invitation, 247 (73%) completed the questionnaire; 18 of the respondents were excluded because they used an older version of the system, used other systems, or EPR system data were missing. Wherever the sample size in the results is other than 229, it is due to missing data. Use of different EPR sections was studied in 53 of the encounters; by this time we were getting results that were very similar to those seen in earlier encounters and we did not consider it necessary to study the use of the different EPR sections in more encounters. Reading in EPR ahead of the encounters was studied in 44 observations. We observed that GPs were using the EPR less than expected from the questionnaire survey, and hence time measurement was added to the last 14 observations. We present the results from all three studies under the same research question headings.

The availability of individual patient records has improved, but the availability of the information within each record should be better

Saving time looking for patient records, was pointed out by many in the focus groups as a great advantage of EPRs compared to paper records; illustrated by this quote:

The EPR is always available and you can easily maneuver between different records. (No 1)

The focus group interviews revealed that the GPs had almost immediate access to the index pages of different sections in the EPR. However, this access did not imply that access to relevant progress notes and documents was easy. Patient records with many progress notes and documents were often dominated by redundancy of information and the GPs had problems with achieving sufficient overview. Many of the respondents felt it was troublesome to track earlier episodes and notes in the EPR:

My main problem is decreased availability of the information within the EPR in the case of chronically ill patients and patients that have been visiting a number of times. (No 2)

Some of the informants indicated that the overview some times could be better in previous paper records:

"When using paper records we could spread out the papers on the desk to get an overview." (No 3)

Data from the observation study revealed that the GPs rarely spent time searching for historical information in the EPR other than the latest progress notes, medications and results on laboratory tests. Instead, the GPs seemed to rely on their own memory or obtained information through asking the patients about previous episodes. Practically all GPs entered the patient record starting from the list of patients in the appointment book in the EPR. They read the eventual attached remarks or comments made by the health secretary or nurse. GPs read the previous progress note or other parts of the EPR before calling the patient into the office in 36 of 44 observed encounters.

This was partly confirmed by results from the questionnaire study: Practically all respondents (99%) reported to find it useful to check upon previous notes while working with patients; 37% sometimes reported to give up searching for information because it was too time-consuming, and 35% found it easier to ask the patient again rather than to search in the patient record. Almost a third (28%)

only occasionally tried to search for information because they found it was too time-consuming. More than half of the respondents (57%) found it difficult to display a summary of the actual progress notes.

GP use of EPRs seems to be efficient and comprehensive, but also entails administrative tasks previously done by secretaries

The data from the focus groups revealed that a majority of the GPs emphasized the great time and work savings offered by EPR systems compared to paper records. This was exemplified by renewal of regular prescriptions and account keeping, as well as use of text templates and automatic reuse of administrative and clinical information when writing referral letters, requisitions and forms as presented in this quote:

You don't need to write the headings over and over again, and you can also reuse text templates. (No 3)

On the other hand, a shift in administrative workload from health secretaries to GPS was also pointed out in the focus groups. Examples mentioned were scheduling and filling in forms as well as writing referral letters and updating demographic data; illustrated by this quote:

Earlier I dictated referrals. Now I type them myself. (No 4)

These findings were supported by data from the observations. We saw GPs filling in forms, scheduling patients and updating patient contact information, as well as doing all the work surrounding preparation of referral letters. Some even put the referral letter in the envelope themselves (when not sent electronically). We also observed that a few GPs retyped the same information for each referral letter and requisition instead of reusing former information. The use of the EPRs systems was comprehensive. In 53 of the 80 observed encounters, we recorded which EPR sections were in use. We found that 3 to 13 different sections of the EPR were in use during an encounter, with a mean of 6.2 and a median of 6. We also measured the total time spent using the EPR system in 14 of the observed encounters. Data revealed that the time spent registering and documenting in the EPR in the observed encounters was only half of the time compared to what was estimated by respondents in the questionnaire survey (Figure 1). The observed mean time to read an EPR was 49 seconds with a range of 5–150 seconds. According to the questionnaire respondents, encounters lasted between 10 and 21 minutes (Figure 2), and the time recorded in the EPR was related to the encounter time as shown in Figure 3.

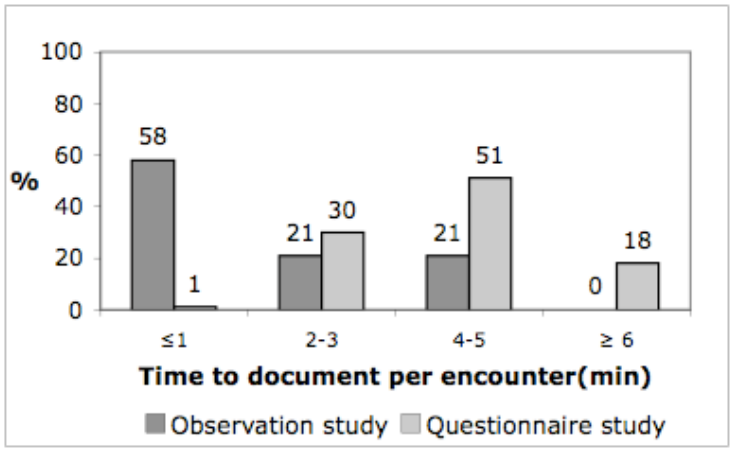

Figure 1
Time spent to document in EPR. Differences in time spent to document during an encounter registered in the observation study (No 14) and the questionnaire study (No = 227).

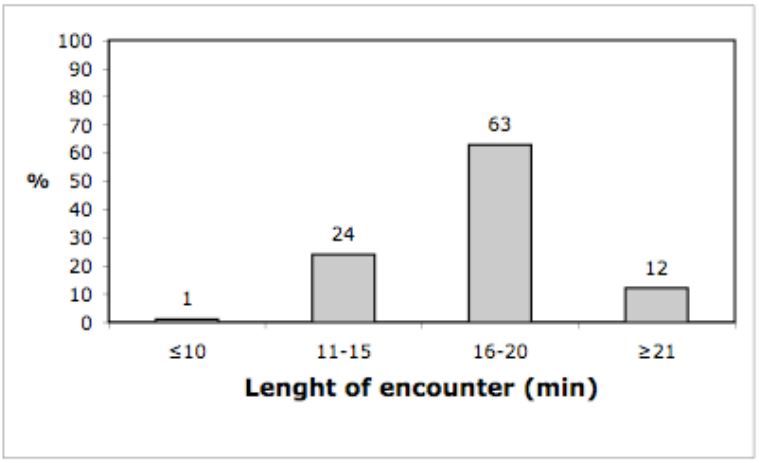

Figure 2
Length of the encounter. Distribution of the length of the encounter reported by GPs in the questionnaire study (No = 227).

Concerns about the effects of EPRs and computers on the clinician-patient relationship

During the focus group sessions several participants expressed concerns about the potential negative influence of computers on the clinician-patient relationship, particularly when the computer screen drew the GP's attention away from the patient. A majority of the respondents stated that they tried to avoid such disturbances by postponing the documentation in the EPR until after the patient had left. Other GPs claimed to record information during encounters when it seemed to be natural and without disturbance of the relationship. The majority of the GPs claimed that the use of EPRs seldom disturbed the clinician-patient relationship in their opinion, and that working with EPRs was not very different from working with paper records in this respect. Some GPs stated that it was both relevant and useful to conduct documentation work while the patient was still in the room:

When I am not sure if have understood things right; I write the record note while the patient is present, show him the note and ask if it is correctly formulated. (No 5)

In the observation study we interviewed 24 of the patient after the encounters. None of them expressed discomfort with the GP's use of the computer during the encounter nor felt that the screen was an obstacle between them and the clinician. During interviews with all the observed GPs, most of them stated they were aware of the possibility of disturbing their relationship with the patient, and that they tried to avoid such disturbance. We observed that most of the GPs read in the EPR before the encounter began, minimized the use of the EPR during the encounters, and often did the documentation work when the patient had left.

Discussion

In this study we have found that although the availability of the EPRs was almost immediate, availability of the information within EPRs was not always satisfactory. Use of EPRs was efficient and comprehensive and tightly interwoven with the working processes in their medical practices, but also encompassed more administrative tasks for the physicians compared to paper records. Use of EPRs did not seem to disturb the clinician-patient relationship.

