UiT The Arctic University of Norway

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Rehabilitation after moderate to severe trauma in accordance to Norwegian guidelines

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Foreword

This text was written as a part of the subject MED-3950, a subject within the fifth year of medical studies at the Faculty of Health Sciences at UiT the Arctic University of Norway.

I reached out to one of my professors, Audny G. W. Anke, during my fourth year after a lecture of hers, and asked her to be my supervisor for my masters. She helped me find a reasonable thesis statement under a project already in the works, as well as set me up with my co-supervisor, Christoph Schäfer, a PhD candidate. My master's thesis would be a part of their team and their larger collaborative study with Oslo University Hospital (OUS) and the University Hospital of North Norway (UNN). It focuses on rehabilitation after a traumatic injury according to the Norwegian guidelines with a focus on the prevalence of rehabilitation needs, the services provided, and functional outcomes across all age groups, levels of injury severity, and geographical regions in the first year after trauma. The aim is to get a better understanding of where to focus future efforts of improvement in the field. My part would be focusing on data from UNN only.

My greatest thanks to my main supervisor Audny Anke for your lovely guidance and patience, as well as helping me make my work as precise as possible. Also, lots of thanks to Christoph Schäfer for your support and technical assistance. This would not be possible without all involved in the original study, and thank you for the opportunity to participate in this collaboration.

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Background

Severe traumatic injuries are a significant cause of long-lasting morbidity and early death, with functional and psychological consequences. As a way to prevent and mitigate this, *Nasjonal Kompetansetjeneste for traumatology (NKT)* revised in 2017 the national guidelines from 2007, including guidelines for best practice when it comes to rehabilitation after trauma. This study aimed to look at some of these guidelines in practice at the University Hospital of North Norway (UNN), in an acute setting and the follow-up.

Method

A prospective study of 47 patients of all ages with moderate to severe trauma, defined by a New Injury Severity Score > 9, admitted to the trauma center of Northern Norway within 72 hours after injury during one year. Approximately 41 patients received follow-up at six months.

Results

When looking at these 47 patients it was revealed that 6% got assessed during the first 72 hours, 52% of the 21 patients who had a stay of over two days in an intensive care unit received rehabilitation in the acute phase, and 30% got transferred directly to a specialized rehabilitation unit after discharge. Furthermore, fifteen percent of those who got follow-up received assistance through ambulatory rehabilitation teams, and two patients in total received psychological follow-up. Lastly 25% of 20 had symptoms consistent with post-traumatic stress disorder, and 35% of 23 had a continuous severe disability at six months.

Conclusion

This study is suggesting an indication of a low percentage of patients receiving rehabilitation in accordance to the national both in the acute phase, and when looking at psychological sequela and standardized follow-up in the period after discharge. The findings from this study highlight the need for an improvement to the systems currently in use.

1 Background

Following a traumatic injury, individuals undergo a sudden and momentous transition from their everyday selves to patients who now require medical attention. This will oftentimes introduce new functional challenges which can impact most of their daily life, also in the long term (1). It is important to acknowledge the mental health implications following this traumatic event, such as depression, anxiety and Post Traumatic Stress Disorder (PTSD), which oftentimes are overlooked (2).

Traumatic injuries are a main cause for long-lasting morbidity and early death (3). Studies has shown that over 60% of trauma patients experienced a reduction in life quality two years post-trauma (4). Another study showed that more than 80% of patients had residual impairments 3 years after (5). This goes to show that physical trauma can be long-lasting and impact life much longer than the actual injury, and there is a need for follow-up through professionals such as psychiatrists and functional rehabilitation to mitigate long-term consequences.

A study from Gabbe, Sutherland (6) revealed that almost 70% still used health care services at 6 months post-injury. The most commonly used health care services post-trauma at 6 months were physiotherapy and occupational therapy. Of those that didn't use the services but were disabled, the number one reason was that they were sent directly home after discharge, and not to another institution such as an inpatient rehabilitation center (6). What this can show, is that a safety-net, such as guidelines on a national level, can in theory catch these patients who are at risk of further disablement (3, 7).

The Norwegian national general guidelines in rehabilitation states that the target group for rehabilitation are people who have, or are in great danger of having, limitations in their physical, psychical, cognitive and/or social functions (8). There is work to regain function lost, or to master living with their potential limitations. This can both include physical and psychological constraints.

This general guideline provides the central principles and overall requirements for the provision of services in rehabilitation. It lays the groundwork for the regulations that are in place to ensure that the correct services are provided and that those are made on an individual level by a multidisciplinary team (8). The multidisciplinary team works out rehabilitation needs that take the whole individual into account – such as pre-existing conditions, the injury

and its severity, and sociodemographic factors that may affect recovery, but also the personal goals (3, 8).

1.1 National Trauma Plan

In 2007 a national trauma plan was published. This included recommendations for early rehabilitation and transfers – recommendations that admittedly were not followed (9). Therefore, a new, revised plan was published in 2017 by the *Nasjonal Kompetansetjeneste for Traumatology (NKT)* based on best practice and available evidence and made by representatives in the entire treatment chain (10). The guidelines state the need for an apt capacity in late rehabilitation regardless of residency in the country. The focus is both on early rehabilitation and good follow-up, with readmissions and check-ups, a system for learning and mastery both for injured and next of kin and cooperation between specialist health services and the districts.

In early rehabilitation, they have three central, strong recommendations that account for all damage groups. These being; all patients in an intensive care unit (ICU) at the trauma center shall be assessed by a specialist in physical medicine and rehabilitation within 72 hours; rehabilitation shall begin early at the trauma center in the acute phase; and patients admitted at the trauma center ICU shall be directly transferred to a specialized rehabilitation center, not indirectly through a local hospital.

The trauma plan looks at the early interventions for rehabilitation, and in this study the three highlighted recommendations will be looked at to see if they have been followed at University Hospital of North Norway (UNN).

Aside from the three guidelines in the acute phase already mentioned, the national guidelines also include guidelines for the follow-up after discharge. These include among others that there must be systems in place to catch psychological sequelae and that the trauma centers should communicate with the local, primary-care facilities to establish standardized patient follow-up through equal rehabilitation services across all regions, including predictable systems such as interdisciplinary teams, e.g., the ambulatory rehabilitation teams (ART) (9).

