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# Cervical spine surgery in the Northern Norway Regional Health Authority area in 2014–18

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## ORIGINAL ARTICLE

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## **BACKGROUND**

Knowledge about the variation in treatment rates is needed to assess whether the access to health services is equitable. The objective of this study was to investigate the rates of surgical treatment of degenerative cervical spine disease in Norway and the Northern Norway Regional Health Authority area and the local coverage in the Northern Norway Regional Health Authority area, and to assess the activity in the region.

## **MATERIAL AND METHOD**

We included cervical spine procedures recorded in the Norwegian Patient Registry from the years 2014–18 and estimated age-standardised treatment rates for Norway, the health regions and health trusts in Northern Norway Regional Health Authority. We estimated the local coverage as the proportion of patients resident in the Northern Norway Regional Health Authority area who had undergone surgery at the University Hospital of North Norway in Tromsø.

## **RESULTS**

The treatment rate remained stable at an average of 29.6 surgical procedures per 100 000 inhabitants (aged 18–105) per year. The rate for residents in the Northern Norway Regional Health Authority area was 23.0 procedures per 100 000 inhabitants per year (78 % of the national average). The rates in Finnmark and the areas of residence served by the University Hospital of North Norway were close to the national average. Residents in the Nordland and Helgeland areas had lower rates in each year of the study period, with an average of 16.6 and 18.1 procedures per 100 000 inhabitants per year respectively. This corresponds to 56 % and 61 % of the national average. Local coverage in the Northern Norway Regional Health Authority area increased from 69 % in 2014 to 91 % in 2018.

## **INTERPRETATION**

The treatment rate for degenerative cervical spine disease was lower in the Northern Norway Regional Health Authority area than in the rest of Norway. For this to be compensated and the local coverage to be increased to 100 %, we have estimated that the activity needs to be increased by approximately 35 surgical procedures per year.

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## **Main findings**

The average rate of surgical treatment for degenerative cervical spine disease in Norwegian public hospitals remained stable at 29.6 surgeries per 100 000 inhabitants (aged 18–105) per year during the period 2014–18.

The treatment rate was lower (78 % of the national average) for residents within the Northern Norway Regional Health Authority area, mainly because of lower rates among residents in Nordland (56 % of the national average) and Helgeland (61 %).

Service provision coverage within Northern Norway Regional Health Authority area was low in 2014, but increased to 91 % as a result of approximately 30 more cervical spine surgeries per year in the University Hospital of North Norway in Tromsø.

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Cervical and lumbar spine conditions are the most common cause of non-fatal health loss and short-term sickness absence, and the second most frequent reason for disability (1, 2). Diagnostic imaging is recommended for serious neurological deficits that cause suspicion of spinal cord compression (myelopathy) and clinical indications of nerve root compression (radiculopathy) that persist for more than four to six weeks (3). More than 50 % of patients examined by diagnostic imaging are diagnosed with a herniated disc or spinal stenosis (4). Many are therefore referred for assessment with a view to surgical treatment.

We have previously reported that the rate of surgical treatment for degenerative lumbar spine disease in Norway increased from 78 to 120 procedures per 100 000 inhabitants per year from 1999 to 2013 (5). Thereafter, the rate remained stable at approximately 120 procedures per 100 000 inhabitants per year in the period 2014–18 (6). In the Northern Norway Regional Health Authority area, the rate of fusion and/or surgical procedures with other instrumentation, and the local coverage of all surgical treatment for degenerative lumbar spine conditions were lower than in other parts of Norway (6). Cervical spine surgery is centralised to the neurosurgical departments in the university hospitals. In addition, some private hospitals perform cervical spine surgery for patients who meet the cost themselves or have private health insurance.

The total rate of surgical treatment of degenerative cervical spine disease in public and private hospitals increased from 17 to 29 surgeries per 100 000 inhabitants per year from 2008 to 2014 (7).

The University Hospital of North Norway performs more than 80 % of the lumbar spine surgery for residents in the Northern Norway Regional Health area (6) and is the only hospital in the region to perform cervical spine surgery. It is thus natural to consider the rates for lumbar and cervical spine surgery jointly when assessing the capacity for and access to treatment in the region. The objective of this study was to investigate the rates of surgical treatment for degenerative cervical spine disease in Norway and in the Northern Norway Regional Health Authority area, including the local coverage in the latter, and to assess the activity in the region.