The results indicate that although GP EPR systems are successfully adopted and highly integrated with the clinical work, there are still needs and functionality to be met. The information within the EPR was not always easily available. Instead of looking up information in the EPR, GPs often relied on their own or their patients' memory. This was revealed both in the focus groups, the observations and the questionnaire. Other studies also have confirmed

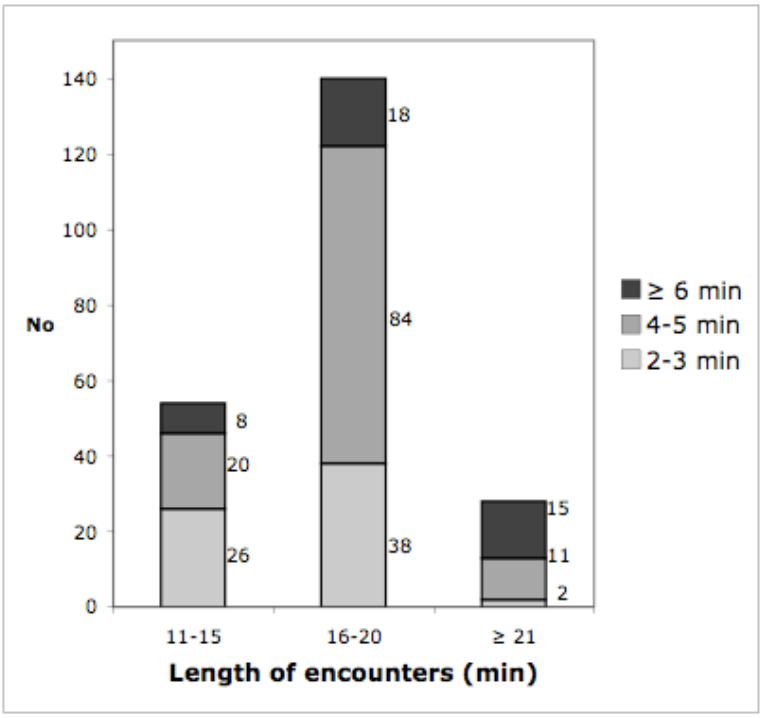

Figure 3
Length of encounters and time spent to document in the EPR. Reported by GPs in the questionnaire study (No = 222). One encounter lasting less than 10 minutes and one encounter with documentation time less than one minute were left out from the figure.

that physicians have greater difficulties in achieving a clinical overview of the situation of the patient when using an EPR system [11].

We found that GPs used the EPR widely and preferred them to paper records. We have in another questionnaire study identified extensive use of EPR with support of 21 of 23 important clinical tasks without need of additional support from paper records. (Paper submitted for publication). Hammond et al. have suggested that clinical information systems do lead to a significant improvement in documentation over handwritten flowsheets, both in volume and accuracy [12]. Other studies suggest that quality improvement is dependent on physicians' use of the EPR system instead of paper for most of their daily tasks [13-15].

We registered that GPs spent less time on reading and recording in the EPR than estimated by the doctors themselves in the questionnaire and that the use of EPR was limited during encounters. Studies support that EPRs can be well-designed and efficient clinical tools [16], but on the other hand EPRs can also become a burden if not well designed [5,17]. This study supports a shift of administrative work from health secretaries to GPs using EPRs compared to paper records. This is in accordance with other studies that have identified greater benefits of EPRs to health secretaries compared to nurses and physicians [18].

In earlier studies patients meant that a computer diminishes the doctor's personal touch and could be regarded as an obstacle to eye contact [19,20]. Our results are in line with more recent studies claiming that well designed EPRs do not disturb the clinician-patient relationship [2].

We believe that the high acceptance and adoption of EPRs in Norway is related to user-centered design, integration, a strong support base of users, and reported improved care quality (personal communication). This is also supported by other studies [21,22]. Other studies report that direct reports and judgments of specific task efficacy from colleagues relate to behavior more often than usability and a general user satisfaction [23]. These factors may also have contributed to the rapid and successful adoption in Norway

In this study both qualitative and quantitative methods were used to obtain data on experiences, behavior and practice processes. We used different methods and in addition observer triangulation to strengthen validity and relevance as well as credibility, confirmability and transferability in the study [24]. The questionnaire gave us representative and sound data on the dissemination of EPR systems and the use of specified clinical tasks, as well as user satisfaction [25]. The interviews uncovered relevant new issues, user experiences and a better understanding of behavior and reactions related to the use of EPRs. We experienced that the observations were preferable to uncover actual use of EPRs during encounters, use of supplementary sources of information, and to study the clinician-patient communication. Although qualitative methods are recommended when evaluating health information systems [26-28], there are several possible limitations to take in account [10]. We believe a combination of methods very often is necessary. Differences in gender or age could possibly introduce biases, but the questionnaire data did not reveal any differences related to gender or age percentiles, and we did not discover any such differences when analyzing the qualitative material either. Although we experienced that common culture and terminology probable eased recruitment of participants and the communication within the focus groups, the authors' previous work as GPs and a background similar to that of the respondents could possibly lead to blind spots or biases when conducting and analyzing the study.

One of the motivations of conducting group interviews was to ensure individual reflections in the groups upon different opinions to ensure internal informant validation. Further validation strategies like negotiations and discussions between TC and AG and research assistants were implemented to avoid errors in the transcription from oral to written information and to validate the findings in both focus groups and observations. Triangulation was carried out in the conduct and analysis of observations to ensure that important or contradictory results related to the research questions were not left out.

The observations revealed issues not thought of when designing a questionnaire. We identified late the need of recording the time used on the EPR during encounters. Time spent on documentation was overestimated by the GPs in questionnaires compared to what we observed. Additional time recordings could have strengthened this discovery. The clinician-patient relationship was another issue not planned for in the questionnaire. Even though the selection of GPs for the focus groups and observations were not randomized, we hold the selection to be representative due to the arbitrary recruitment of different GPs from medical practices in rural and urban districts in the existing groups. We also hold the results to be representative and strengthened when confirmed by several methods.

Conclusion

Although GPs are generally satisfied with their EPRs systems, there are still unmet needs and functionality to be covered. It is urgent to find methods that can make a better representation of information in large patient records. Further studies are necessary to reveal why and how the introduction of EPRs have increased the administrative workload of physicians and how it could be reduced, as well as clarify contradictory results on time spent on EPR in primary care encounters.

Competing interests

The author(s) declare that they have no competing interests.

Authors' contributions

TC planned the investigation and developed the part of the questionnaires used in this study as well as the interview and observation guides with support from his supervisor, AG. TC organized the administration of the questionnaires, focus groups and observations, and analyzed the data with contributions from AG. TC wrote the manuscript with advice from AG.

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References

1. Wyatt JC, Wyatt SM: **When and how to evaluate health information systems?** *Int J Med Inf* 2003, **69(2-3):**251-259.
2. Powsner SM, Wyatt JC, Wright P: **Opportunities for and challenges of computerisation.** *Lancet* 1998, **352:**6.

