Student thesis

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Orthopaedic injuries in multi-trauma patients

Prevalence, treatment and need for rehabilitation

Student thesis in Medicine
Supervisor: Lars Gunnar Johnsen
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Introduction and background

Trauma is one of the leading causes of death and disability to an otherwise young and healthy population, with injuries being the main cause of death for Norwegians below 45 years of age(1). In Norway the socio-economic costs due to home, education, sports and leisure accidents were estimated to cost the Norwegian society NOK 167 billion in 2002 (equivalent to NOK 200 billion 2017)(2). Almost 300,000 patients receive annual medical treatment in hospitals, 168,000 of these only in hospitals, the rest combined primary care and hospital(1). In addition, the cost of traffic accidents alone for the Norwegian society amounted to NOK 28 billion in 2011.

Based on experience from treatment of trauma patients, knowledge of the financial reimbursement system in Norway (Innsatsstyrt finansiering, DRG) and information from the Norwegian Patient Registry, one can assume that the primary (index) treatment of severely injured patients is expensive. However, there is little information about the relationship between the expensive primary treatment of multi-trauma patients and post injury rehabilitation in Norway. This study will try to explore this relationship in more detail.

Each year between 400 and 500 patients come to St. Olavs Hospital with a trauma that triggers the trauma alarm. Approximately 100 of these are seriously injured, multi-trauma patients, with an Injury Severity Score (ISS)(3) of more than 15. In the acute phase these patients receive very resource intensive care such as evacuation, assessment, surgeries and intensive care stays.

Standardized clinical pathways are meant to guide evidence-based healthcare. The aim is to translate practice guideline recommendations into clinical process of care. This is the definition from WHO on clinical pathways (CPWs)(4):

> *"A CPW is a structured multidisciplinary care plan with the following characteristics: [1] it is used to translate guidelines or evidence into local structures; [2] it details the steps in a course of treatment or care in a plan, pathway, algorithm, guideline, protocol or other "inventory of actions"; and [3] it aims to standardize care for a specific clinical problem, procedure or episode of healthcare in a specific population."*.

This means that we have a good overview of what treatment patients who have CPWs receive. CPW is mostly not established in Norway for multi trauma patients, except university hospitals in Oslo and Bergen. In the multi trauma patient, it is usually the patients with a traumatic brain injury (TBI) or a spinal cord injury (SCI) that have CPW. The patients without a TBI or SCI are not in a CPW, and we do not know what kind of treatment these patients get. A recent review by Naess et al. could not find any studies covering early integrated rehabilitation for trauma patients without traumatic brain associated injuries(5). This study aims to provide a better understanding of what treatment and rehabilitation the orthopaedic multi trauma patient gets at St. Olavs Hospital. Patients with an established CPW or who are not managed by orthopaedic have not been included.

In similar cases like stroke patients it is well established that it is cost effective to have intensive rehabilitation starting as soon as possible after the stroke(6). According to the National Trauma Care Plan for Norway released in 2015, it is mandatory to have established rehabilitation centres in relation to the four Level 1 trauma hospitals in Norway(7).

The purpose of this study is to improve the current knowledge regarding treatment of multi-trauma patients with orthopaedic injuries, including rehabilitation, as this is a field with limited knowledge in Norway today. The study will give an impression of the degree of fulfilment of the rehabilitation service according to the National Trauma Plan at St. Olavs Hospital.

Material and method

The data material used for this study is based on registrations done by the trauma registrar working with the National Trauma register (*Nasjonalt traumeregister*), a national database where a local trauma registrar from each trauma centre collects data on trauma patients stored in a local database and a national database. The aim of the Trauma register is to ensure equal, high-quality care for seriously injured patient regardless of age, sex and place of living(8). In this study we accessed the local database from St. Olavs Hospital. Based on this database, the registrar made a list of all patients arriving at St. Olavs Hospital with an ISS above 15. The material gives the date of admission at St. Olavs Hospital, ISS, NISS and national identity number. Based on the national identity number, each patient was looked up in the electronic patient record system Doculive at St. Olavs hospital. The patient record was accessed from the date of trauma to a maximum of two years later, including admissions and treatments at

local hospital related to the trauma. We have excluded treatments and hospital stays which is not a consequence of the trauma. Readmittance needed to treat injuries or complications from the trauma has also been included.

