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Patient influx to emergency departments at two Norwegian university hospitals from 2012–21

ORIGINAL ARTICLE

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Background

The increased patient visits to emergency departments is a global challenge. We aimed to map the patient influx and population at two Norwegian university hospitals over time.

Material and method

A retrospective, descriptive study of patient visits (patients ≥ 16 years of age) to the emergency departments of Haukeland University Hospital, Bergen, and St Olav's Hospital, Trondheim University Hospital in the period 2012–21. Data were retrieved from electronic patient records and the patient administration system.

Result

A total of 585 780 patient visits were included. The number of patient visits in the emergency departments was 30 696 in 2012 and 40 396 in 2021 at Haukeland University Hospital, and 18 967 in 2012 and 28 822 in 2021 at St Olav's Hospital. The largest increase during the study period appeared to be in the age group 67–79 years, with an increase of 57 % (from 6 190 to 9 691) at Haukeland University Hospital, and 77 % (from 3 849 to 6 817) at St Olav's Hospital. The proportion of hospital admissions was 82 % in 2012 and 74 % in 2021 at Haukeland University Hospital, and 87 % in 2012 and 61 % in 2021 at St Olav's Hospital. Of the patients that were admitted, the median age was 65 years, while the median age of those who were discharged from the emergency department was 48 years at Haukeland University Hospital and 52 years at St Olav's Hospital.

Interpretation

The study showed an increase in patient influx at the emergency departments at Haukeland University Hospital and St Olav's Hospital over ten years. The number of older adults in the population will continue to increase in the years ahead, and the need for emergency care will increase correspondingly. It is important that healthcare services are aware of changes in the patient influx and population in order to ensure patient safety and the working environment at emergency departments in the future.

Main findings

The number of patient visits to the emergency departments at Haukeland University Hospital, Bergen, and St Olav's Hospital, Trondheim University Hospital increased during the period 2012–21.

The largest percentage increase in patient visits appeared to be in the age group 67–79 years.

The proportion of hospital admissions appeared to decrease during the study period.

Increased patient influx to emergency departments (EDs) is a global challenge to patient management (1). Capacity overload can create challenges for patient flow and have adverse consequences for patients and staff (1, 2). Demographics and trends in patient influx have been examined (3–6), but there is a lack of up-to-date studies.

Efficiency and patient safety in EDs have long been central themes in the Norwegian health service. In 2007, a nationwide inspection uncovered serious shortcomings in EDs within the somatic specialist health service (7). Concerns were found in over half of the EDs in relation to the professional adequacy of clinical assessments and diagnoses, with high patient influx and long waiting times identified as risk factors. This led to calls for more systematic and

targeted management. The first national clinical guidelines for EDs, which were introduced in 2014 and revised in 2022 (8), emphasised the need for continuous monitoring of the activity. The Norwegian Institute of Public Health's report on EDs and the risk zone for patient safety also highlighted the importance of regular data collection for effective management and planning (9).

In this study, we evaluated patient visits over a ten-year period in the EDs at Haukeland University Hospital, Bergen, and St Olav's Hospital, Trondheim University Hospital. The aim was to update the knowledge on patient influx to aid the planning of future emergency services.

Some of the data from St Olav's Hospital used in this study has been published previously, including data on patient influx in the period 6 January to 22 March 2020 (3), data on patient influx and length of stay in the EDs for the entire study period, and hospital admissions (6). This study presents additional data for the same period from St Olav's Hospital, along with previously unpublished data from Haukeland University Hospital.

Material and method

This is a retrospective observational study of patient visits to the EDs at Haukeland University Hospital, Bergen, and St Olav's Hospital, Trondheim University Hospital in the period 1 January 2012 to 31 December 2021.

Hospital setting

St Olav's Hospital serves as the local and regional hospital for 327 000 and 730 000 people respectively, and is Trondheim municipality's only ED (10). The ED primarily treats patients over the age of 16 and all patients requiring treatment by a team (i.e. medical emergency team, stroke team and trauma team). Patients who typically bypass the ED are those with ear, nose and throat (ENT), gynaecological and eye conditions, as well as those on the fast-track pathway for a coronary intervention or with hip fractures.