1.2 Ambulatory Rehabilitation Team

When the need for rehabilitation cannot be met at the hospital, but instead outlasts the original stay, one can apply for help in the form of an ambulatory rehabilitation team (ART). In the region that is the north of Norway there are 7 of these ambulatory teams (11). Their job is

based on the regulation of habilitation, rehabilitation, and coordination first publicized in 2011. Paragraph 15 sounds as follows; Services in habilitation and rehabilitation must give the services as an outpatient service if it is not applicable to do so in an institution (12). This service is an interdisciplinary effort with a lot of different applications, meant to help those with lengthy, complicated needs for rehabilitation. Besides helping the person itself, it can also include the surrounding family, colleagues, and community.

1.3 Psychological Outcomes and Post Traumatic Stress Disorder

There is a high incidence of PTSD among survivors of a traumatic physical injury. Studies have shown, as with Wiseman et al. (2), that the number may be as high as 30 to 93 percent. The consequence can be a risk of several other mental health co-morbidities, including anxiety and depression, and other factors impacting long term recovery. PTSD were also shown to result in an overall reduced quality of life (2). The physical injury has a large impact on mental health and sense of self, and the long-term effects of a single injury have been shown to reduce stability in previously stable lives, physically but also financially, socially, and in a life as a part of a community (13).

The diagnosis of PTSD is set based on a whole picture of symptoms following a physical or psychological traumatic event. Mostly it is a heightened sense of anxiety and physiological response not proportional to surrounding events. It includes symptoms such as extreme fear and general helplessness, and often recurring memories of the incident. The whole of it can result in an avoidance of people, places or objects that can be connected to the incident (2). The fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) also states as a criterion that the symptoms have to continue past the first 30 days to be considered PTSD (14).

The DSM-IV classified PTSD as an anxiety disorder that develops in response to a perceived traumatic event. It utilized three categories to sum up the symptoms of PTSD: intrusion, avoidance and hyperarousal. Intrusion is reexperiencing the event through dreams, flashbacks, and intrusive thoughts. Avoidance consists of consciously or unconsciously avoiding possible reminders of the traumatic event. Hyperarousal can be seen as difficulties sleeping and concentrating, irritability, and hypervigilance (14). The new DSM-5 from 2013 categorizes the symptoms into four clusters in which patients can have symptoms of varying degrees. These aspects can be summed up into intrusion, avoidance, alterations in cognitions and

mood, and lastly alterations in arousal and reactivity. The new edition still has a criterion that the symptoms must last longer than a month (15).

1.4 National multicenter study

In April 2021 a protocol article was published, outlining the major multicenter study between the two trauma centers Oslo University Hospital (OUS) and the University Hospital of North Norway (UNN), which sought to better the future efforts of improving rehabilitation at the trauma centers (16). It would look into rehabilitation needs and costs for patients after moderate to severe injury over several articles each assessing their own aspects. This includes comparing the care provided to the national guidelines, the patients' and their next of kin's perception of care provided and function after the injury, and then identifying patients at risk for not receiving those needs.

As of this study, three articles have been published besides the original protocol. When looking at the adherence to national guidelines when looking at the two centers together, Schäfer et al. (17) found that 18% of patients in the ICU were assessed by a specialist in physical medicine and rehabilitation during the first 72 hours, 70% of the patients with a longer stay than two days at the ICU received therapist treatment, and only 22% was transferred directly to a specialized rehabilitation unit from the acute ward.

Moksnes et al. (18) looked at patient functioning at six and 12 months following the injury. Their findings include that 11% had a continued severe disability at six months, which fell to 8% at 12 months, and approximately half of patients in total still had either severe or moderate disability even after 12 months.

Lastly, in their second article, Moksnes et al. (19) address the factors associated with different discharge destinations, in context with the guideline that states that patients should be transferred to a specialized rehabilitation center/unit. They found that the severity of injuries to head and spine was the strongest association with direct transfer to specialized rehabilitation, and that children most often were sent home after discharge.

2 Objective

The objective of this study is to assess patient rehabilitation following moderate to severe trauma, in accordance with Norwegian guidelines (National Traumaplan, 2017 ed.) (9). Specifically, the study aims to describe sociodemographic and injury-related variables of the

patients treated at UNN, evaluate adherence to guidelines for acute rehabilitation at UNN, investigate general functioning, and symptoms of post-traumatic stress after 6 months, and assess the utilization of professional support services and ARTs after discharge from the trauma center.

The recommendations from the National Traumaplan evaluated are:

(1) All patients in an intensive care unit (ICU) at the trauma center shall be assessed by a specialist in physical medicine and rehabilitation within 72 hours; (2) rehabilitation shall begin early in the intensive care phase at the trauma center; (3) patients admitted at the trauma center ICU shall be directly transferred to a specialized rehabilitation center, and not indirectly through a local hospital.

(4) There must be systems in place to catch psychological sequelae; (5) the trauma centers should communicate with the primary-care facilities to establish patient follow-up, including predictable systems such as the ambulatory rehabilitation teams (ART).

3 Method

3.1 Study design

This study uses data collected from the original multicenter, prospective observational study conducted at the two trauma centers OUS and UNN, and the follow-up at 6 months. The original study is outlined in the protocol published in 2021 by Soberg et.al (16). The original data collected from UNN, collected between 1 February 2020 to 21 January 2021, was extrapolated for the use of this study, as well as the data from the six-month follow-up. UNN serves as both the regional trauma center of Northern Norway and the local trauma hospital for Tromsø (19). The north of Norway is considered a rural part of the country and is known for the low population density settled over long distances (16).

3.2 Participants

Patients of all ages were mainly identified through trauma team activation on hospital arrival. The patients were then assessed by a participating doctor with expertise in scoring the injury. A research assistant would after this assessment validate that the inclusion criteria are met, and offer the patient to participate in the study.

The inclusion criteria were: a New Injury Severity Score (NISS) > 9, a hospital stay longer than 2 days, admission to the regional trauma centers either directly or through local hospitals within 72 hours post-injury, and Norwegian residency.