Originally, we planned to use data from 2015, 2016 and 2017. To be able to meet the deadline, the data from 2017 was not used. We also planned on sending a questionnaire to the patients to evaluate their function and health today, and asking what kind of rehabilitation they might have received. The process of accessing the local database took more time than planned, making it necessary to discard the questionnaires for the patients.

Going through the electronic patient records, we registered the following variables:

1. Patient gender
2. Date of trauma
3. Age
4. ISS
5. NISS
6. Number of surgeries
7. Operating time from start of anaesthesia to end of surgery, in minutes
8. Number of specialities involved in treating the patient (excl. paraclinical specialities like microbiology and radiology)
9. Where the patient was discharged (home, institution, mors, other)
10. Days in intensive care unit
11. Days in hospital
12. Sent directly to specialised rehabilitation at discharge yes/no
13. Classification of injury: fracture only, soft tissue only, multi trauma
14. ICD-10 classification, first five diagnosis
15. IFS, first six procedures
16. Days until first contact with physiotherapist
17. Social worker
18. Speech and language therapist
19. Dietitian
20. Psychiatrist
21. Psychologist or psychiatric nurse
22. Neuropsychologist

23. Occupational therapist
24. Orthopaedic engineer
25. Managed by orthopaedic department yes/no

Exclusions

A few of the registered traumas by the registrar did not have an electronic patient record to be found or had incomplete data. We had no means to identify the cause of this, and it could be caused by a multitude of reasons. These traumas have been excluded from the analyses. Patients with already established CPWs have been excluded, this means patients with either TBI or SCI being excluded from analyses, even if the treatment were done by orthopaedics. The treatment of patient groups with established CPWs can easily be predicted by the CPW. This study aims to answer what treatment orthopaedic multi trauma patients got, as this is a group without CPW. Patients who died from their injuries are also excluded.

We have also excluded patients transferred out of Helse Midt-Norge (the regional area St. Olavs serves as Level 1 Trauma centre), as we can't access the patient records outside of this region. Primarily this was tourists being transported to their home country, or Norwegian nationals living in other regions in Norway. In total 58 patients were included.

Results

Material before exclusions:

During the time period of 2015-2016, 250 individual patients came to St. Olavs Hospital with an ISS-score above 15. The average ISS-score of all patients were 25, and the patient had a mean age of 46,6. Most of the patients, 73,4%, were male. The patients averaged 1.5 surgeries, where each surgery averaged at close to 3 hours (163 minutes). Mean length of stay was a week (6.95 days) in an intensive care unit (ICU) and 16,5 days admitted to hospital in total. These numbers show a diverse group of patients, who required resource intensive treatment, over the course of prolonged hospital stays three times the 2017-average in Norway(9).

After exclusions

The orthopaedic patients are similar to the trauma patients prior to exclusions, with an average age of 48, ISS of 24 and NISS of 28. 70,7% of the included patients were male. The majority of patients were clustered in the lowest half of ISS, with only 8 patients with an ISS

of 30 or more. NISS were substantially higher, almost a third of the patients, 18 individuals scored 30 or more. Length of stay for the orthopaedic patients averaged 8,35 days in ICU and 24,66 in hospital, both higher than the group of multi-trauma patients before exclusions. The longest stay in hospital was 76 days, and the longest ICU stay was 53 days.