3. Pizziferri L, Kittler AF, Volk LA, Honour MM, Gupta S, Wang S, Wang T, Lippincott M, Li Q, Bates DW: **Primary care physician time utilization before and after implementation of an electronic health record: A time-motion study.** *J Biomed Inform* 2005, **38(3):**176-188.
4. Lo H, Newmark L, Yoon C, Volk L, Carlson V, Kittler A, Lippincott M, Wang T, Bates D: **Electronic health records in specialty care: a time-motion study.** *J Am Med Inform Assoc* 2007.
5. Sullivan F, Mitchell E: **Has general practitioner computing made a difference to patient care? A systematic review of published reports.** *BMJ* 1995, **311:**848-852.
6. Protti D, Wright G, Treweek S, Johansen I: **Primary care computing in England and Scotland: a comparison with Denmark.** *Inform Prim Care* 2006, **14(2):**93-99.
7. Henderson J, Britt H, Miller G: **Extent and utilisation of computerisation in Australian general practice.** *Med J Aust* 2006, **185(2):**84-87.
8. Tange HJ: **The paper-based patient record: Is it really so bad?** *Comput Methods Programs Biomed* 1995, **48(1):**127-131.
9. Booth N, Robinson P, Kohannejad J: **Identification of high-quality consultation practice in primary care: the effects of computer use on doctor-patient rapport.** *Inform Prim Care* 2004, **12(2):**75-83.
10. Malterud K: **Qualitative research: standards, challenges, and guidelines.** *Lancet* 2001, **358(9280):**483-488.
11. Neve K, Iversen R, Andersen C: **Is it possible for nurses and doctors to form a useful clinical overview of an EHR?** *Stud Health Technol Inform* 2006, **122:**314-319.
12. Hammond J, Johnson HM, Varas R, Ward CG: **A qualitative comparison of paper flowsheets vs a computer-based clinical information system.** *Chest* 1991, **99(1):**155.
13. Miller RH, Sim I: **Physicians' Use Of Electronic Medical Records: Barriers And Solutions.** *Health Affairs* 2004, **23(2):**116-126.
14. Mikkelsen G, Aasly J: **Concordance of information in parallel electronic and paper based patient records.** *Int J Med Inf* 2001, **63(3):**123-131.
15. Carr-Bains S, de Lusignan S: **Moving to paperlessness: a case study from a large general practice.** *Inform Prim Care* 2003, **11(3):**157-165.
16. Knottnerus J: **Role of the electronic patient record in the development of general practice in The Netherlands.** *Methods Inf Med* 1999, **38(4-5):**350-354.
17. Poissant L, Pereira J, Tamblyn R, Kawasumi Y: **The Impact of Electronic Health Records on Time Efficiency of Physicians and Nurses: A Systematic Review.** *JAMIA* 2005, **12(5):**505-516.
18. Laerum H, Karlsen TH, Faxvaag A: **Use of and attitudes to a hospital information system by medical secretaries, nurses and physicians deprived of the paper-based medical record: a case report.** *BMC Med Inform Decis Mak* 2004, **4:**18.
19. Cruickshank PJ: **Computers in medicine: patients' attitudes.** *JR Coll Gen Pract* 1984, **34(259):**77-80.
20. Bright S: **Nearest and dearest.** *Br J Healthcare Comput 1991; march: 58* 1991, **9:**.
21. Monteiro E: **Integrating Health Information Systems: A Critical Appraisal.** *Methods Inf Med* 2003, **42(4):**428-432.
22. Ford EW, Menachemi N, Phillips MT: **Predicting the Adoption of Electronic Health Records by Physicians: When Will Health Care be Paperless?** *JAMIA* 2006, **13(1):**106-112.
23. Weir CR, Crockett R, Gohlinghorst S, McCarthy C: **Does user satisfaction relate to adoption behavior?: an exploratory analysis using CPRS implementation.** *AMIA Annual Symposium* 2000.
24. Lincoln YS: **Emerging Criteria for Quality in Qualitative and Interpretive Research.** *Qualitative Inquiry* 1995, **1(3):**275.
25. Laerum H, Ellingsen G, Faxvaag A: **Doctors' use of electronic medical records systems in hospitals: cross sectional survey.** *BMJ* 2001, **323(7325):**1344-1348.
26. Mays N, Pope C: **Qualitative Research: Rigour and qualitative research.** In *BMJ Volume 311*. Issue 6997 Br Med Assoc; 1995:109-112.
27. Kaplan B, Shaw NT: **Future directions in evaluation research: people, organizational, and social issues.** *Methods Inf Med* 2004, **43(3):**215-231.
28. Chapple A: **Explicit guidelines for qualitative research: a step in the right direction, a defence of the'soft' option, or a form of sociological imperialism?** *Fam Pract* 1998, **15(6):**556-561.

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PAPER 2

i

Norwegians GPs' use of electronic patient record systems.

Tom Christensen [1a], MD, **Arild Faxvaag**[1], MD, PhD, **Hallvard Lærum**[2], MD PhD, **Anders Grimsmo**[1], MD, PhD.

[1] Norwegian EHR Research Centre, Faculty of Medicine, Norwegian University of Science and Technology in Trondheim, MTFS 7489 Trondheim, Norway

[2] Rikshospitalet-Radiumhospitalet HF Medical Centre, Rikshospitalet 0027 Oslo, Norway

[a] Corresponding author

Tom Christensen

Telephone: +4791165970 Telefax: +4773551530

e-Mail: tom.christensen@ntnu.no

Postal address: Norwegian EHR Research Centre,

MTFS,

7489 Trondheim,

Norway

ABSTRACT

Objective: To evaluate GPs use of electronic patient record systems with emphasis on the ability of the systems to support important clinical tasks and to compare the findings with results from a hospital study.

Methods: National, cross-sectional questionnaire survey in Norwegian primary care where 247 (73%) of 338 GPs responded. Proportions of the respondents who reported to use the EPR system to conduct 23 central clinical tasks, differences in the proportions of users of different EPR systems and user satisfaction and perceived usefulness of the EPR system were measured.

Results: The GPs reported high usage of their EPR systems. There were no significant differences in functionality between the systems, but there were differences in reported software and hardware dysfunction and user satisfaction. The respondents reported high scores in computer literacy and there was no correlation between computer usage and respondent age or gender. A comparison with hospital physicians' use of hospital EPR systems reveals that primary care EPR systems support clinical tasks far better than hospital systems with better overall user satisfaction and reported impact on the overall quality of the work.

Conclusion: EPR systems in Norwegian primary care that have been developed in accordance with the principles of user-centered design have achieved widespread adoption and highly integrated use. The quality and efficiency of the clinical work has

increased in contrast to the situation of their hospital colleagues, who report more modest use and benefits of EPR systems.

Keywords:

Patient Records, Computerized;

Computer Systems Evaluation;

Task Performance

1. Introduction

For more than four decades electronic patient record (EPR) systems and other patient-centered information systems have been thought of as efficient remedies for a sector burdened with patient data archived on paper and corresponding labor-intensive, manual routines [1]. Since their inception in the 1960s, EPR systems have undergone continuous development and are increasingly being employed in hospitals and primary care facilities throughout the world [2]. In many countries and regions their adoption shows great variation [3], both for primary care and in-hospital use [4; 5]. At first glance, it may seem like a paradox that some health care providers and organizations hesitate to implement a technology that many regard as sufficiently mature; however, establishing an EPR system entails large expenses and profound organizational changes must be made before the investment is returned. In some cases, employees have also failed to embrace the EPR system and its implementation approach factors [6; 7]. Factors such as the size of the organization, its "change readiness," and properties of the EPR system and its implementation project are factors thought to influence the outcome of an EPR system implementation [8].

Development of EPR systems for Norwegian hospitals began in the early 1980s [9]. As of 2006, most somatic hospitals had implemented one of the three commercially available systems. In 2001, a cross-sectional survey of hospital physicians' use of EPR systems revealed that the systems differed in their ability to support important clinical tasks, showing that important features were missing from the systems and possibly indicating a usability problem. Not surprisingly, hospital physicians reported that EPR

systems had only a modest impact on the effectiveness and overall quality of their clinical work [10].

In the Norwegian primary care sector, the first EPR systems were implemented in 1979 and several other systems were implemented in the 1980s [11]. The earliest EPR system development efforts were dominated by the needs of those interested in collecting data for statistical and epidemiological purposes [12-14]. These systems, however, failed to achieve widespread acceptance among physicians. The goal of the developers of the first primary care EPR systems that were accepted and adopted among GPs was to create an EPR system with high usability that supported both clinical and administrative tasks. Key capabilities of these systems were to provide physicians with an improved patient overview and to enable the creation of EPR documents as free or semi-structured text [12]. To achieve this; these pioneers emphasized user influence and participation during development of the system, an information technology (IT) system development method now called "user-centered design" [15; 16]. The systems were developed without public funding. In 1991, an analysis of the usability and clinical usefulness of Norwegian GP EPR systems concluded that two of the three systems were highly usable, and these were developed by user-centered design [17].

Norwegian primary care is organized as a patient list system. Most GPs are self-employed and work in small group medical practices. The average number of patients listed is about 1,300. Payments are a combination of fee-for-service and capitation-based systems. Few GPs are on a fixed salary. 98% of GPs use an EPR system in their clinical practice [18]. The two principal EPR system vendors are Profdoc ASA (65%) and Infodoc AS (30%); less than 5% of GPs use other EPR systems. All systems have functions for authentications, patient administration, appointment scheduling, clinical

notes, drug prescriptions, computerized physician order entries, reimbursements, and electronic communications, as well as a repository for documents and forms. Although GPs still have a paper archive that contains the old paper record and some incoming paper documents, the need to update the paper archive is diminishing due to increasing electronic communications and scanning.

In this cross-sectional survey we investigated GP use of EPR systems while conducting clinical tasks, their opinion about the system as well as their rating of the effect of the EPR systems on the overall quality and efficiency of the work. The results were compared with data from a corresponding study of Norwegian hospital physicians.