Exclusion criteria were: non-Norwegian residents or patients with insufficient language capabilities in either Norwegian or English, as well as patients who did not survive in the acute departments at the trauma center. Finally, patients who had a reduced cognitive resilience were also excluded. This includes patients who went through a psychotic episode at the time of admission, and patients with dementia.

3.3 Measures

The NISS score is acquired by the Abbreviated Injury Scale (AIS), and is used as a standardized tool in research of trauma populations (20). The AIS is utilized to code the body region affected and the severity of each injury individually. Injury severity is graded on a scale of 1–6. Injuries graded 1–2 are classified as minor to moderate, while injuries graded 3–6 are considered severe to maximal in severity (21). NISS uses the AIS scores to make a total measure of anatomical injury. It was a modification to the original Injury Severity Score (ISS) from 1974 (20). The score is based on the sum of the squares of the AIS scores of the three most severe injuries, regardless of the body region in which they occur. 9-15 is considered moderate severity, 16-24 is severe, 25-75 is profound (16). A NISS score > 9 was the cut-off in this study, as this is the level at which patients were recommend a rehabilitation assessment as stated by the National Institute for Health and Care Excellence (NICE) guidelines (7).

At admittance to the trauma center with a NISS score of > 9 the patient is included in the National Trauma Registry (NPR) as well as the local registry. What this means for the study is that the trauma severity scores can be validated, done by registrars certified to assess injury severity trough the AIS (16). Other information needed was collected from medical records.

3.4 Data collection

3.4.1 Baseline

The primary data was collected through information in the medical records, and included sociodemographic data and injury-related data. The injury-related data was diagnosis, type of accident, severity of injury (NISS), most devastating injury (AIS), time spent in the ICU, substance use at the time of injury (yes/no) and preexisting comorbidities presented through the Norwegian version of the American Society of Anesthesiologists Physical Status

Classification System (ASA) (22). The ASA score rises in correlation with the number of comorbidities. The patient is given a 1 when the patient is healthy, 2 means to have a mild systemic disease without noteworthy functional limitations, and a score of 3-4 means moderate to severe systemic disease (23).

The sociodemographic factors were age, gender, living situation, and education/work status at the time of injury. Living situation was categorized as *living alone* or *living with somebody*. Education was divided for those over 18 into *low (<= 13 years), higher (> 13 years),* and *unknown.* Work was also divided for those over 18 into *not working/pensioned,* and *working/studying.*

Data was also collected if the hospital followed the three guidelines; Assessment by a specialist in physical medicine and rehabilitation at the ICU within 72h, acute ICU rehabilitation, and transfer after acute trauma care to a specialized rehabilitation unit.

An assessment within 72 hours by a physical medicine and rehabilitation specialist at the ICU was only counted if there was documentation in the electronic medical files. Acute rehabilitation services were defined as all documented interventions by therapeutic professionals provided to patients in the ICU, it had to be an intervention by at least one professional other than physicians and nurses, such as physiotherapists, psychologists, occupational therapists, speech therapists, and/or social workers. Transfer after acute care was defined as a rehabilitation unit, local hospital, home, or nursing home/others, where a rehabilitation unit meant treatment in specialized hospital departments/institutions.

3.4.2 Six months follow-up

After 6 months a follow-up was conducted, collecting information through a telephone interview (questionnaire) and the medical records. If sociodemographic information was missing from the medical records, it was now obtained. The goal of this investigation was to get an overview over the last 6 months concerning rehabilitation services after discharge, a self-assessment of own functioning compared to received rehabilitation services, to evaluate function post-trauma through the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0), and also to see symptomatic signs of PTSD through the Impact of Events scale Revised (IES-R).

The WHODAS 2.0 is a tool that assesses functioning and disability. It is based on the six categories of the International Classification of Functioning, Disability, and Health (ICF):

mobility, cognition, self-care, getting along, life activities, and participation. There are two versions, a 36-question one, and a simpler 12-question one – which is used in this context (24). There are two questions in each of the six categories, each focusing on the last four weeks and whether daily functioning was hindered during that time. It is used as a self-report questionnaire. The answer is given from *no difficulty* to *extreme difficulty/inability to perform activity*, a range from 1-5. The total (a range from 12-60) is divided by 12 to get the average general disability score, which also is on a range from 1-5, 1 being no disability and 5 being extreme disability (25).

The Impact of Event Scale (IES) is a self-report tool made by Horowitz and first published in 1979 (26). It is used to measure how often intrusive and avoidant experiences occur following a specific event. Although the IES was not initially intended to diagnose PTSD, it became widely adopted by researchers studying traumatic stress soon after its introduction, laying the groundwork for further exploration in the field (27). It is a tool meant to be used as an instrument to measure the level of *subjective* impact as a result of a traumatic event. The questions were formulated based on commonly used statements meant to describe episodes of distress by persons who had undergone recent life changes (26). A revised version, the IES-R, was made in 1997 by Weiss and Marmar (28), based on the diagnosis criteria found in the DSM-IV. After the incorporation of the DSM-5 in 2013, in which there now are four categories instead of three, a question arose about the IES-R and whether it still has value as a screening tool (29). As previously stated the questionnaire is not used to give a diagnosis, but there is still value in the IES-R, to use it to screen for symptoms, as they still are comparable between the fourth and the fifth editions (30).

The IES-R is a self-report questionnaire with 22 questions, each offering five response options ranging from 0 (not at all) to 4 (extremely), indicating the degree of relevance to the participant. The scoring range is therefore 0-88. There are three subscales, divided into Intrusion, Avoidance, and Hyperarousal. The questions are sorted into eight each in intrusion and avoidance, and six in hyperarousal. A score of 33 or more represents the best cut-off for a probable diagnosis (31, 32). As for the cut-off for the subscales (intrusion, avoidance, hyperarousal), Creamer & Bell (32) found that there is no consistent cut-off at this level, a finding that is common across several other instruments used to measure PTSD. They theorize that it probably relates more to the DSM definition of PTSD than the psychometric properties of the instruments such as the IES-R (32).