Most common ICD-diagnoses in the orthopaedic patients after excluding patients with neurological injuries were S32.X (Fracture of lumbar spine and pelvis) with count of 33 ICD-diagnosis, and S22.X (Fracture of rib(s), sternum and thoracic spine) with count of 32. S42.X (Fracture of shoulder and upper arm) with count of 17, S52.X (Fracture of forearm) count of 15, S72.X (Fracture of femur) count 15 and S82.X (Fracture of lower leg, including ankle) count of 15. Many of the other diagnoses only occurs a few times in the material, displaying that the patients have a unique set of injuries following the trauma.

Only six patients did not receive any surgeries for their injuries, including these patients, the mean no. of surgeries were 3,19. Total time of surgeries for patients undergoing surgery, averaged at more than 11 hours at 677 minutes. In this study we defined the start of surgery as the beginning of anaesthesia, to the end of surgery. This is registered in the anaesthesia-journal. The median value was 407 minutes, proving that some of the patients underwent more complex surgeries than the majority, or suffered complications like infected wounds or compartment syndrome requiring additional surgeries giving the most extreme values and increasing the mean value.

The patients were discharged almost evenly between an institution and their home, with 30 and 28 respectively. This includes all kind of institutions, both specialised rehabilitation units, nursing homes, rehabilitation in specialist health care or psychiatric hospital. 25% of the patients discharged to an institution, were not sent to a rehabilitation institution. Of all the orthopaedic patients 40% were sent directly to a rehabilitation unit, one of these patients as outpatient follow-up. In this material Betania Malvik, Fosen DMS and Levanger hospital rehabilitation have been classified as specialised units. Betania Malvik is a private foundation, with a contract with the public Helse Midt-Norge RHF. The website states them to offer specialised rehabilitation, but does not specify the presence of a specialist in physical medicine and rehabilitation. Fosen DMS is a collaboration between several municipalities and St. Olavs hospital, which have a specialist in general practice attending every day. The rehabilitation unit in Levanger is a part of the Levanger local hospital with specialist in

physical and rehabilitation medicine. The contract for private institutions does not require specific specialist, as long as a physician is involved(10). None of these institutions are specialised for rehabilitation of severely injured patients. There is no equivalent alternative to Sunnaas in Helse Midt. Notably no patients received an intermediate rehabilitation stay during their initial stay at St. Olavs hospital or their respective local hospital. For the patients that were discharged home, there were no standardized follow up in primary care, including no standardization of referral to a physiotherapist or occupational therapist. Some municipalities might have standardized routines for this, though the hospital took no part in this.

During the initial stay, 90% of all patients were in contact with a physiotherapist, in average at day 5,6 days. The day of trauma/admittance is defined as day 1. Of the different groups of hospital staff included in our study, the physiotherapist was the only therapist the majority of patients were evaluated by, in what could be seen as routinely. The occupational therapist was in contact with 26% of the patients, on average at day 30 of hospitalization. This could be due to them being in contact with some of the most severely injured patients most in need of custom aids after discharge. None of the other staff saw more than 15% of the patients, and for some the patient record shows it was on the initiative of the patients, for instance asking to see a psychiatrist. There is not any routinely use of any other than the physiotherapist. The patients were on the other hand usually not managed singlehanded by orthopaedics, even though a few were. On average 3 different specialists were involved, but in some cases as many as 10. The paraclinical specialisations like radiologists have not been included. The trauma team has not been counted, as this is a set team regardless of patient injury. Anaesthesiologists have also not been included, as they are needed regardless of what kind of surgery or ICU-stay the patient needed.

All figures and numbers referred to in this section is presented in detail at the end of this article in a separate section for tables and figures.

Discussion / Interpretation

Comparing our data and results from the entire group of multi trauma patients before any exclusions with the data of orthopaedic multi trauma patients, one can see that the latter group had longer stays in hospital, in the ICU and required more surgeries in the management of their injuries. The groups were otherwise similar considering age, sex, and ISS-scores. The

pre-exclusion group is a group which in large are very varied regarding their injuries, but are severely injured and requiring intensive treatment for their injuries and expensive hospital stays.