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## Material and method

### Study design and data source

We used data from the Norwegian Patient Registry (NPR) on hospitalisations in the period 2014–18. The registry includes all surgical treatment of degenerative cervical spine disease, but excludes surgeries that were performed in private hospitals and paid for by the patients themselves or by private health insurance. The authors take full responsibility for the interpretation and presentation of the data from the Norwegian Patient Registry.

The data extraction was undertaken by the Centre for Clinical Documentation and Evaluation (SKDE) and was based on an algorithm validated by the Norwegian Registry for Spine Surgery (7, 8). The algorithm included patients with ICD-10 diagnostic codes for degenerative cervical spine disease combined with NCSP procedure codes for decompression or fusion surgery. It excluded patients who underwent surgery for cancer or other tumours, infections or injuries (fractures), as well as patients who underwent repeat surgery to remove osteosynthesis material.

### Treatment rates

Treatment rates were calculated as the number of surgical procedures per 100 000 inhabitants per area of residence per year. As in the Norwegian Health Atlas, areas of residence were defined at three levels: the geographical catchment areas of the regional health authorities, the health trusts and the local hospitals (9). The rates included all patients treated surgically per year, divided by the population (aged 18–105) registered by Statistics Norway in the area of residence as of 1 January in the same year, standardised by sex and age with 2015 as the reference year. The analysis encompassed the entire country, but we focused on residents in the Northern Norway Regional Health Authority area, i.e. the areas of residence served by the health trusts Finnmark Hospital (Finnmark), University Hospital of North Norway (Troms and Ofoten districts), Nordland Hospital (Nordland) and Helgeland Hospital (Helgeland).

### Local coverage

Local coverage in the Northern Norway Regional Health Authority area was defined as the proportion of residents in the region who underwent spine surgery at the University Hospital of North Norway (10).

### Ethics

The Centre for Clinical Documentation and Evaluation is authorised to analyse data from the Norwegian Patient Registry pursuant to the General Data Protection Regulation and exempted from the duty of confidentiality by the Regional Committee for Medical and Health Research Ethics. As a consequence, the study was not subject to notification. For reasons of data

protection, the Centre for Clinical Documentation and Evaluation hides the exact figures for registrations that occur with a frequency of less than five per year, but this has no effect on the total figures.