Further data included in the follow-up were which rehabilitation services were offered during these 6 months and through which sector of the health care system, as in specialized, primary, or other. This was answered by a questionnaire made for the original study. Questions included whether the patient received treatment or rehabilitation by either in-patient or out-patient at a hospital or a rehabilitation department, a social worker, occupational therapist, and/or a psychologist, and lastly through an ART.

3.5 Ethics

This study and data collection were conducted in accordance with the Declaration of Helsinki and its ethical standards. The original multicenter study was approved by the Committee for Medical Research Ethics, Health Region South East (reference number 31676) and the Data Protection Officers at OUS and UNN (approval number 19/26515 and project number 02423) (17). This study has also been approved under the same approval and project number.

Consent was given through written consent either from the patient or their relatives in cases where the patient was unable to consent by themselves. If the patient later was able to consent, the consent was obtained directly from them. The consent was given in written form, after both oral and written information. They were allowed to recant their consent without cause at any time, also after data was collected. Younger patients aged 7–16 years received the written information in a language adapted to their age. Parental consent was given for participants younger than 18. Adolescents aged 16–17 years would also have to give their own consent.

Since this study only focuses on the data collected from patients treated at the trauma center at UNN, the sample size is rather small. The participants come from a definite area, which means there is a smaller margin for identifying the patients through the data collected. This data cannot be used in an identifiable matter. This will be kept in mind while analyzing and writing.

3.6 Statistical analysis

IBM SPSS Statistics Version 29.0 (IBM Corp., Armonk, NY, USA) was used in the analysis. Descriptive data are used for participants' injury-related data, the sociodemographic factors, and when looking at the adherence to each guideline. This is presented as proportions (percentages), and medians with range.

The sociodemographic factors include patients' age (continuous), gender, living situation (living alone/not living alone), work situation (working or studying/not working or pensioned), and educational level (high education > 13 years/lower education ≤ 13 years). The analysis further considers acute injury-related variables such as the type and severity of injuries, substance use at the time of injury (yes/no), pre-injury ASA score (sorted into 1-2 and 3-4), and length of stay in an ICU (continuous). Specific injury variables includes type of injury (fall, transport, other), the NISS, sorted into moderate/severe as well as a continuous variable, and AIS of the dominating injured body region, sorted into head, extremities, spine (with/without cord), face and thorax/abdomen, as well as the dominating region dichotomized into yes/no. Assessment by a physician in the ICU, and acute rehabilitation received in the ICU are included as dichotomized variables, and transfer after discharge are given as a nominal variable (home, specialized rehabilitation center, local hospital, nursing home/other).

When analyzing rehabilitation in the acute phase in the ICU only patients with a longer stay than 2 days are counted. All participants are included in the analysis when describing transfer from the trauma center as well as assessment during the first three days, irrespective of their length of stay in the ICU or their injury severity.

Associations and correlations are analyzed through non-parametric statistics, including Fisher's exact test and Mann-Whitney, because of the small sample size and not normally distributed continuous variables. Results are presented as a p-value of statistical relatability, with a p-value < 0.05 as statistically significant, while between 0.05-0.10 show a tendency for correlation.

4 Results

4.1 Participants

Originally 69 patients were considered for participation (figure 1). Of these, nine were excluded by not meeting the inclusion criteria, these being death in the acute phase, dementia, or psychosis. From the remaining group, thirteen did not join the study by not giving consent and were therefore excluded. Of the 47 included participants, there are 36 (76.6%) male, see table 1. The participants had an average age of 47 years, a median of 51 years, with a range of seven to 88 years. Ten (21%) had a higher education, defined as more than 13 years of schooling, twenty (43%) worked or studied full time, and 12 (26%) lived alone at the time of injury. Additionally, five participants were under 18 years of age.

Of the 13 eligible who did not consent were 11 male (85%) and two had no registered gender. The ages of these eleven men had a median age of 51 (21-88). This compared to 77% of the included in the study being men, and the median age of 51 of all included, means that age and gender of non-consenters did not differ significantly from those included in the study.

The total number of included patients in the original multicenter study was 538, and the data for these 47 were extracted from UNN.

4.2 Injury-related data

Table 2 presents injury-related variables. The most common type of accident, with 21 (45%) participants, had an accident in traffic, either as a road user or in a vehicle. The second most common was from a fall with 16 (34%). Median NISS was 19, and 32 (68%) sustained a NISS score of more than 15 which was severe by definition. The head region had the largest proportion of AIS scores 3 to 5, with 19 (40%) participants having this injury as the most dominating, followed by thorax/abdomen 13 (28%) and spine (without spinal cord) six (13%). Five (11%) participants had confirmed substance use at the time of injury, and 41 (87%) had an ASA score of 1 or 2. Lastly, twenty-one (45%) stayed for longer than 2 days in the ICU.

4.3 Acute Phase Assessment

As shown in Table 3, which shows adherence to the three guidelines for acute rehabilitation that is being assessed in this study, forty-four (94%) were not assessed by a specialist in physical medicine and rehabilitation within three days. In total, twenty-one (45%) had a stay at the ICU for longer than two days, and of these, eleven (52%) received early rehabilitation, in addition to one person who received early rehabilitation despite not having been admitted to the ICU for longer than two days. Non-parametric analysis of significant factors associated with therapist intervention in the ICU (table 5) shows that patients who were more injured and had a longer stay at the ICU tended to receive rehabilitation at the ICU.

At discharge, fourteen (30%) were transferred directly to a specialized rehabilitation unit, however, most, twenty-three (49%), were transferred directly home. There was an even split by those transferred to a local hospital or to either a nursing home or other institution, with 5 (11%) sent to each. When looking at only the 32 patients with severe trauma (NISS > 15), 14 (44%) were transferred to a rehabilitation center while 12 (38%) were sent home and 4 (13%) to a local hospital. All of the patients who were sent to a specialized rehabilitation center were severely injured as defined by NISS > 15. Non-parametric analysis of factors associated with

direct transfer to a specialized rehabilitation department (table 6) showed that a higher NISS score and head trauma (AIS >2) were predictors for direct transfer, and patients also tended to have a longer stay in the ICU.