In our group of interest, the orthopaedic multi-trauma patient, it was hard to predict what kind of treatment and subsequent follow-up a patient would get based on the initial description of the trauma and the injuries the first day after admission. There was no obvious standardization, and no CPW for these patients. Physiotherapists were usually involved early on in the management of orthopaedic patients, and on average they were first in contact with the patient 1 day prior to transferal from ICU to a regular ward. Further management might seem to be done ad hoc, where sometimes the patient him-/herself had to ask to see a social worker, psychiatrist or similar.

For some patients it seemed that further rehabilitation often was the result of individual physicians remembering to think of it. Sometimes a referral to Lian, the most specialized rehabilitation in Helse Midt, was sent, but usually not accepted due to the patient group not being prioritized if no sign of TBI or SCI. In one instance an uncertain finding on cerebral MRI which *could* indicate TBI were used to leverage the need for rehabilitation in a patient with primarily orthopaedic injuries. The patients that got post-injury rehabilitation were mostly sent to rehabilitation units in the region, but with fewer resources and not specialised for this group of patients.

The majority of patients were not sent directly to rehabilitation but were sent either home or to another institution like a nursing home. Usually discharged without a documented plan for rehabilitation. Primary health care is not necessarily prepared to give this patient group an adequate rehabilitation without recommendations from specialists evaluating each individual patient. The most important finding here is the lack of a well-coordinated cooperation between primary and secondary health care.

The national trauma plan gives the following strong recommendations for all groups of trauma-patients (author's translation)(7):

- Patients in ICU in a trauma centre have to be assessed by a specialist from a rehabilitation unit within 3 days after the injury
- Rehabilitation have to start during the intensive care-phase in the trauma centre

- Patients have to be transferred directly from emergency wards in a trauma centre to rehabilitation, not by waiting in a local hospital without specialised rehabilitation
- It must be defined regional rehabilitation units responsible for different injuries. Few units need to be responsible for the most seriously injured
- The units need to be known for the trauma centres
- In a trauma centre the orthopaedist and neurosurgeon are defined as the link to rehabilitation
- It needs to be a system that discovers psychological sequela, patients with a serious pain problem, and patients at risk of developing addiction throughout the patient pathway
- The trauma centres should, in collaboration with the municipalities, define standardized clinical pathways which gives equal rehabilitation regardless of regional levels of health administration. It must be established good and predictable systems for follow up and cooperation:
    - Available beds or day units for assessment and rehabilitation
    - Late phase offer of multidisciplinary rehabilitation regardless of patient's home address
    - Coping/managing facility for the family, including children
    - Interdisciplinary out-patient clinic lead by a specialist in physical medicine and rehabilitation
    - Ambulating rehabilitation teams

There are certain changes to this study that would have given us more valuable information. There could have been defined more clearly what kind of specialists involved in patient management, where specialist in physical medicine and rehabilitation would be particularly interesting. The study would also have been improved by a larger sample size, as was originally planned**.** The national trauma plan points to missing follow up for readmittance and hospital check-ups, which could have been included in this study as a separate variable.

Conclusion

Based on the findings in this study, none of the strong recommendations in the national trauma plan seems to be implemented at St. Olavs Hospital for the orthopaedic multi-trauma patient, despite massive use of resources in the initial treatment. There is little evidence on this specific subgroup's benefits from rehabilitation, but there is evidence in general and for

other groups that early, standardized patient pathways including rehabilitation is beneficial for the patient and can be cost-effective for society. Our recommendation is to implement the strong recommendations from the national trauma plan for this patient group as soon as possible.