## Results

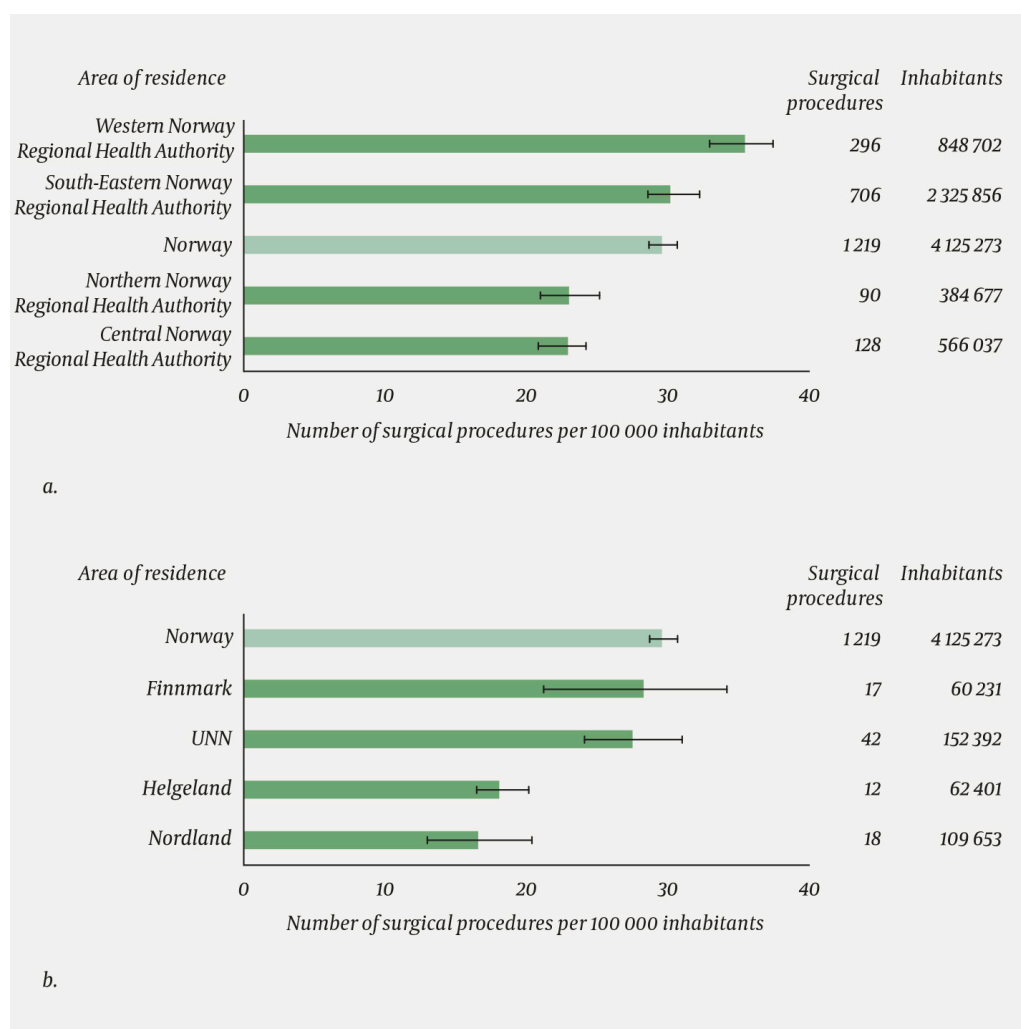
### Activity and treatment rates

The rate of surgical treatment for degenerative cervical spine disease in Norway remained stable at an average of 29.6 surgical procedures per 100 000 inhabitants per year from 2014 to 2018 (Table 1). The average treatment rate for residents in the Western Norway Regional Health Authority area was 35.5 procedures per 100 000 inhabitants per year, which is equivalent to 120 % of the national average, while the rate for residents in the South-Eastern Norway Regional Health Authority amounted to 30.2 procedures per 100 000 inhabitants per year, which is very close to the national average (Figure 1a). For residents in the Northern and Central Norway Regional Health Authority areas the rates were 23.0 and 22.9 procedures per 100 000 inhabitants per year respectively. This is equivalent to 78 % of the national average.

**Table 1**

Number of inhabitants (aged 18–105), number of surgical procedures for degenerative cervical spine disease and treatment rates standardised by sex and age (number of surgical procedures per 100 000 inhabitants per area of residence per year) for residents in Norway as a whole and the Northern Norway Regional Health Authority area, 2014–18.

Area of residence	2014	2015	2016	2017	2018	Average
Norway						
Inhabitants, <i>n</i>	4 040 198	4 086 583	4 127 266	4 166 612	4 205 704	4 125 273
Surgical procedures, <i>n</i>	1 159	1 258	1 222	1 250	1 206	1 219
Treatment rate	28.7	30.8	29.6	30.1	28.8	29.6
Northern Norway Regional Health Authority						
Inhabitants, <i>n</i>	379 613	381 911	384 991	387 430	389 438	384 677
Surgical procedures, <i>n</i>	89	81	87	92	99	90
Treatment rate	22.9	21.0	22.4	23.5	25.3	23.0



**Figure 1** Average number of surgical procedures for degenerative cervical spine disease per 100 000 inhabitants (aged 18–105) per year during the period 2014–18, standardised for sex and age, by a) the health regions as regions of residence and b) the health trusts within Northern Norway Regional Health Authority as areas of residence. The interval shows the variation in annual rates, from the lowest to the highest. UNN = University Hospital of North Norway.

There were large variations in the annual treatment rates for the areas of residence served by the Northern Norway Regional Health Authority (Figure 1b). The average rates for the areas of residence of Finnmark and University Hospital of North Norway were close to the national average, with 28.3 and 27.5 surgical procedures per 100 000 inhabitants per year respectively. Residents in Nordland and the Helgeland had lower rates in each year of the study period, with averages of 16.6 and 18.1 surgical procedures per 100 000 inhabitants per year respectively. These rates are equivalent to 56 % and 61 % of the national average respectively. The treatment rates for the areas of residence served by the local hospitals showed a large variation, with a ratio of 3 between the highest and lowest rate. Because of the small number of observations in some areas of residence we have chosen not to report specific rates.