Finally, thirty-two (68%) received physiotherapy in the acute phase although not necessarily at the ICU, and the results show from those known that a patient on average got 5.4 appointments, with a range from 1-21. Lastly, psychological follow-up was provided in the acute phase to one patient. Both are presented in table 4.

4.4 Guidelines in association to functioning and Post Traumatic Stress

There are 20 respondents and 27 missing entries to answer for the Impact of Event Scale-Revised (IES-R) at six months. Table 7 shows the non-parametric analysis of the respondents versus the non-responders to the IES-R. It shows a mild association between head or face trauma and not responding to the IES-R.

Of the 20 respondents, seventeen were (85%) male and three (15%) female. Among the respondents, five (25%) participants had a total score of 24 or more where there is a clinical concern for PTSD, with three of these scoring above cut-off for PTSD, i.e., 33 or higher. The average IES-R score for men was 17, and 16 for women. None of the three above cutoff received follow-up by a psychologist.

As for the WHODAS 2.0 assessment, there are 23 responses and 24 missing entries after six months. Of the 23 respondents, seventeen (73%) were male and three (13%) female. Among the respondents, three (13%) reported no disability, 12 (52%) had mild to moderate disability, and eight (35%) had severe disability. The severe was distributed between seven male and one female. One person with severe disability got follow-up by AMT. Of the eight with severe disability, one had cut-off PTSD, and one more severe through the IES-R.

One of the patients with severe disability received ICU rehabilitation, one other was assessed by a specialist in physical medicine and rehabilitation and four were sent to a rehabilitation facility.

Two of the three individuals with an IES-R score above the cut-off of 33 had severe disability according to WHODAS 2.0, the other had a mild to moderate disability.

4.5 Follow-up during the six months following the first discharge from the hospital

Out of the total 47, there were 41 responses about follow-up rehabilitation and/or treatment after discharge, including whether they received help through an ART, all shown in Table 8.

The answers for where the patients received treatment or rehabilitation could be given by either/or through specialist health care, primary health care, or other not specified, the last including a general practitioner. A total of 26 (63%) got treatment or rehabilitation through specialist health care, sixteen (39%) through primary health care, and 24 (59%) through other not specified. One could answer none of these or more than one option, and eight participants responded that they got help through all three, and three none.

As shown in Table 8, of 26 participants who received rehabilitation through specialist health care, five (19%) got it through readmission to a specialized rehabilitation unit, either in or outside of a hospital, and six (23%) through admission to another department in a hospital. These other departments included orthopedics, pediatrics, neurosurgery, neurology, BUP, and gastro-surgery. Furthermore, sixteen (62%) received outpatient follow-up either at the hospital or at a rehabilitation unit. The outpatient departments involved were specialties such as physical medicine and rehabilitation, gastro-surgical, and orthopedic dentistry, as well as neurosurgery, radiology, and orthopedics. Lastly, one (4%) got follow-up by either a psychiatrist, psychologist, or a social worker.

Sixteen responded that they got help through primary care. Of these, four (25%) participants had a stay at a nursing home. Notably, these individuals were not directly sent to the nursing home, as there was no overlap between those who reported being discharged to a nursing home/other as seen in Table 3. None of the participants received help from a psychologist, however, six (15%) participants received assistance from the ARTs.

The last category, treatment or rehabilitation through other not specified services, is not defined, but 24 answered that they got help through these services. Of these, eighteen (75%) participants received assistance from their general practitioner. No one received follow-up from a psychiatrist, psychologist, or a social worker.

5 Discussion

This study aimed to assess patient rehabilitation, both in the acute setting and in the follow-up, after moderate to severe trauma, in accordance with Norwegian guidelines (National Traumaplan, 2017 ed.) for patients treated at UNN. The main findings include that only three (6%) patients were assessed by a specialist in physical medicine and rehabilitation during the first 3 days. A slight majority of the patients who had a stay of longer than 2 days in the ICU, received rehabilitation during the intensive care phase. Patients with acute ICU rehabilitation tended to be more severely injured and to have longer ICU stays than those without. Fourteen (30%) patients were transferred directly to a specialized rehabilitation unit from acute trauma center care, but most were discharged home (49%). Patients transferred directly had statistically significantly higher injury severity and longer ICU stays. When looking at only the patients with severe trauma, 44% were sent to a rehabilitation unit.

Six individuals (15%) of the forty-one who answered at six months received assistance through an ART. Only one individual received psychological follow-up in the acute phase, and one more received such care through specialist health care during the six months after discharge. Among the participants, three out of twenty individuals who filled in the questionnaire (15%) exhibited symptoms consistent with PTSD according to the IES-R, and 35% had a severe disability according to the WHODAS 2.0 at six months after trauma.

5.1 Adherence to Guidelines for Acute Rehabilitation

The first guideline in the acute phase states that all patients in an ICU at the trauma center shall be assessed by a specialist in physical medicine and rehabilitation within 72 hours. Findings in this study could indicate a lack of proper follow-up in the acute, critical phase as per this recommendation, which is similarly reported from the national study by Schäfer et al. (17), where 18 percent of patients at ICU got an assessment by a specialist in physical medicine and rehabilitation in the first 72 hours, compared to 6% in this study. The national study included the trauma centers of OUS and UNN. Compared to the national levels it could show an indication of low adherence to this guideline nationally, yet lower still in the northern region.

The second guideline that was looked at was: rehabilitation should begin early in the intensive care phase. Schäfer et al. (17) found that on a national level, 70% of the patients staying for

longer than two days in an ICU received rehabilitation through therapist treatment, while it was only documented in half of the cases locally.

The last guideline states that patients admitted at the trauma center ICU shall be directly transferred to rehabilitation, bypassing admission to a local hospital without specialized rehabilitation. Nationally, twenty-two percent were transferred directly to a specialized rehabilitation unit from the acute ward but here it was closer to a third (17). Schäfer et al. also looked at the numbers when selecting only the patients with the most severe injuries, defined as a NISS score above 15. When looking at only this group the number increased to 26% being transferred to a rehabilitation unit. Our findings with the same definition show that locally the number was closer to half.