Figures and tables

Table 1 – age, ISS and NISS for all data

		age	ISS	NISS
N	Valid	247	247	247
	Missing	3	3	3
Mean		46.59	25.27	30.89
Median		49.00	22.00	27.00
Range		90	59	59
Minimum		3	16	16

3 traumas from the registrar's registration to the database did not include any further details than date of admittance, making it impossible to look up electronic patient records. These have been excluded.

Table 2 – gender distribution before exclusions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	182	72.8	73.4	73.4
	female	66	26.4	26.6	100.0
	Total	248	99.2	100.0	
Missing	System	2	.8		
Total		250	100.0		

2 traumas did not include gender for the patient, and since a few traumas were missing further information and a national identity number, it was not possible to look it up.

Table 3 – hospital- and ICU-stay, surgeries and no. of specialists involved

		No. of surgeries	Combined minutes of surgery	No. of specialities involved	Days in ICU	Days admitted in total
N	Valid	245	232	243	239	244
	Missing	5	18	7	11	6
Mean		1.51	246.97	3.05	6.95	16.45
Median		1.00	115.50	3.00	4.00	12.00
Range		13	2763	9	53	75
Minimum		0	0	1	0	1

Overview of all patients before exclusions. Combined minutes of surgery refers to the total time for all the surgeries a patient underwent, from start of anaesthesia to end of surgery.

Table 4 – age, ISS, NISS of orthopaedic patients

		age	ISS	NISS
N	Valid	58	58	58
	Missing	0	0	0
Mean		48.05	24.38	28.03
Median		48.50	22.00	27.00

Age, ISS and NISS of the orthopaedic patients after exclusions

Table 5 – gender distribution of orthopaedic patients

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	41	70.7	70.7	70.7
	female	17	29.3	29.3	100.0
	Total	58	100.0	100.0	

Gender distribution of orthopaedic patients after exclusions

Table 6 – Surgeries orthopaedic patients

N	Valid	58
	Missing	0
Mean		3.19
Median		2.00
Range		13
Minimum		0
Maximum		13

Number of surgeries for orthopaedic patients, after exclusions. Patients without any surgery have been included in calculations.

Table 7 – minutes of surgery

N	Valid	45
	Missing	13
Mean		677.64
Median		407.00
Range		2748
Minimum		15
Maximum		2763

Combined duration of all surgeries for each of the orthopaedic patients. Missing values refers to 6 patients which did not undergo surgery, and 7 patients were the patient record was incomplete to evaluate length of surgery. Missing values have been excluded. Minutes defined as start of anaesthesia to end of surgery.

Table 8 - Discharges

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	home	28	48.3	48.3	48.3
	institution	30	51.7	51.7	100.0
	Total	58	100.0	100.0	

Overview of where the orthopaedic patients were discharged to.

Table 9 – Directly to specialist rehabilitation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	35	60.3	60.3	60.3
	yes	23	39.7	39.7	100.0
	Total	58	100.0	100.0	

The proportion of the orthopaedic patients sent directly to some sort of specialist rehabilitation, including Betania Malvik, Fosen DMS and Levanger outside of St. Olavs.

Table 10 – Day of contact with different therapists

		Physiotherapist	Social worker	Speech therapist	Dietitian	Psychiatrist	Psychologist or psychiatric nurse	Neuropsychologist	Occupational therapist	Orthopaedic engineer
N	Valid	52	5	0	3	8	4	0	15	5
	Missing	6	53	58	55	50	54	58	43	53
Mean		5.58	11.00		19.00	13.63	18.75		29.67	50.40
Median		5.00	12.00		20.00	11.50	13.00		20.00	52.00

Day of admittance equals day 1. All groups except the orthopaedic engineer documents in DocuLive, which we can't directly access. Missing values have not been included in calculations. A missing value represents that no documented contact happened.

Table 11 – Number of specialists involved in patient management

N	Valid	58
	Missing	0
Mean		3.28
Median		3.00
Range		9
Minimum		1
Maximum		10

Number of specialists involved in managing the orthopaedic patients, excluding specialities like radiology, anaesthesia and microbiology, because their role is supportive, while the patient "belongs" to a different department.