Several hospitals in the Bergen area provide emergency medical care for patients in the specialist health service. Haukeland University Hospital serves as the local hospital for 290 000 people with medical complaints, 433 000 people with other conditions, and as the regional hospital for

1 000 000 people (11). The ED deals with all acute conditions for all age groups, but children with non-surgical medical issues, pregnant women, women in need of gynaecological care and fast-track patients with hip fractures often bypass the ED.

Data collection

Data on patients visits were retrieved from the EDs' patient record systems (Akuttdatabasen, Helse-Vest IKT, version 1.5.5, Stavanger, and Meona, Mesalvo Freiburg, Germany). These records were linked to the hospitals' patient administration system (Nimes, Logex AS, Oslo, Norway and the Norwegian Population Register) for information on patient pathways.

In 2017, Haukeland University Hospital replaced the electronic patient record (EPR) software Akuttdatabasen with Meona. After this change, all data for 2018 (and a brief period in November 2015), except for the number of patient visits, were missing. The data on date/time of death and the patients' gender were also missing for the period 2019–21.

The number of patient visits with incomplete data was registered, and those lacking individual variables were excluded from the calculation of percentages.

Length of stay was calculated as the time from ED admission up until discharge. Where this was registered as < 5 min or > 2 days, the length of stay for the patient visit was recorded as not available.

Mortality rates after 24 hours, 7 days and 30 days were calculated based on date/time of arrival at the ED and date/time of death, and reported per 1 000 patient visits.

Chief complaints and medical specialty involved were examined for 2021, and for Haukeland University Hospital these were based on referral diagnoses and for St Olav's Hospital on Emergency Signs and Symptoms (ESS) codes.

In the ED at Haukeland University Hospital, the triage level was assessed using the South African Triage Scale (SATS) Norway (12), while St Olav's Hospital used the Rapid Emergency Triage and Treatment System (RETTS) (13). Patient visits reported as admission to a ward, surgical department, observation unit or intensive care unit were grouped together as 'hospital admission'.

Patient visit was defined as a patient registered and evaluated in the ED. This means that the same patient could be represented by more than one patient visit. Patient visits for patients < 16 years of age were excluded. Age categories were 16–66 years, 67–79 years and ≥ 80 years. For some results, the study period was divided into two five-year periods: 2012–16 and 2017–21.

Data were analysed using R (R Core Team, version 4.3.0, 2023) and RStudio (RStudio Team, version 2023.06.0 + 421, 2023) and presented as a mean and a standard deviation (SD) or 95 % confidence interval (CI), number (n) and percentage (%). Median and interquartile range were used for data with a non-normal distribution.

Ethics

Use of data from St Olav's Hospital was approved by the hospital's data protection officer (ESA no. 16/9114), and the study was considered a quality improvement project, and did not therefore require submission to the Regional Committee for Medical and Health Research Ethics (REK Central, 2016/1813). Use of data from Haukeland University Hospital for the years 2012–17 was approved by the hospital's data protection officer and REK West (2018/2128). For the period 2018–21, only aggregated data were used, which did not require REK approval.

Results

A total of 602 653 patient visits were registered in the two EDs for the study period 2012–21. Of these, 15 255 at Haukeland University Hospital and 1 618 at St Olav's Hospital were excluded due to age < 16 years. Thus, the study included 349 884 and 235 896 patient visits, respectively.

Of the total 585 780 patient visits at Haukeland University Hospital and St Olav's Hospital, data were missing for age in 43 980 and 4 956 patient visits, for gender in 154 492 and

4 958 patients, for length of stay in 65 578 and 494, for triage levels in 46 159 and 532, and for treatment levels in 41 721 and 96, respectively. At Haukeland University Hospital, data on admission date/time were missing for 40 630 and date/time of death for 154 485. The high numbers for gender and date/time of death at Haukeland University Hospital were due to missing data after the year 2017.

The median age was 62 years (Table 1). At Haukeland University Hospital, in the age groups < 80 years, 46 % were women, compared to 57 % among those aged ≥ 80 years. The corresponding figures for St Olav's Hospital were 49 % and 57 %, respectively.

Table 1

Age, gender and length of stay for patient visits in the EDs at Haukeland University Hospital and St Olav's Hospital in the period 2012–21.