Overall, this does seem to indicate that there is slightly better adherence on a national level compared to local levels. That being said, and as the previous authors also discuss, is that few receive an early assessment by a specialist in physical medicine and rehabilitation and few receive a direct transfer to a specialized rehabilitation unit. At UNN fewer patients are documented to have received early rehabilitation at the ICU than nationally. All this to say, there seems to be a need for better integration nationally, but maybe especially at UNN.

While there are few studies showcasing the importance of adherence to guidelines in rehabilitation after trauma, in a study from Cnossen et al. (33), looking at adherence to guidelines and outcome from traumatic brain injury specifically, they found a lower mortality rate when the guidelines from the Brain Trauma Foundation were followed. One study, however, the UK National Clinical Audit for Specialist Rehabilitation following Major Injury (NCASRI 2019) (34) looked at rehabilitation after traumatic injuries in England using several guidelines and national standards as reference, including the National Institute for Health and Care Excellence (NICE) guideline which was also used in the revision of the Norwegian national guidelines (7, 8). In their report, they also found a poor integration of rehabilitation medicine in general at the local hospitals and a poor following of many of the guidelines. This includes points such as 43-74% getting the proper screening of rehabilitation needs at the trauma centers, a little more than half getting an assessment by the recommended time after referral (< 10 days) as recommended by the NHS England (NHSE) national standard, and 40% of patients being admitted to specialized rehabilitation.

Ultimately, rehabilitation medicine in trauma patients may be an overlooked field in several countries, including Norway, and that despite there being guidelines, few are being followed for a majority of patients. This being the case, it is good that some countries are trying to bring this to light by evolving better systems in the future. Yet still, there is a need for more research into the outcomes of following versus not following the guidelines for rehabilitation after trauma.

5.2 Post-traumatic stress and functioning at 6 months follow-up

A Swedish multicenter study by Wihlke et al. (35) found that 20% of trauma patients had significant symptoms of PTSD after six months, using the Posttraumatic Symptom Scale-10 (PTSS-10). Notably, they also found that the number had fallen to 16% after a year. Another Dutch study by Kreis et al. (36) presented that 22.6% of patients with polytrauma had PTSD as diagnosed by the Zelf Inventarisatie Lijst (ZIL) after a year. This fits the 20% in this study who got an IES-R score above 24, meaning a clinical concern for PTSD, even though it is not of diagnostic value. Agarwal et al. (37) report that 13% of individuals screened positive for PTSD one month after a traumatic injury, as assessed by the Post-Traumatic Stress Disorder Checklist (PCL-5). This is a lower percentage than the rest and the findings from this study, but in their discussion, they hypothesize that it is lower because they offer trauma psychology services at the trauma center. Note that studies use different scales for diagnosing symptoms of PTSD. This may introduce inconsistencies when comparing the different studies.

Early psychological treatment for PTSD has been shown to decrease symptoms. A review from Roberts et. al (37) found no clinical evidence of an effect of such treatment when the patient did not show any early traumatic stress symptoms through screening measures. However, for those who did, there was a significant effect of several forms of treatment, including cognitive behavioral therapy (CBT-T). Zatzik et al. (38) found significantly reduced symptoms of PTSD after six months of injury – though not at 12 months – when compared to a control group after receiving early intervention. Here as well the patients were screened at admittance for symptoms. They also revealed that the effects increased when the trauma center had good protocol implementation. Another point to take into consideration is that just a stay in an ICU alone can cause symptoms compatible with PTSD (39), not just the traumatic injury itself, which this study did not factor in.

This study from the trauma center in Northern Norway shows a very limited psychological follow-up during both the acute phase, and in the long term, with under five percent in total getting psychological follow-up. In the national study by Shäfer et al. (17), which included the trauma center in the south of Norway, there was a higher degree of psychological follow-up (16%). A Norwegian study by Skogstad et al. (40) looked at intervention by nurses trained to provide short-term psychological help to patients after injury. They also used the IES-R to document symptoms and included patients with a score of more than 20. What they found was that patients who received this treatment had an increase in daily functioning as well as a reduction of symptoms. The findings of Finstad et al. (41) are in agreement that a minority of patients received information about the possibility of heightened psychological reactions and risk of mental health affectations to the suffered trauma, and few were assessed in an early phase nor offered a psychiatric consultation. A part of the national guidelines is to implement systems for minimizing psychological sequelae, and this could be one cost-effective way to do so.

One consideration is the several missing responses. There may be a higher percentage of patients who received help through a psychiatrist, psychologist, or social worker that were unreported. Those who received help through their general practitioner (GP) may also have received psychological help that is not mentioned elsewhere. There is a role for the GP in psychological treatment after trauma (42). The GP could have given referrals that went over the six-month period we looked at. This would just be speculation however, but something to keep in mind.

One article from the national study by Moksnes et al. (18) also looked at patient functioning at six and 12 months following the injury. They found that 11% had a severe disability at six months compared to around one-third in this substudy. However, in their article, they used the Glasgow Outcome Scale Extended (GOSE) to measure disability, instead of the WHODAS 2.0 as in this study. Using different tools for measuring disability should be kept in mind when comparing the two. There is limited literature utilizing both in the same study, but an article from Kersten et al. (43) also expresses the disability after trauma, although 12 months after, not six, with both the GOSE and WHODAS 2.0. They concluded that 15% had severe disability using the GOSE and 23% using WHODAS 2.0. On a national level, there do seem to be fewer with a severe disability at six months. More articles not yet published from the original study will look into disability on a national level using WHODAS 2.0.

5.3 Ambulatory Rehabilitation Teams and systemic follow-up

There is literature looking at the place for interdisciplinary teams in rehabilitation, such as a report for The Norwegian Institute of Health (NHI) from 2019, but it mostly covers the professional standpoint and not the functioning of the patient (44). There is little on how patient functioning after trauma is affected. A Norwegian review from Naess et al. (45) tried to look at this, but there was not much to be found of good quality. This taken into account, they mention that patients after a traumatic brain injury who did receive early interdisciplinary rehabilitation had a greater chance of going back to work and having fewer medical complications.