Table 12 – Number of specialists involved in patient management frequencies

	No. of specialities	Frequency	Percent	Valid Percent
Valid	1	6	10.3	10.3
	2	13	22.4	22.4
	3	18	31.0	31.0
	4	12	20.7	20.7
	5	3	5.2	5.2
	6	4	6.9	6.9
	7	1	1.7	1.7
	10	1	1.7	1.7
	Total	58	100.0	100.0

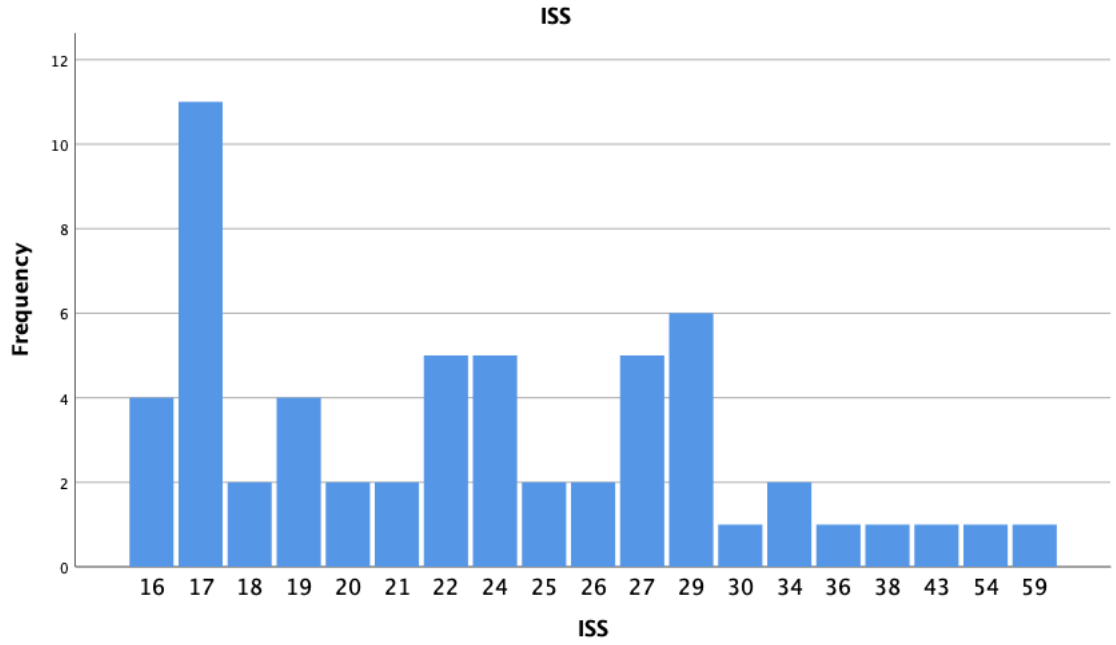
Distribution of number of specialists involved in patient management of the orthopaedic patients.

Table 13 - Length of hospitalization and ICU-stay

		Days in ICU	Days in hospital
N	Valid	55	58
	Missing	3	0
Mean		8.35	24.66
Median		4.00	21.50
Range		53	74
Minimum		0	2
Maximum		53	76