	Haukeland University Hospital *N*=349 884	St Olav's Hospital *N*=235 896
Age (years), median (interquartile range)	62 (41–77)	62 (41–76)
Gender (female), number (%)1	93 397 (48)	116 128 (50)
Length of stay (hours, minutes), median (interquartile range)	2 h 27 mins (1 h 34 mins–3 h 37 mins)	3 h (1 h 44 mins–4 h)

[1]Patient visits with incomplete data were not included in the calculation of percentages (%)

Abdominal pain (13 % and 16 %) and chest pain (11 % and 10 %) were the most common reasons for contact at both EDs (Table 2), and the majority of patient visits were medical (44 % and 53 %) or surgical (24 % and 25 %) (Table 2).

Table 2

Chief complaints and assigned medical specialty for patient visits in the EDs at Haukeland University Hospital and St Olav's Hospital in 2021

	Haukeland University Hospital *N*=40 396	St Olav's Hospital *N*=28 822
Chief complaints[1], number (%)[2]		
Abdominal pain	5 222 (13)	4 592 (16)
Chest pain	4 358 (11)	3 008 (10)
Suspected stroke	2 041 (5)	2 210 (8)
Dyspnoea	1 713 (4)	1 551 (5)
Other	27 062 (67)	14 333 (50)
Assigned medical specialty[1], number (%)[2]		
Internal medicine including oncology	17 964 (44)	15 197 (53)
Surgery	9 679 (24)	7 075 (25)
Neurology	4 399 (11)	1 795 (6)
Orthopaedics	3 093 (8)	2 218 (8)
Neurosurgery	2 220 (5)	501 (1.7)
Other[3]	2 759 (7)	2 036 (7)

[1]Based on Emergency Signs and Symptoms codes (St Olav's Hospital) and admission diagnoses (Haukeland University Hospital)

[2]Patient visits with incomplete data were not included in the calculation of percentages (%)

[3]Includes dermatology, gynaecology and obstetrics, ophthalmology, otolaryngology, and emergency medicine

The ED at Haukeland University Hospital had a mean of 3.8 (SD 2.2) new patient visits per hour, and the corresponding figure at St Olav's Hospital was 2.5 (SD 1.6) (Figure 1). For new patient visits with the highest triage level, the mean per hour at Haukeland University Hospital was 0.4 (SD 0.2), compared to 0.3 (SD 0.1) at St Olav's Hospital.