A part of the guideline states the need for predictable systems for patient follow-up, including systems such as the ARTs. Finstad et al. (41) documented the adverse effect of not giving proper patient follow-up, and its effect on mental health. The authors describe that trauma patients felt a lack of information, both about their health situation at discharge, and follow-up treatment and care, and that this increased emotional distress. This was especially clear when the patient was discharged to home. They also found that there was a lack of a plan concerning further rehabilitation in the primary health care, despite the national guidelines. Comparing this to our findings of the usage of ARTs and psychological follow-up, there is little to suggest predictable systems given the low number of patients receiving such. One important consideration is the absence of data explaining why patients received follow-up care through these teams while others did not. As such, it is impossible to draw conclusions about the availability of existing systems. The dataset does not include information about patients who could have been eligible for this type of assistance but didn't pursue it, as well as how many patients were denied it if they applied. Further research into function between groups after receiving or not receiving individualized care through ARTs would be insightful, as well as looking into the selection process of who receives it and how many patients knew that such teams existed.

5.4 Strengths and Weaknesses

The major limitations in this study can be boiled down to a small sample size, and many missing responses for the follow-up. This implies a question of generalizability. The dropout analysis only consisted of age and gender, so there was no information about socioeconomic factors or their injury severity. It is also a weakness that assessments done by a specialist in physical medicine and rehabilitation may have been underreported given that they had to be

documented formally in the electronic records. In practice, this might have gone undocumented.

A strength of this study is that it is a prospective study, which is a strength given that it follows participants over time and therefore reduces biases such as recall bias. It also negates selection biases. There is a relatively high inclusion rate, with 22% of eligible patients who did not consent to join the study.

For a better representative outcome of the rehabilitation services and functional and psychological outcomes for a population based in Northern Norway, there should be more conclusive evidence. Further research should include a more comprehensive data collection, preferably over a longer period of time, to expand the pool of participants, as well as reducing missing data in follow-up.

6 Conclusion

To summarize, the general rehabilitation guidelines are in place to ensure patient care after a traumatic injury, to improve outcomes and minimize complications. This study draws attention to the apparently low percentage of patients receiving rehabilitation after traumatic injury at UNN per the national rehabilitation guidelines. This includes both in the acute setting in the hospital, but also follow-up care in the months afterward. Particularly, assessment in the acute phase by a physician was documented in very few cases. Compared to national measures, the percentages seem to be slightly lower overall, although more patients with severe injuries are sent to a specialized rehabilitation facility locally. This study's limitations must be taken into account when interpreting the results such as the small sample size and several missing responses in the follow-up. Despite these limitations, the findings from this study could be used to highlight the need for improvements in the current systems and suggest implementing, e.g., routine assessments in the acute phase. The goal would be to better align patient care with national guidelines and ultimately improve patient outcomes.

7 Attachments

Table 1 Sociodemographic variables of 47 included participants with moderate/severe physical trauma after injury

Sociodemographic variables of 47 included participants with moderate/severe physical trauma after injury	Count N (%)
Age, years	
Median, (range)	51 (7-88)
Mean (SD)	47 (21,8)
Sex n(%)	
Male	36 (77)
Female	11 (23)
Living situation n(%)	
Living alone	12 (26)
Living with somebody	35 (74)
Education n(%)	
Low, <=13 years	28 (60)
Higher, >13 years	10 (21)
Unknown	4 (9)
Under 18 years	5 (11)
Work n(%)	
Not working/pensioned	20 (43)
Working/studying	21 (45)
Unknown/under 18 years	6 (13)

Table 2 Injury-related variables for 47 patients after moderate/severe physical trauma after injury

Injury-related variables for 47 patients after moderate/ severe physical trauma after injury	Count, N (%)
Substance use 15 n(%)	
Yes	5 (11)
No/unknown	42 (89)
Type of accident n(1%)	
Transport	21 (45)
Fall	16 (34)
Other	10 (21)
Time spent in an Intensive Care Unit (ICU) >2 days	
Yes	21 (45)
No	26 (55)
ASA pre-injury n(%)	
ASA 1-2	41 (87)
ASA ≥3	6 (13)
Abbreviated Injury Scale (AIS) n(%) by most dominating injury	
Head	19 (40)

Extremities	5 (11)
Spinal cord	3 (6)
Face	1 (2)
Thorax/abdomen	13 (28)
Spine, without cord	6 (13)
Injury Severity Score (ISS)	
Median (range)	16 (4-66)
ISS ≥16 n(%)	26 (55)
New Injury Severity Score (NISS)	
Median (range)	19 (10-66))
Moderate NISS 10-15 n(%)	15 (32)
Severe NISS 16-75 n(%)	32 (68)

Table 3 Adherence to guidelines in acute phase for 47 and 21 patients with moderate to severe trauma after injury

Adherence to guidelines in acute phase for 47 patients with moderate to severe trauma after injury	Count, N (%)
Assessment within 3 days by a specialist in physical medicine and rehabilitation	
Yes	3 (6)
No	44 (94)
Acute rehabilitation in ICU after a stay of 2 days or more n=21	
Yes	11 (52)
No	10 (48)
Transfer after acute trauma center care	
Home	23 (49)
Local hospital	5 (11)
Rehabilitation center	14 (30)
Nursing home/other	5 (11)

Table 4 Physiotherapy in acute phase of 47 patients with moderate to severe injury

Physiotherapy and psychological follow-up in acute phase of 47 participants after moderate to severe injury	Count N (%)
Physiotherapy in acute phase	
Yes	32 (68)
Unknown /missing	15 (32)

Mean number of times	5,4
Range	20 (1-21)
Psychological follow-up in acute phase	
Yes	1 (2)
No	46 (98)

Table 5 Acute rehabilitation in 21 patients with moderate to severe trauma and a stay of 2 days or more in an intensive care unit (ICU)