2. Methods

2.1. The Questionnaire

To assess GP use of the EPR systems we used a questionnaire originally developed and validated for evaluating physicians' use of EPR systems within a hospital setting [10]. The questionnaire was later used in two hospital studies [19; 20]. The central part of the questionnaire builds upon information-related tasks essential to physicians' work with questions on the respondents' use of information systems while conducting 24 clinical tasks. We found the questionnaire relevant for primary care with few adjustments. Question 21 concerning discharge reports was irrelevant for GPS's and was replaced by question 22, claim reimbursement, which was not accounted for in the hospital study. One question on inertia of the system was added. An English version of the original questionnaire can be downloaded from the website where it was first published [10].

2.2. Selection of Participants, Data Collection, and Analysis

We decided to conduct our study among users of Profdoc Vision, Profdoc WinMed, and Infodoc since the vast majority of GPs use these three systems. Of all physicians in Norway, 97% are members of the Norwegian Medical Association. A database from the Norwegian Medical Association containing 4,114 names and addresses of Norwegian GPs was paired with a list of 1,988 practices using EPR systems obtained from the vendors. The GPs were grouped according to which of the three EPR systems they used and a random sample of 408 participants, 136 from each EPR group, was selected. Data were collected between February and June 2003. Each participant was sent an information letter followed by the questionnaire one week later. We collected the last questionnaires four months later, after two written reminders followed by three reminders by telephone. The questionnaires were scanned using Teleform® and the data analyzed with SPSS® for Windows®, Version 11.5.1.

3. Results

3.1. Respondent demographics, access to computers and computer literacy

A total of 408 GPs were invited to participate in the study, of which 70 did not respond due to unknown address, leave of absence, or resignation. Of the 338 GPs who received an invitation, 247 (73%) completed the questionnaire. Eighteen of the respondents were excluded because they used an old version of the system, used other systems, or because the name of the used EPR system was missing. A total of 63 GPs (28%) reported using Infodoc Windows, 83 (36%) used Profdoc WinMed, and 83 (37%) used Profdoc Vision. When the denominator is other than 229 in the results, it is because of missing data.

Of the 229 respondents included, 17% were younger than 35 years old, 46% were 35 to 50, and 37% were over 50; 33% were women, 67% were men, and four had missing gender data. All respondents were working as GPs, 200 of them as GPs for listed patients, 16 as substitutes, eight in other GP positions, and five failed to provide this information. Overall, female doctors were younger than male doctors (Table I).

Table I. Number (n) of GPs related to sex and age percentiles.

Gender	<35years (n = 39)	35-50years (n = 106)	>50years (n = 80)	Total (n = 225)
Men	17	69	65	151
Female	22	37	15	74

A total of 155 of 226 GPs (68%) had access to computers in other rooms used for clinical work (e.g., emergency and examination rooms) in addition to the computer in the medical office. Only 20 of 157 respondents (13%) reported having problems

accessing a computer because of use by others on a weekly or daily basis. A total of 34% reported being hindered due to software or hardware problems monthly, weekly or daily against 47% for hospital users (Table II).

Table II. Frequencies of software/hardware errors. n = number

Frequency	GP systems (n = 225)	Hospital systems (n = 219)
Never, n (%)	16 (7)	6 (3)
< Monthly, n (%)	131 (57)	107 (50)
Monthly, n (%)	44 (19)	47 (22)
Weekly, n (%)	24 (11)	47 (22)
Daily, n (%)	10 (4)	6 (3)

A full 96% reported owning a computer, 50% used three or more fingers while typing, and another 30% had mastered touch-typing. A total of 82% described their computer skills as medium or better than average. There were no significant differences between the users of the three EPR systems. Hospital physicians also scored high in computer literacy without significant differences from GP scores.

3.2. Use of EPR system to support clinical tasks

The GPs reported to get assistance from their EPR system while conducting 21 of 24 clinical tasks. Tasks not supported were “Obtain information on investigation or treatment procedures”, “Obtain general medical knowledge”, and “Give written general medical information to patients”. These three tasks are sometimes supported by other

information systems and this explains the scores on these questions (Fig. 1). Results from the hospital study are shown as well for later comparison.

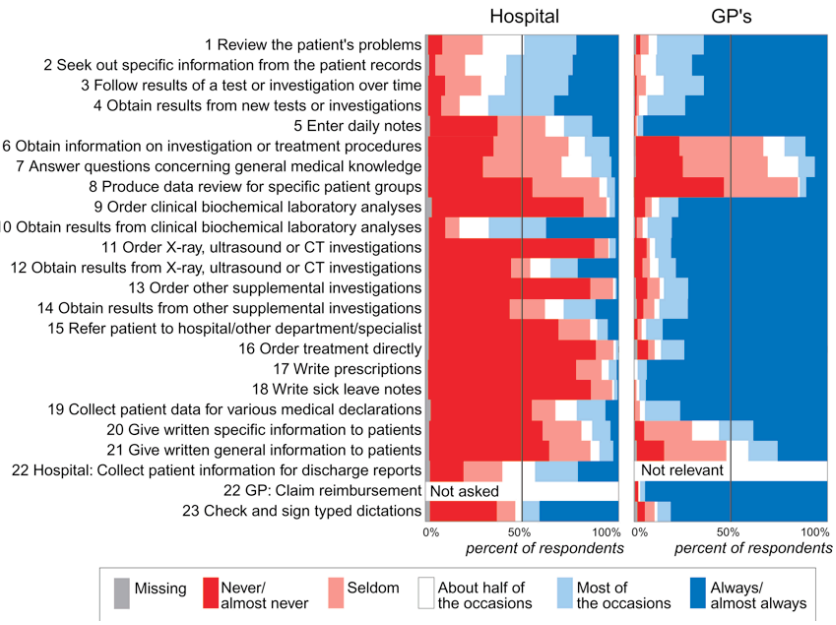

Fig. 1 - Use of information systems for clinical tasks. The coloured sections represent the percentages of respondents correlated to the scales illustrated.

We found that GPs used the EPR systems extensively for all but two of the clinical tasks they supported: “Give specific written information to patients” and “Produce data reviews for specific patient groups”. There were no significant differences in the abilities of Profdoc Vision, Infodoc Windows, and Profdoc WinMed to support clinical tasks.

When asked to rate the impact of the EPR system on the performance and quality of their clinical work, the GPs reported that their work had become significantly

easier to perform and that the use of an EPR system also had significantly increased the quality of their work. They strongly agreed that the system was worth the time and effort required to use it. They also rated both their satisfaction and success to be good or excellent (Fig. 2). P values of differences of highest scores between GPs and hospital physicians calculated with X^2 formula were highly significant for all five questions (p<0,001). Results from the hospital study are shown as well for later comparison.

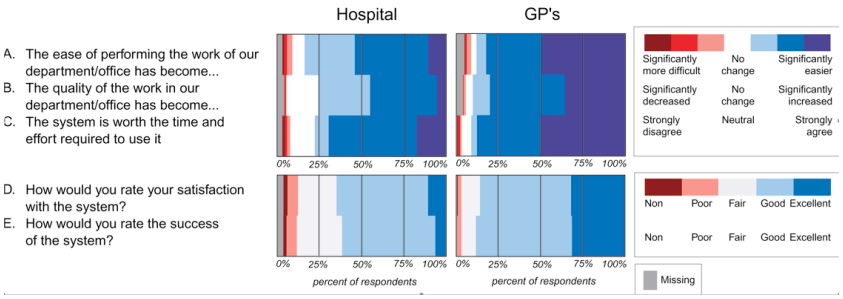

Fig. 2 - User Satisfaction with the hospital and GP systems as a whole. The coloured sections represent the percentages of respondents correlated to the scales illustrated.

There were some differences between the systems according to failures and 58% of users of Profdoc Vision reported hardware and software failure monthly, weekly or daily, against 23% for Profdoc WinMed (p<0.001) and 19% for Infodoc (p<0.001).

On average, user satisfaction was high, two of the systems being better than the third when satisfaction and success of the systems were rated (Fig. 3). The *p* values of the differences of the highest scores between GP systems were calculated with the X^2

formula. For Questions A, D, and E respondents using WinMed and Infodoc ERP system were significantly more satisfied than respondents using Vision ($p < 0.001$).

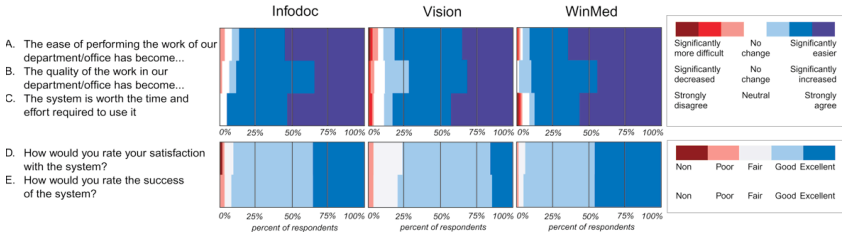

Fig. 3 - User satisfaction with the different GP systems as a whole. The coloured sections represent the percentages of respondents correlated to the scales illustrated.