## Local coverage

The total number of surgical procedures for degenerative cervical spine disease for residents in the Northern Norway Regional Health Authority area amounted to 447 (Table 2). The proportion of procedures performed at the University Hospital of North Norway was 385/447, which corresponds to a local coverage of 86 %. The local coverage increased gradually from 61/89 (69 %) in 2014 to 90/99 (91 %) in 2018.

**Table 2**

Place of treatment for patients resident in the Northern Norway Regional Health Authority area who underwent surgery for degenerative cervical spine disease, 2014–18.1 Number of surgical procedures (%). UNN = University Hospital of North Norway.

Place of treatment location	2014	2015	2016	2017	2018	Average
UNN Tromsø	61 (69)	70 (86)	79 (91)	85 (92)	90 (91)	77 (86)
Central Norway Regional Health Authority	10 (11)	/	/	/	5 (5)	5 (6)
Western Norway Regional Health Authority	14 (16)	6 (7)	5 (6)	/	/	6 (7)
South-Eastern Norway Regional Health Authority	/	/	/	/	/	1 (1)
Total	89 (100)	81 (100)	87 (100)	92 (100)	99 (100)	90 (100)

<sup>1</sup>For reasons of data protection, the Centre for Clinical Documentation and Evaluation hides the exact figures for registrations that occur with a frequency of less than 5 per year, but this has no effect on the totals. Frequencies < 5 are marked with a slash.

## Discussion

The rate of surgical treatment for degenerative cervical spine disease in Norway remained stable from 2014 to 2018, although with some variation between the health regions. The highest rate was among residents in the Western Norway Regional Health Authority area and the lowest among residents in the Central Norway and Northern Norway Regional Health Authority areas. In the Northern Norway Regional Health Authority area the rate was close to the national average in Finnmark and the area of residence served by the



University Hospital of North Norway, but low among residents in Nordland and Helgeland. The local coverage was low in 2014, but increased gradually thereafter.

### **Treatment rates**

Kristiansen et al. have previously estimated the rates of surgical treatment for degenerative cervical spine disease in Norway, and reported an increase from 16.9 to 29.4 procedures per 100 000 inhabitants per year from 2008 to 2014 (7). The underlying data consisted of figures from the Norwegian Patient Registry ( $n = 5\,918$ ) that correspond to our data, as well as data from Oslofjordklinikken ( $n = 593$ ), which treats patients who meet the cost themselves or use private health insurance, and encompassed more than 99 % of the total activity. The proportion of patients who had met the cost themselves or used private health insurance amounted to 9.1 %. We found that the rate of publicly funded treatment had remained stable at an average of 29.6 procedures per 100 000 inhabitants per year until 2018. The Norwegian Registry for Spine Surgery also estimates rates based on data from the Norwegian Patient Registry, and reported a stable rate of approximately 30 surgical procedures per 100 000 inhabitants per year in 2019 and 2020 (11). The total rate of both publicly and privately funded treatment is therefore likely to have increased slightly also after 2014. We had no access to data on privately funded treatment, and Kristiansen et al. did not report whether this proportion remained stable or increased from 2008 to 2014 (7). In any case, a growing population and a higher proportion of older people can be expected to give rise to a continued increase in the number of surgical procedures per year.

The treatment rate also remained stable among residents in the Northern Norway Regional Health Authority area, although at 78 % of the national average. Similar inter-regional differences also prevailed in the period 2008–14 (7). The large annual variations in some regions of residence are likely to be random in areas with few inhabitants. The intra-regional differences were considerable. The average rates were close to the national average in Finnmark and the areas of residence served by the University Hospital of North Norway, but below it among residents in Nordland (56 %) and Helgeland (61 %). We cannot exclude the possibility that there are differences in the prevalence of degenerative cervical spine disease between geographical areas, but we consider this to be a fairly unlikely reason for the lower rates in the Northern Norway Regional Health Authority area. Geographical variations in the access to diagnostic imaging or specialist examination, better provision of non-surgical treatment and long waiting times for surgical treatment can be possible causes. Kristiansen et al. found that residents in areas with low rates of publicly funded treatment also had the lowest rates of surgical procedures paid for by the patients themselves or by private health insurance (7). Privately funded treatment replacing publicly funded treatment is therefore an unlikely reason for the lower rates among residents in the Nordland and Helgeland regions.