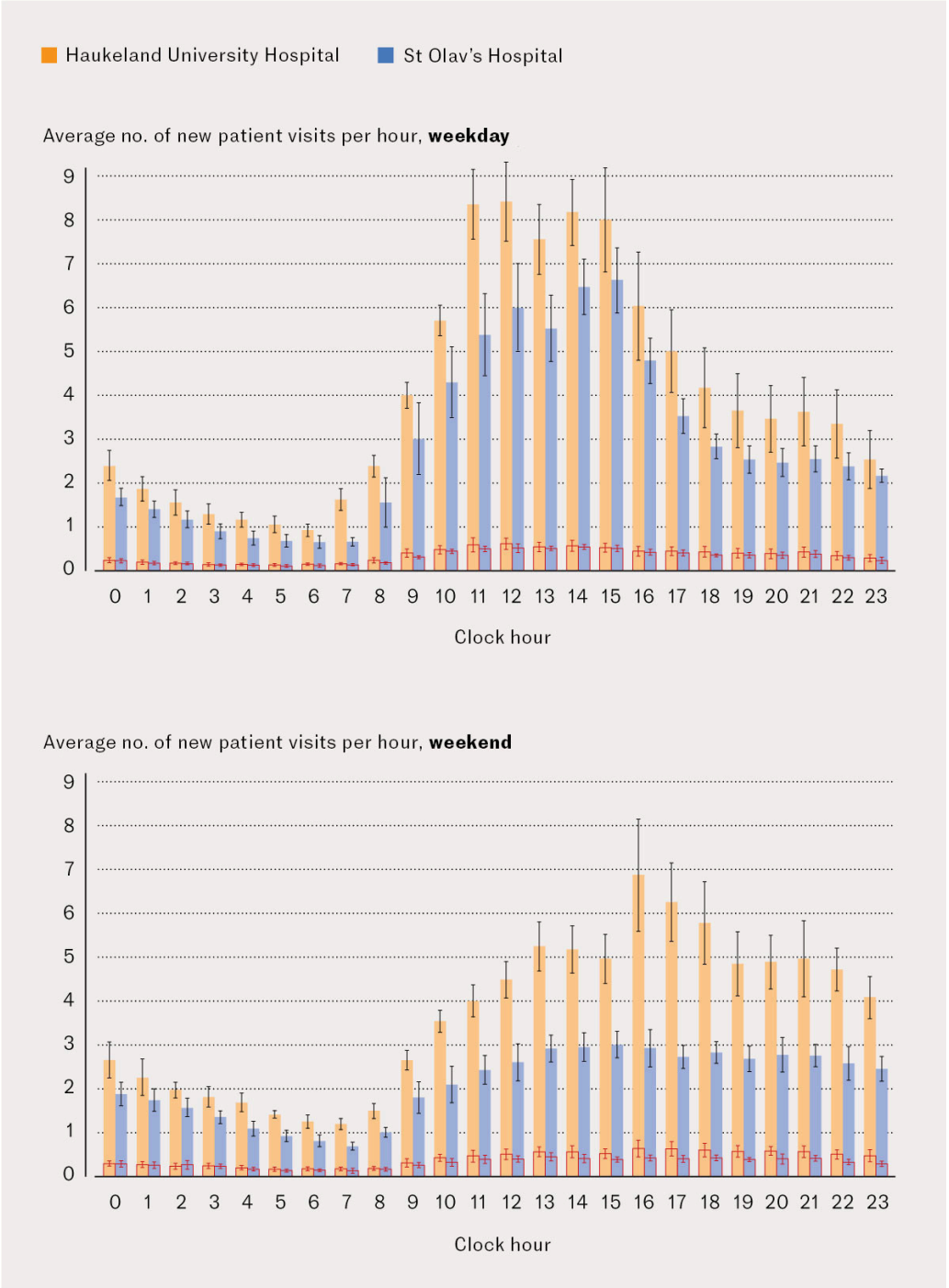

Figure 1 Number (mean, 95 % CI) of patient visits in the ED per hour at Haukeland University Hospital (orange, N=303 725) and St Olav's Hospital (blue, N=235 364), distributed by weekday (upper panel) and weekend (lower panel) 2012–21. Red boxes indicate patient visits with the highest triage level.

The ED at Haukeland University Hospital had a median (interquartile range) annual increase of 856 (362–1 350) patient visits, from 30 696 in 2012 to 40 396 in 2021; representing a total increase of 32 %. At St Olav's Hospital, the median annual increase was 1 040 (762–1 318), from 18 967 in 2012 to 28 822 in 2021; representing a total increase of 52 % (Figure 2). The corresponding total increases distributed by age groups 16–66 years, 67–79 years and ≥ 80 years were 25 % (from