3.3. Evaluation of EPR systems; comparison with hospital physicians

For comparison, we present data on GPs' use of information systems along with similar data obtained from hospital physicians in a 2001 study. This was a national cross-sectional study involving 219 physicians (response rate 72%) from 32 randomly chosen hospital departments in 19 hospitals with an EPR system. The three hospital EPR systems in the study had a somewhat poorer functionality compared with the EPR systems used by the GP respondents of this study. A key finding was that the hospital physicians did not utilize parts of the implemented functionality in the hospital EPR systems [10]. There were striking differences in the reported use of the EPR systems for the clinical tasks (Fig. 1). According to Lærum, 11 to 19 of 23 tasks were covered by the different hospital EPR systems and some tasks were covered by other information

systems. A total of 87% of the GPs reported that they use the EPR system to write clinical notes, prescriptions, sick notes, and referral letters always or almost always, whereas less than 20% of hospital doctors reported using an information system to do the same. There were also differences with regard to the first four tasks: 85-90% of GPs whereas only 50% of the hospital physicians reported using these functions most of the time or always.

GPs also valued their EPR system far higher than their hospital colleagues: 88% of GPs agreed that the EPR system was worth the time and effort required to use it, compared with 60% of hospital doctors; and 87% of GPs reported being satisfied with their EPR systems, compared with 77% of their hospital colleagues. Likewise, the GPs reported a much more positive impact of the EPR system on the ease of performing the work and the overall quality of their work and 89% of GPs reported that their system had been a success, whereas only 70% of the hospital doctors reported the same (Fig. 2).

4. Discussion

In this study we have shown that the clinical work of Norwegian GPs is tightly interwoven with the use of an EPR system and that the vast majority of the GPs are satisfied with their systems, reporting a positive impact on both the quality and efficiency of their work. The three most commonly used EPR systems support administrative tasks to the same degree. One of the systems had more system errors. The situation of the GPs stands in contrast to that of their colleagues at Norwegian hospitals who in a corresponding study reported to use the EPR system for far fewer clinical tasks and appear to be far less satisfied with their system. We believe our study

sample is representative of the Norwegian GP population, as it was drawn from a database representing 97% of all Norwegian GPs and the response rate was 73%. Dropouts were mainly due to incorrect or incomplete address lists and should not have introduced any bias; nor have X^2 formula analyses between the system distribution among non-responders (p=0.19) and responders (p=0.16) indicated possible bias. There was no correlation between respondents' age and sex and any of the results.

Norwegian GPs use of their EPR system deserves to be characterized as extensive and integrated, and the EPR system has made their clinical work independent of paper records. We hypothesize it may be a direct relation between the degree of immersion of the EPR system in clinical work and how positive the GPs rate the impact of their system on the quality and efficiency of their work. Although other European studies also have documented extensive use of EPR systems in primary care [18; 21], this study, in our opinion, documents one of the most profound positive impacts of an information system on the clinical practice of GPs. This however does not imply that the functionality of Norwegian primary care EPR systems cannot be improved further. In an interview study many GPs expressed a need for improved decision support functionality [22]. These findings are in accordance with other studies recommending that GP systems should be further developed [23].

Taking into account the poor penetration of primary care EPR systems in some jurisdictions, this report shows that it is possible to develop EPR systems that GPs perceive as useful and therefore decide to purchase, implement, and use in clinical practice [24; 25]. In an era of public willingness to spend on the implementation of health care IT programs, it should be noted that the Norwegian primary care EPR system scenario has emerged without involvement of any national health care

authorities or agencies and with little, if any support from national health care IT programs. Generalizations of the results or discussion of their possible application to other countries should however be done with great caution because of cultural and regulatory differences as well as differences in the way the healthcare systems are organized and financed [26].

In this study we have used a questionnaire to collect data on physicians' use of EPR systems, data that also could have been obtained by observing GPs. Compared with observational data, greater care must be taken when inferring from data obtained through the use of questionnaires [27; 28]. We however defend the use of a questionnaire in this study because of the aim to reach out to a sufficiently large and therefore probably representative sample of Norwegian GPs. We choose to apply a task-centered questionnaire that has undergone a formal validation and that has been used in several other studies [10; 19; 20]. The fact that few data were missing indicates that the questionnaire was well understood and thoroughly completed by the respondents. In another study we collected data through observing GPs using EPR systems while conducting clinical work. Analyses of these data largely verify the results we obtained in the survey study [29].

Since the hospital data were obtained in 2001 and the GP data in 2003, it may be argued that the former data set is too old. We have documented, and thus acknowledge that the EPR situation in some Norwegian hospitals has developed since 2001 [19; 20], but argue that the primary care EPR systems did not change much in the period between the hospital study in 2001 and the primary care study in 2003. We therefore believe that our data depict the EPR situation in the Norwegian healthcare system at the beginning

of this decade and that the different timing of the studies therefore does not preclude us from comparing EPR use in primary care with that in the hospital setting.

It may also be argued that such a comparison is not valid because of fundamental differences between GPs' and hospital physicians' work. Most of the clinical work of GPs is conducted in one or a very few offices, at the vicinity of a desktop computer dedicated to the use of the GP whereas the work of hospital physicians is far less stationary. Likewise, the documentation work of hospital physicians occurs at a greater distance from the EPR system compared with primary care because of a more extensive use of dictaphones and transcription services. Also, the work of hospital physicians is regularly coupled with the use of clinical information systems that have been tailored to the needs of one or a few departments or that are an integrated part of medical devices in use at the department [9; 30; 31]. On the other hand, there is a considerable overlap between the clinical tasks of GP and that of hospital physicians. Irrespective of clinical specialty, ambulatory or in-patient settings, all physicians document, communicate and evaluate medical problems they have solved and clinical decisions they have made.

The principal finding when comparing Norwegian primary care with the hospital setting is that EPR systems appear much less integrated with the clinical work of hospital physicians. Accordingly, hospital physicians report a much weaker beneficial impact of the EPR system on the quality and efficiency of their work. Finally, hospital physicians are much less satisfied with their EPR system compared with their colleagues in primary care. We have previously shown that hospital physicians' use of the EPR systems increases when the paper-based patient record is removed from clinical workflow. Physicians at these paper-deprived hospitals report a more positive impact

and appear better satisfied with the EPR system [20; 32]. Taken together, these data indicate that physicians evaluate the impact and value of an EPR system from the perspective of the EPR system as a tool — i.e. they primarily see the EPR system as a device that may be used to solve clinical problems.

Some of the differences between primary care and hospital physicians' EPR system use may be due to differences in the users' skills and ability to use the system. The availability of many systems other than the EPR system may lead hospital physicians to put less emphasis on learning how to utilize the many functions of an EPR system. There were however no significant differences in computer literacy between GPs and hospital physicians.

The observed differences between GPs' and hospital physicians' use and esteem of their EPR system may also be explained by fundamental differences in how EPR systems are designed, developed, ordered and implemented in the two sectors. In Norwegian primary care, where the GP is self-employed and partly is reimbursed per patient, the individual who purchases the system is also an end user. Emphasis may therefore be laid on usability and clinical usefulness when deciding which EPR system to purchase. As was mentioned in the introduction, the most successful Norwegian primary care EPR systems were either developed by, or in close relation with GPs. This may explain the rapid adoption of these systems by the sector [7; 33].

The ordering of hospital EPR systems is regularly conducted in the interest of other stakeholders than the end users [34]. Hospital leaders and administrators may see the EPR system also as a tool for improving their control over their physicians and may wish to use the EPR system to impose on the clinical behavior of the physicians. For instance, the interest in hospital workflow systems and technologies supporting clinical

pathways may be interpreted with this perspective [35]. We argue that the interests of stakeholders other than end-users may come at the expense of emphasis on clinical utility, usability and other user interface aspects, and believe that this has contributed to the delay in achieving EPR systems that are valued as tools by hospital physicians in Norway. In our opinion, this should imply that hospital leaders should secure the interests of the end-users when purchasing and implementing an EPR system and that healthcare information systems should be developed according to the principles of user-centered design [15].