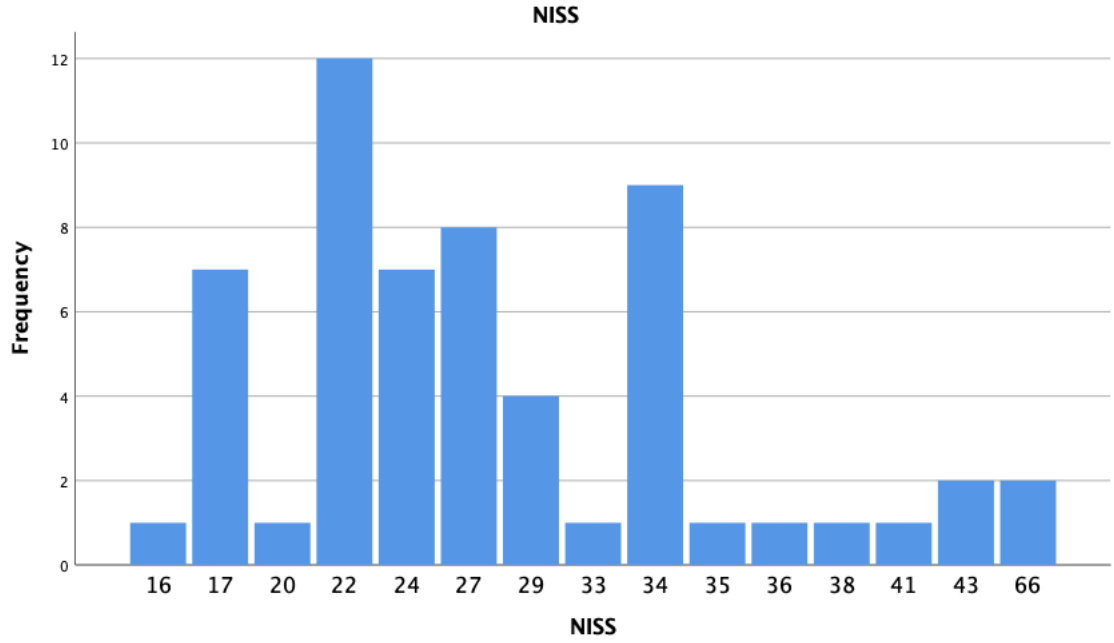
Length of stay in hospital and ICU combined for orthopaedic patients. For three patients the electronic records are incomplete for when transfer from ICU to ward happened. The missing data have been excluded in the analyses.

Figure 1 – distribution of ISS



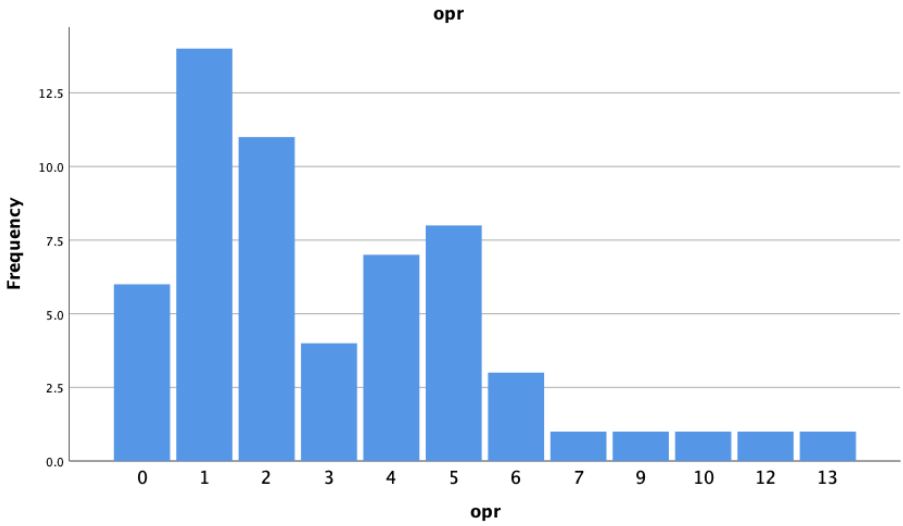
Frequency and distribution of ISS for the orthopaedic patients.

Figure 2 – distribution of NISS



Frequency and distribution of NISS in the orthopaedic patients.

Figure 3 – distribution of surgeries



Frequency and distribution of number of surgeries for the orthopaedic patients.