Variable	N=21 (100%)	Acute rehab at ICU 11 (52%)	No acute rehab at ICU 10 (48%)	Mann-Whitney U Test p-value	Fisher's Exact Test p-value
Age, years, median (range)	37 (7-77)	42 (13-17)	39 (16-77)	0,418	
Gender, female, n (%)	7 (33)	3 (43)	4 (57)		
Gender, male, n (%)	14 (67)	8 (57)	6 (43)		,659
NISS, median (range)	24 (11-59)	38 (12-59)	19 (11-50)	**0,066**	
length of stay at ICU, median (range) (n=18)	11 (2-39)	11 (2-39)	3 (2-26)	**0,075**	
WHODAS 2.0 score median (range) (n=5)	8 (5-42)	9 (5-42)	8 (7-8)	0,564	
IES score median (range) (n=5)	15 (0-47)	25 (0-42)	8 (0-15)	0,374	

Table 6 Discharge from acute care in the trauma center directly to specialized rehabilitation in 47 patients with moderate to severe trauma

Variable	N=47 (100%)	Direct transfer to a rehabilitation department, 14 (30%)	Transfer other 33 (70%)	Mann-Whitney U Test p-value	Fisher's Exact Test p-value
Age, years, median (range)	51 (7-88)	57 (22-77)	53 (18-88)	0,545	
Gender, female, n (%)	11 (23)	2 (18)	9 (82)		
Gender, male, n (%)	36 (77)	12 (33)	24 (67)		0,464
NISS, median (range)	19 (10-66)	23 (17-38)	17 (11-34)	**0,002**	

Length of stay, median (range)	11 (0-39)	1 (0-29)	0 (0-3)	**0,021**	
WHODAS 2.0 score, median (range)	8 (0-42)	13 (5-42)	8 (0-25)	0,203	
IES score, median (range)	15 (0-47)	14 (0-25)	15 (3-47)	0,431	
Working, n(%)	21 (45)	8 (38)	13 (62)		
Not working, n(%)	20 (43)	6 (30)	14 (70)		0,744
Highest AIS head, n(%)	18 (38)	10 (56)	8 (44)		
Highest AIS not head, n(%)	29 (62)	4 (14)	25 (86)		**0,004**

Table 7 Follow-up with the Impact of Events scale Revised (IES-R) after six months of 47 patients with moderate to severe injury

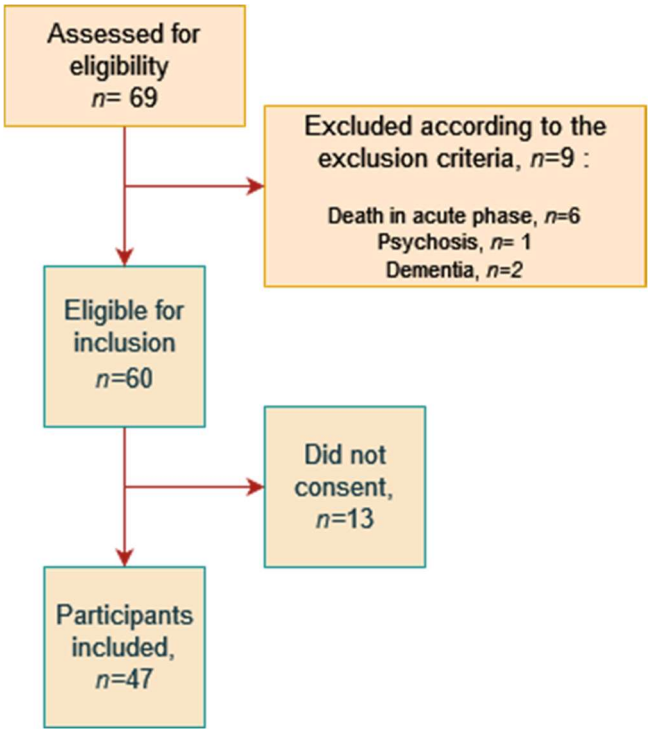
	N 47	Follow up through IES-R N 20 (43%)	No follow-up trough IES-R N 27 (57%)	Mann-Whitney U Test p-value	Fisher's Exact Test p-value
Age, years (median)	51 (7-88)	53 (18-88)	46 (7-79)	0,312	
Gender, female, n (%)	11 (23)	3 (27)	8 (73)		
Gender, male, n (%)	36 (77)	19 (53)	17 (47)		0,310
NISS, median (range)	19 (10-66)	18 (11-38)	19 (10-66)	0,643	
ASA 1-2, n(%)	41 (87)	17 (41)	24 (59)		
ASA >=3, n(%)	6 (13)	3 (50)	3 (50)		1,000
Head/face, n (%)	20 (42)	5 (25)	15 (75)		**0,044**
Thorax-abdomen, n (%)	13 (28)	7 (54)	6 (46)		0,511
Extremities/spine, n (%)	14 (30)	8 (57)	6 (43)		0,214

Table 8 Means of treatment and rehabilitation for 41 patients up to six months after discharge

Means of treatment and rehabilitation for 41 patients up to 6 months after discharge	Count N, (%) Not cumulative
Treatment and rehabilitation through specialist health care	**26 (63)**
Readmission to specialized rehabilitation unit	5 (19)
Readmission to other acute hospital departments	6 (23)
Rehabilitation through outpatient services at a hospital or rehabilitation	16 (62)
Follow-up by psychologist or social worker	1 (4)
Treatment and rehabilitation through primary health care	**16 (39)**
Admission to nursing home (not directly)	4 (25)
Help through home care services/nurse-on-call services	1 (6)
Physiotherapy	7 (44)
Occupational therapy	2 (13)
Psychiatric nurse	0 (0)
Treatment and rehabilitation through other not specified services	**24 (59)**
General practitioner	18 (75)
Physiotherapy	9 (38)
Psychologist or social worker	0 (0)
Occupational therapy	1 (4)
Speech therapy	1 (4)
Follow-up through Ambulatory Rehabilitation Team	
Yes	6 (15)
No	35 (85)

Abbr: ICU: Intensive Care Unit, ASA: American Society of Anesthesiologists Physical Status Classification System, NISS: New Injury Severity Score, WHODAS 2.0: World Health Organization Disability Assessment Schedule 2.0, IES-R: The Impact of Event Scale-Revised, AIS: Abbreviated Injury Scale

Figure 1 Flowchart of the inclusion of 47 participants from 69 assessed



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