5. Conclusion

We have argued that a physician user-centered approach to the design and implementation of primary care EPR systems has led to wide adoption and highly integrated use of the systems in the Norwegian primary care sector. The users also report a profound impact of the EPR systems on the quality and efficiency of their work. Our results should encourage the application of physician user-centered approach in hospital domains.

Summary points

What was known before the study?

- Although EPR systems are increasingly being employed in hospitals and primary care facilities throughout the world, their adoption shows great variation in many countries and regions
- In some cases, employees have failed to embrace the EPR system and its implementation approach factors, and major successes are relatively few.
- Costs and fragmentation of EPR systems are described as barriers to implementation.

What this study adds to our knowledge?

- The clinical work of GPs in Norway is tightly interwoven with the use of EPR systems that were developed by user-centered design and without public funding.
- GPs are satisfied with their systems, reporting a positive impact on both the quality and efficiency of their work.
- GPs are more satisfied and use their systems more intensively than hospital physicians.

6. Authors' contributions

Tom Christensen is the main author responsible for the whole content of the article, including conception and design, acquisition, analysis and statistics of data as well as drafting and revising and final approval of the article. Arild Faxvaag is responsible for conception and design, analysis, revisions and final approval. Hallvard Lærum is responsible for conception and design, analysis, revising and approval as well as the results from the hospital study. Anders Grimsmo is responsible for design, analysis, revisions and final approval.

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8. Statement on conflicts of interest

I declare that none of the authors have any financial or other conflicts of interest in the publication of this manuscript and that the final manuscript has been seen and approved by the co-authors.

REFERENCES

[1] Rector AL, Nowlan WA, Kay S. Foundations for an electronic medical record. Methods Inf Med 1991; 30 (3):179-86.

[2] Shortliffe EH, Perreault LE, Wiederhold G, Fagan LM. Medical informatics: computer applications in health care and biomedicne. Second ed. K.J, H; M.J, B, editors. New York: Springer-Verlag New York, Inc.; 2001. 854 p.

[3] Berner E, Detmer D, Simborg D. Will the wave finally break?: A brief view of the adoption of electronic medical records in the United States. J Am Med Inform Assoc 2005; 12 (1):3-7.

[4] Jha A, Ferris T, Donelan K, Desroches C, Shields A, Rosenbaum S et al. How common are electronic health records in the United States?: A summary of the evidence. Health Aff 2006; 25 (6):496-507.

[5] Menachemi N, Brooks RG. EHR and other IT adoption among physicians: results of a large-scale statewide analysis. J Healthc Inf Manag 2006; 20 (3):79-87.

[6] Lium JT, Faxvaag A. Removal of paper-based health records from Norwegian hospitals: effects on clinical workflow. Stud Health Technol Inform 2006; 124:1031.

[7] Ford EW, Menachemi N, Phillips MT. Predicting the Adoption of Electronic Health Records by Physicians: When Will Health Care be Paperless? J Am Med Inform Assoc 2006; 13 (1):106-12.

[8] Russell S, Spooner S. Barriers to EMR adoption in internal medicine and pediatric outpatient practices. Tenn Med 2004; 97 (10):457-60.

[9] Ellingsen G, Monteiro E. Big is beautiful: electronic patient records in large Norwegian hospitals 1980s-2001. Methods Inf Med 2003; 42 (4):366-70.

[10] Laerum H, Ellingsen G, Faxvaag A. Doctors' use of electronic medical records systems in hospitals: cross sectional survey. BMJ 2001; 323 (7325):1344-8.

[11] Bassoe CF, Sorli WG. ADP in general practice. Tidsskr Nor Laegeforen 1983; 103 (15):1270-5.

[12] Bjørndal A, Maarmann-Moe K. [Automatic data processing in primary health care]. Tidsskrift for den Norske laegeforening. 1993; 113 (10):1236-50.

[13] Nilsen JF, Fosse S. [A computerized medical record system for primary health care]. Tidsskr Nor Laegeforen 1982; 102 (25):1285-8.

[14] Hasvold T. A computerized medical record. "The Balsfjord system". Scand J Prim Health Care 1984; 2 (3):125-8.

[15] Johnson C, Johnson T, Zhang J. A user-centered framework for redesigning health care interfaces. J Biomed Inform 2005; 38 (1):75-87.

[16] Koch S. Designing Clinically Useful Systems: Examples from Medicine and Dentistry. Adv Dent Res 2003; 17 (1):65-8.

[17] Valnes KN, Aarseth HP. [A user evaluation of software programs in family practice]. Tidsskr Nor Laegeforen 1995; 115 (2):230-3.

[18] Meyer I. Benchmarking IT use among General Practitioners in Europe. Bonn: European Commission, Information Society and Media Directorate General, April 2008.

[19] Laerum H, Faxvaag A. Task-oriented evaluation of electronic medical records systems: development and validation of a questionnaire for physicians. BMC Med Inform Decis Mak 2004; 4:1.

[20] Lium JT, Lærum H, Schulz T, Faxvaag A. From the Front Line, Report from a Near Paperless Hospital: Mixed Reception Among Health Care Professionals. J Am Med Inform Assoc 2006; 13 (6):668-75.

[21] Protti D, Wright G, Treweek S, Johansen I. Primary care computing in England and Scotland: a comparison with Denmark. Inform Prim Care 2006; 14 (2):93-9.

[22] Christensen T, Grimsmo A. Expectations for the next generation of electronic patient records in primary care: a triangulated study. Inform Prim Care 2008; 16 (1):21-8.

[23] Covell DG, Uman GC, Manning PR. Information needs in office practice: are they being met? Ann Intern Med 1985; 103 (4):596-9.

[24] Simon JS, Rundall TG, Shortell SM. Drivers of Electronic Medical Record Adoption Among Medical Groups. Jt Comm J Qual Patient Saf 2005; 31 (11):631-9.

[25] Lenhart JG, Honess K, Covington D, Johnson KE. An analysis of trends, perceptions, and use patterns of electronic medical records among US family practice residency programs. Fam Med 2000; 32 (2):109-14.

[26] Heeks R. Health information systems: failure, success and improvisation. Int J Med Inform 2006; 75 (2):125-37.

[27] Strasberg HR, Tudiver F, Holbrook AM, Geiger G, Keshavjee KK, Troyan S. Moving towards an electronic patient record: a survey to assess the needs of community family physicians. Proc AMIA Symp 1998; 230:4.

[28] Wyatt JC, Wyatt SM. When and how to evaluate health information systems? Int J Med Inf 2003; 69 (2-3):251-9.

[29] Christensen T, Grimsmo A. Instant availability of patient records, but diminished availability of information: a multi-method study of GPs use of electronic patient records. BMC Med Inform Decis Mak 2008; 8 (12).

[30] Vedvik E, Faxvaag A. The fate of clinical department systems at the dawn of hospital-wide Electronic health records in a Norwegian university hospital. Stud Health Technol Inform 2006; 124:298-303.

[31] Valdes I, Kibbe DC, Tolleson G, Kunik ME, Petersen LA. Barriers to proliferation of electronic medical records. Inform Prim Care 2004; 12 (1):3-9.

[32] Laerum H, Karlsen TH, Faxvaag A. Effects of scanning and eliminating paper-based medical records on hospital physicians' clinical work practice. J Am Med Inform Assoc 2003; 10 (6):588-95.

[33] Bomba D. A comparative study of computerised medical records usage among general practitioners in Australia and Sweden. In Medinfo. Seoul, Korea; 1998. 55-9 p.

[34] Ammenwerth E, Gräber S, Herrmann G, Bürkle T, König J. Evaluation of health information systems—problems and challenges. Int J Med Inform 2003; 71 (2-3):125-35.

[35] Kuhn KA, Giuse DA. From Hospital Information Systems to Health Information Systems. Methods Inf Med 2001; 40 (4):275-87.

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93. Sverre Helge Torp: *erb*B ONCOGENES IN HUMAN GLIOMAS AND MENINGIOMAS.
94. Olav M. Linaker: MENTAL RETARDATION AND PSYCHIATRY. Past and present.
95. Per Oscar Feet: INCREASED ANTIDEPRESSANT AND ANTIPANIC EFFECT IN COMBINED TREATMENT WITH DIXYRAZINE AND TRICYCLIC ANTIDEPRESSANTS.
96. Stein Olav Samstad: CROSS SECTIONAL FLOW VELOCITY PROFILES FROM TWO-DIMENSIONAL DOPPLER ULTRASOUND: Studies on early mitral blood flow.
97. Bjørn Backe: STUDIES IN ANTENATAL CARE.
98. Gerd Inger Ringdal: QUALITY OF LIFE IN CANCER PATIENTS.
99. Torvid Kiserud: THE DUCTUS VENOSUS IN THE HUMAN FETUS.
100. Hans E. Fjøsne: HORMONAL REGULATION OF PROSTATIC METABOLISM.
101. Eylert Brodtkorb: CLINICAL ASPECTS OF EPILEPSY IN THE MENTALLY RETARDED.
102. Roar Juul: PEPTIDERGIC MECHANISMS IN HUMAN SUBARACHNOID HEMORRHAGE.
103. Unni Syversen: CHROMOGRANIN A. Phsysiological and Clinical Role.