Kotkansalo et al. analysed data from nationwide Finnish registries for the years 1999–2015 and found an average rate of 26 surgical procedures for degenerative cervical spine disease per 100 000 inhabitants per year (12). The rate increased from 19 to 35 procedures per 100 000 inhabitants per year from

1999 to 2013 before levelling off. The rate after 2013 was somewhat higher than the one we report for Norway (29.6 procedures per 100 000 inhabitants per year in Norway). The Finnish study included procedures that were paid for by the patients themselves or by private health insurance (A. Kotkansalo, personal communication, 2021). The total rates of publicly and privately funded surgical treatment of degenerative cervical spine disease are therefore likely to have been fairly similar in Norway and Finland. We are not aware of any similar studies from other European countries. The treatment rates in Norway and Finland are far lower than in the United States, where it increased from 51 to 62 surgical procedures per 100 000 inhabitants per year from 2002 to 2009 (13). Lopez et al. analysed data for inhabitants older than 65 years who were insured through Medicare, and reported 85 surgical procedures per 100 000 inhabitants in 2017 (14). There was a large geographical variation from 35 to 190 procedures per 100 000 inhabitants per year, and the increase in the average rate did not level off as it did in Norway and Finland (14).

### **Local coverage**

Local coverage in the area of Northern Norway Regional Health Authority was 69 % in 2014, but increased to 91 % in 2018 as a result of approximately 30 additional cervical spine procedures per year at the University Hospital of North Norway in Tromsø in 2018 compared to 2014. Most procedures for degenerative cervical spine disease can be performed as day surgery, and the capacity increased during the study period. This is therefore a likely reason for the increase in local coverage.

### **Assessment of the activity in within the Northern Norway Regional Health Authority**

Wennberg categorises health services as effective, preference-sensitive or supply-sensitive (15). Effective services have a well documented effect and there is a high degree of consensus regarding their utility. Little variation is expected in the use of such services, and in line with this, both Norwegian and Finnish studies show little geographical variation and stable rates for cervical spine surgery as treatment for myelopathy (7, 12). Treatment of pain in cases of radiculopathy is the most common indication for cervical spine surgery, and can be categorised as preference-sensitive (16). No generally recognised method is available for estimating the need for such healthcare services in a population, but equality in service provision with little geographical variation is a Norwegian health policy objective. We therefore estimated what the activity level in the Northern Norway Regional Health Authority area would have been if the treatment rate for residents in this region were equal to the national average. In this case, the average number of surgical procedures per year would be 114; this is equivalent to 24 additional surgical procedures per year. Irrespective of treatment rates, the goal of Northern Norway Regional Health Authority is for patients to prefer their treatment to be provided within the region (17). The number of surgical procedures for degenerative cervical spine disease in public hospitals in other regions was 12 per year on average. If both the low treatment rate and the low local coverage are to be compensated for within the region, the local activity needs to be increased by approximately 35

cervical spine surgeries per year. In addition, there might be a need for better diagnostics and access to specialist examinations among residents in the Nordland and Helgeland regions.

Our equivalent calculations for lumbar spine surgery estimated a need to increase the activity by approximately 170 interventions per year (6). In total, the estimates indicate a coverage deficiency for spinal surgery of approximately 200 interventions per year in the Northern Norway Regional Health Authority area.

### Strengths and weaknesses

Our use of data from the Norwegian Patient Registry is a strength of this study, since reporting is mandatory and a precondition for activity-based funding. The registry reports high data quality and a general degree of coverage of more than 90 % for surgical procedures (18). However, the degree of coverage for surgical treatment of degenerative cervical spine disease was estimated to be 79.6 % in 2017 (19). The actual rates may thus be higher than those reported by us, and we cannot exclude the possibility that geographical variations in the registration contribute to the observed differences in rates. A further weakness is that we have no data for surgical interventions performed in private hospitals and paid for by the patients themselves or by private health insurance.

### Conclusion

The treatment rate for cervical spine disease was low for residents in Nordland and Helgeland. In order to compensate for this within Northern Norway Regional Health Authority, the local activity needs to increase by approximately 35 surgical procedures per year.

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*The article has been peer reviewed.*

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