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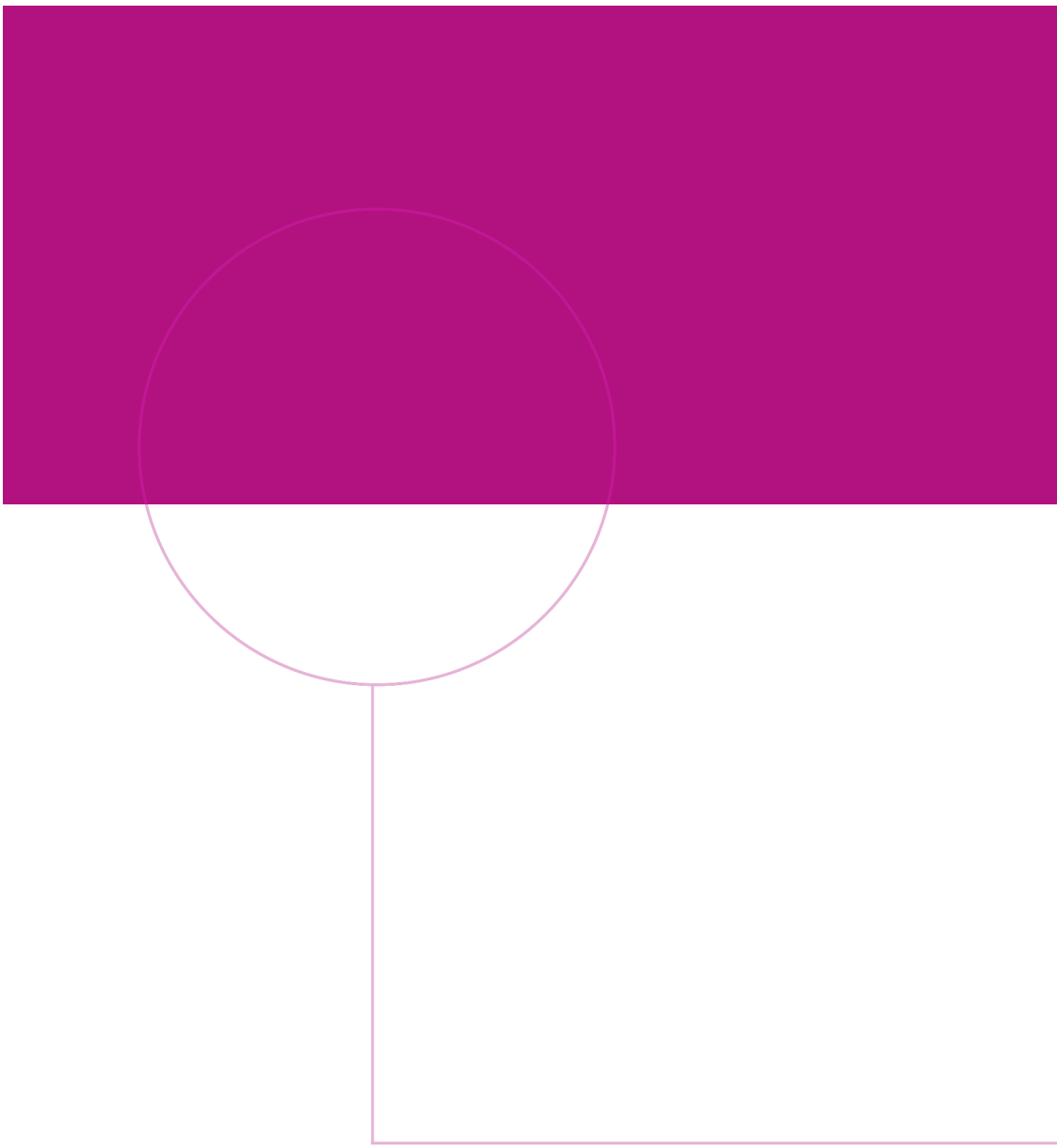

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