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104. Odd Gunnar Brakstad: THERMOSTABLE NUCLEASE AND THE *nuc* GENE IN THE DIAGNOSIS OF *Staphylococcus aureus* INFECTIONS.
105. Terje Engan: NUCLEAR MAGNETIC RESONANCE (NMR) SPECTROSCOPY OF PLASMA IN MALIGNANT DISEASE.
106. Kirsten Rasmussen: VIOLENCE IN THE MENTALLY DISORDERED.
107. Finn Egil Skjeldestad: INDUCED ABORTION: Timetrends and Determinants.
108. Roar Stenseth: THORACIC EPIDURAL ANALGESIA IN AORTOCORONARY BYPASS SURGERY.
109. Arild Faxvaag: STUDIES OF IMMUNE CELL FUNCTION *in mice infected with* MURINE RETROVIRUS.

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110. Svend Aakhus: NONINVASIVE COMPUTERIZED ASSESSMENT OF LEFT VENTRICULAR FUNCTION AND SYSTEMIC ARTERIAL PROPERTIES. Methodology and some clinical applications.
111. Klaus-Dieter Bolz: INTRAVASCULAR ULTRASONOGRAPHY.
112. Petter Aadahl: CARDIOVASCULAR EFFECTS OF THORACIC AORTIC CROSS-CLAMPING.
113. Sigurd Steinshamn: CYTOKINE MEDIATORS DURING GRANULOCYTOPENIC INFECTIONS.
114. Hans Stifoss-Hanssen: SEEKING MEANING OR HAPPINESS?
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116. Torbjørn Grøntvedt: TREATMENT OF ACUTE AND CHRONIC ANTERIOR CRUCIATE LIGAMENT INJURIES. A clinical and biomechanical study.
117. Sigrid Hørven Wigers: CLINICAL STUDIES OF FIBROMYALGIA WITH FOCUS ON ETIOLOGY, TREATMENT AND OUTCOME.
118. Jan Schjøtt: MYOCARDIAL PROTECTION: Functional and Metabolic Characteristics of Two Endogenous Protective Principles.
119. Marit Martinussen: STUDIES OF INTESTINAL BLOOD FLOW AND ITS RELATION TO TRANSITIONAL CIRCULATORY ADAPATION IN NEWBORN INFANTS.
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121. Rune Haaverstad: OEDEMA FORMATION OF THE LOWER EXTREMITIES.
122. Magne Børset: THE ROLE OF CYTOKINES IN MULTIPLE MYELOMA, WITH SPECIAL REFERENCE TO HEPATOCYTE GROWTH FACTOR.
123. Geir Smedslund: A THEORETICAL AND EMPIRICAL INVESTIGATION OF SMOKING, STRESS AND DISEASE: RESULTS FROM A POPULATION SURVEY.

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124. Torstein Vik: GROWTH, MORBIDITY, AND PSYCHOMOTOR DEVELOPMENT IN INFANTS WHO WERE GROWTH RETARDED *IN UTERO*.
125. Siri Forsmo: ASPECTS AND CONSEQUENCES OF OPPORTUNISTIC SCREENING FOR CERVICAL CANCER. Results based on data from three Norwegian counties.
126. Jon S. Skranes: CEREBRAL MRI AND NEURODEVELOPMENTAL OUTCOME IN VERY LOW BIRTH WEIGHT (VLBW) CHILDREN. A follow-up study of a geographically based year cohort of VLBW children at ages one and six years.
127. Knut Bjørnstad: COMPUTERIZED ECHOCARDIOGRAPHY FOR EVALUTION OF CORONARY ARTERY DISEASE.
128. Grethe Elisabeth Borchgrevink: DIAGNOSIS AND TREATMENT OF WHIPLASH/NECK SPRAIN INJURIES CAUSED BY CAR ACCIDENTS.
129. Tor Elsås: NEUROPEPTIDES AND NITRIC OXIDE SYNTHASE IN OCULAR AUTONOMIC AND SENSORY NERVES.
130. Rolf W. Gråwe: EPIDEMIOLOGICAL AND NEUROPSYCHOLOGICAL PERSPECTIVES ON SCHIZOPHRENIA.
131. Tonje Strømholm: CEREBRAL HAEMODYNAMICS DURING THORACIC AORTIC CROSSCLAMPING. An experimental study in pigs.

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132. Martinus Bråten: STUDIES ON SOME PROBLEMS REALTED TO INTRAMEDULLARY NAILING OF FEMORAL FRACTURES.
133. Ståle Nordgård: PROLIFERATIVE ACTIVITY AND DNA CONTENT AS PROGNOSTIC INDICATORS IN ADENOID CYSTIC CARCINOMA OF THE HEAD AND NECK.

134. Egil Lien: SOLUBLE RECEPTORS FOR **TNF** AND **LPS**: RELEASE PATTERN AND POSSIBLE SIGNIFICANCE IN DISEASE.
135. Marit Bjørgaas: HYPOGLYCAEMIA IN CHILDREN WITH DIABETES MELLITUS
136. Frank Skorpen: GENETIC AND FUNCTIONAL ANALYSES OF DNA REPAIR IN HUMAN CELLS.
137. Juan A. Pareja: SUNCT SYNDROME. ON THE CLINICAL PICTURE. ITS DISTINCTION FROM OTHER, SIMILAR HEADACHES.
138. Anders Angelsen: NEUROENDOCRINE CELLS IN HUMAN PROSTATIC CARCINOMAS AND THE PROSTATIC COMPLEX OF RAT, GUINEA PIG, CAT AND DOG.
139. Fabio Antonaci: CHRONIC PAROXYSMAL HEMICRANIA AND HEMICRANIA CONTINUA: TWO DIFFERENT ENTITIES?
140. Sven M. Carlsen: ENDOCRINE AND METABOLIC EFFECTS OF METFORMIN WITH SPECIAL EMPHASIS ON CARDIOVASCULAR RISK FACTORES.

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141. Terje A. Murberg: DEPRESSIVE SYMPTOMS AND COPING AMONG PATIENTS WITH CONGESTIVE HEART FAILURE.
142. Harm-Gerd Karl Blaas: THE EMBRYONIC EXAMINATION. Ultrasound studies on the development of the human embryo.
143. Noèmi Becser Andersen:THE CEPHALIC SENSORY NERVES IN UNILATERAL HEADACHES. Anatomical background and neurophysiological evaluation.
144. Eli-Janne Fiskerstrand: LASER TREATMENT OF PORT WINE STAINS. A study of the efficacy and limitations of the pulsed dye laser. Clinical and morfological analyses aimed at improving the therapeutic outcome.
145. Bård Kulseng: A STUDY OF ALGINATE CAPSULE PROPERTIES AND CYTOKINES IN RELATION TO INSULIN DEPENDENT DIABETES MELLITUS.
146. Terje Haug: STRUCTURE AND REGULATION OF THE HUMAN UNG GENE ENCODING URACIL-DNA GLYCOSYLASE.
147. Heidi Brurok: MANGANESE AND THE HEART. A Magic Metal with Diagnostic and Therapeutic Possibilites.
148. Agnes Kathrine Lie: DIAGNOSIS AND PREVALENCE OF HUMAN PAPILLOMAVIRUS INFECTION IN CERVICAL INTRAEPITELIAL NEOPLASIA. Relationship to Cell Cycle Regulatory Proteins and HLA DQBI Genes.
149. Ronald Mårvik: PHARMACOLOGICAL, PHYSIOLOGICAL AND PATHOPHYSIOLOGICAL STUDIES ON ISOLATED STOMACS.
150. Ketil Jarl Holen: THE ROLE OF ULTRASONOGRAPHY IN THE DIAGNOSIS AND TREATMENT OF HIP DYSPLASIA IN NEWBORNS.
151. Irene Hetlevik: THE ROLE OF CLINICAL GUIDELINES IN CARDIOVASCULAR RISK INTERVENTION IN GENERAL PRACTICE.
152. Katarina Tunòn: ULTRASOUND AND PREDICTION OF GESTATIONAL AGE.
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154. Arild Aamodt: DEVELOPMENT AND PRE-CLINICAL EVALUATION OF A CUSTOM-MADE FEMORAL STEM.
155. Agnar Tegnander: DIAGNOSIS AND FOLLOW-UP OF CHILDREN WITH SUSPECTED OR KNOWN HIP DYSPLASIA.
156. Bent Indredavik: STROKE UNIT TREATMENT: SHORT AND LONG-TERM EFFECTS
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158. Ola Dalsegg Sæther: PATHOPHYSIOLOGY DURING PROXIMAL AORTIC CROSS-CLAMPING CLINICAL AND EXPERIMENTAL STUDIES
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160. Christina Vogt Isaksen: PRENATAL ULTRASOUND AND POSTMORTEM FINDINGS – A TEN YEAR CORRELATIVE STUDY OF FETUSES AND INFANTS WITH DEVELOPMENTAL ANOMALIES.
161. Holger Seidel: HIGH-DOSE METHOTREXATE THERAPY IN CHILDREN WITH ACUTE LYMPHOCYTIC LEUKEMIA: DOSE, CONCENTRATION, AND EFFECT CONSIDERATIONS.
162. Stein Hallan: IMPLEMENTATION OF MODERN MEDICAL DECISION ANALYSIS INTO CLINICAL DIAGNOSIS AND TREATMENT.

163. Malcolm Sue-Chu: INVASIVE AND NON-INVASIVE STUDIES IN CROSS-COUNTRY SKIERS WITH ASTHMA-LIKE SYMPTOMS.
164. Ole-Lars Brekke: EFFECTS OF ANTIOXIDANTS AND FATTY ACIDS ON TUMOR NECROSIS FACTOR-INDUCED CYTOTOXICITY.
165. Jan Lundbom: AORTOCORONARY BYPASS SURGERY: CLINICAL ASPECTS, COST CONSIDERATIONS AND WORKING ABILITY.
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169. Dalius Bansevicius: SHOULDER-NECK REGION IN CERTAIN HEADACHES AND CHRONIC PAIN SYNDROMES.
170. Bettina Kinge: REFRACTIVE ERRORS AND BIOMETRIC CHANGES AMONG UNIVERSITY STUDENTS IN NORWAY.
171. Gunnar Qvigstad: CONSEQUENCES OF HYPERGASTRINEMIA IN MAN
172. Hanne Ellekjær: EPIDEMIOLOGICAL STUDIES OF STROKE IN A NORWEGIAN POPULATION. INCIDENCE, RISK FACTORS AND PROGNOSIS
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174. Astrid Hjelde: SURFACE TENSION AND COMPLEMENT ACTIVATION: Factors influencing bubble formation and bubble effects after decompression.
175. Kjell A. Kvistad: MR IN BREAST CANCER – A CLINICAL STUDY.
176. Ivar Rossvoll: ELECTIVE ORTHOPAEDIC SURGERY IN A DEFINED POPULATION. Studies on demand, waiting time for treatment and incapacity for work.
177. Carina Seidel: PROGNOSTIC VALUE AND BIOLOGICAL EFFECTS OF HEPATOCYTE GROWTH FACTOR AND SYNDECAN-1 IN MULTIPLE MYELOMA.

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178. Alexander Wahba: THE INFLUENCE OF CARDIOPULMONARY BYPASS ON PLATELET FUNCTION AND BLOOD COAGULATION – DETERMINANTS AND CLINICAL CONSEQUENSES
179. Marcus Schmitt-Egenolf: THE RELEVANCE OF THE MAJOR hISTOCOMPATIBILITY COMPLEX FOR THE GENETICS OF PSORIASIS
180. Odrun Arna Gederaas: BIOLOGICAL MECHANISMS INVOLVED IN 5-AMINOLEVULINIC ACID BASED PHOTODYNAMIC THERAPY
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184. Bjørn Olav Haugen: MEASUREMENT OF CARDIAC OUTPUT AND STUDIES OF VELOCITY PROFILES IN AORTIC AND MITRAL FLOW USING TWO- AND THREE-DIMENSIONAL COLOUR FLOW IMAGING
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190. Turid Lingaas Holmen: SMOKING AND HEALTH IN ADOLESCENCE; THE NORD-TRØNDELAG HEALTH STUDY, 1995-97
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193. Kristian Midthjell: DIABETES IN ADULTS IN NORD-TRØNDELAG. PUBLIC HEALTH ASPECTS OF DIABETES MELLITUS IN A LARGE, NON-SELECTED NORWEGIAN POPULATION.
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195. Ulrik Wisløff: CARDIAC EFFECTS OF AEROBIC ENDURANCE TRAINING: HYPERTROPHY, CONTRACTILITY AND CALCUIM HANDLING IN NORMAL AND FAILING HEART
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204. Sylvester Moyo: STUDIES ON STREPTOCOCCUS AGALACTIAE (GROUP B STREPTOCOCCUS) SURFACE-ANCHORED MARKERS WITH EMPHASIS ON STRAINS AND HUMAN SERA FROM ZIMBABWE.
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206. Li Lixin: ON THE REGULATION AND ROLE OF UNCOUPLING PROTEIN-2 IN INSULIN PRODUCING ß-CELLS
207. Anne Hildur Henriksen: SYMPTOMS OF ALLERGY AND ASTHMA VERSUS MARKERS OF LOWER AIRWAY INFLAMMATION AMONG ADOLESCENTS
208. Egil Andreas Fors: NON-MALIGNANT PAIN IN RELATION TO PSYCHOLOGICAL AND ENVIRONTENTAL FACTORS. EXPERIENTAL AND CLINICAL STUDES OF PAIN WITH FOCUS ON FIBROMYALGIA
209. Pål Klepstad: MORPHINE FOR CANCER PAIN
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214. Turid Suzanne Berg-Nielsen: PARENTING PRACTICES AND MENTALLY DISORDERED ADOLESCENTS
215. Astrid Rydning: BLOOD FLOW AS A PROTECTIVE FACTOR FOR THE STOMACH MUCOSA. AN EXPERIMENTAL STUDY ON THE ROLE OF MAST CELLS AND SENSORY AFFERENT NEURONS

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218. Arne Åsberg: EPIDEMIOLOGICAL STUDIES IN HEREDITARY HEMOCHROMATOSIS: PREVALENCE, MORBIDITY AND BENEFIT OF SCREENING.
219. Johan Fredrik Skomsvoll: REPRODUCTIVE OUTCOME IN WOMEN WITH RHEUMATIC DISEASE. A population registry based study of the effects of inflammatory rheumatic disease and connective tissue disease on reproductive outcome in Norwegian women in 1967-1995.
220. Siv Mørkved: URINARY INCONTINENCE DURING PREGNANCY AND AFTER DELIVERY: EFFECT OF PELVIC FLOOR MUSCLE TRAINING IN PREVENTION AND TREATMENT
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228. Sigurd Fasting: ROUTINE BASED RECORDING OF ADVERSE EVENTS DURING ANAESTHESIA – APPLICATION IN QUALITY IMPROVEMENT AND SAFETY
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243. Per Arne Aas: MACROMOLECULAR MAINTENANCE IN HUMAN CELLS – REPAIR OF URACIL IN DNA AND METHYLATIONS IN DNA AND RNA
244. Anna Bofin: FINE NEEDLE ASPIRATION CYTOLOGY IN THE PRIMARY INVESTIGATION OF BREAST TUMOURS AND IN THE DETERMINATION OF TREATMENT STRATEGIES

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250. Ragnhild Støen: ENDOTHELIUM-DEPENDENT VASODILATION IN THE FEMORAL ARTERY OF DEVELOPING PIGLETS
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254. Viggo Pettersen: FROM MUSCLES TO SINGING: THE ACTIVITY OF ACCESSORY BREATHING MUSCLES AND THORAX MOVEMENT IN CLASSICAL SINGING
255. Marianne Fyhn: SPATIAL MAPS IN THE HIPPOCAMPUS AND ENTORHINAL CORTEX
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268. Björn Inge Gustafsson: THE SEROTONIN PRODUCING ENTEROCHROMAFFIN CELL, AND EFFECTS OF HYPERSEROTONINEMIA ON HEART AND BONE

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277. Stein Sundstrøm: IMPROVING TREATMENT IN PATIENTS WITH LUNG CANCER – RESULTS FROM TWO MULITCENTRE RANDOMISED STUDIES
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