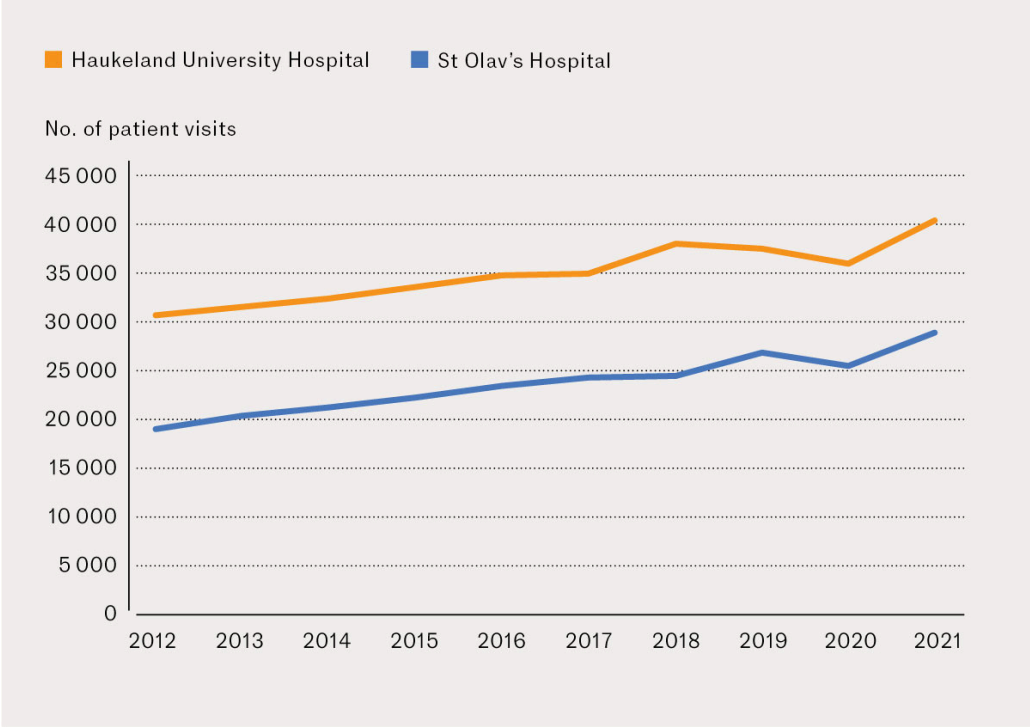

Figure 2 Number of patient visits (n) per year in the EDs at Haukeland University Hospital (orange, N=349 884) and St Olav's Hospital (blue, N=235 896) in the period 2012–21.

17 908 to 22 348), 57 % (from 6 190 to 9 691) and 27 % (from 6 598 to 8 356), respectively, at Haukeland University Hospital. At St Olav's Hospital, the changes in the respective age groups were 57 % (from 10 308 to 16 156), 77 % (from 3 848 to 6 817) and 48 % (from 3 726 to 5 531) (Figure 3). The proportion of elderly (≥ 67 years) was 41 % (2012–16) and 44 % (2017–21) for both EDs combined.

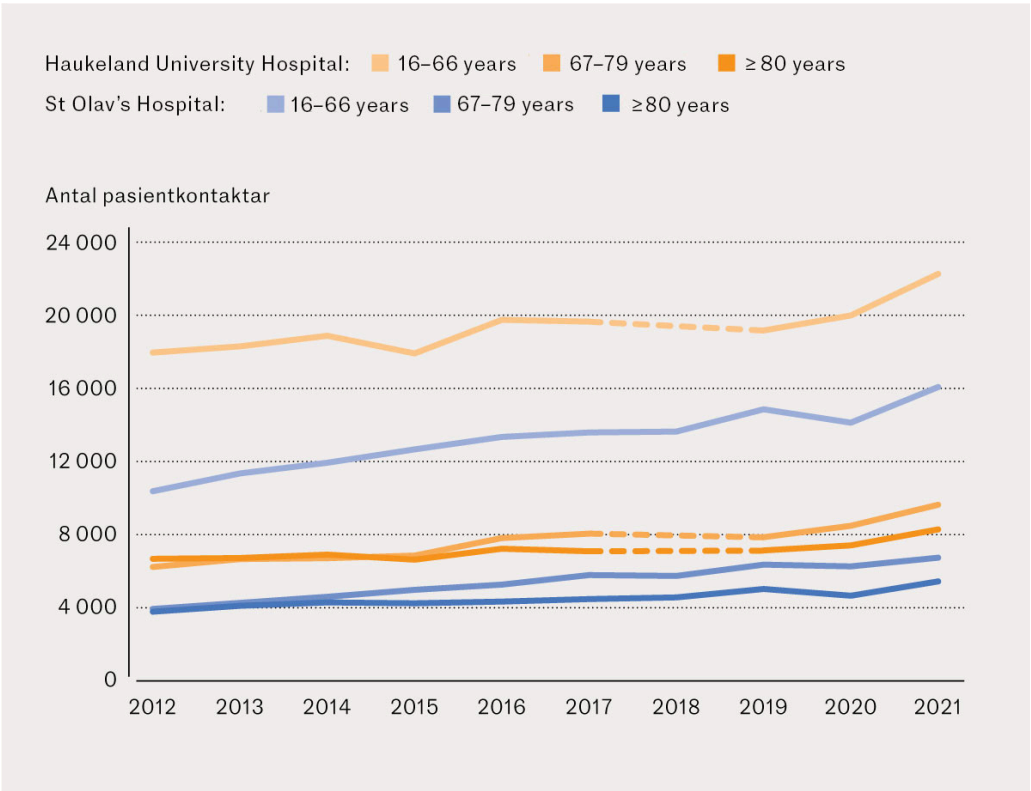

Figure 3 Number of patient visits (n) per year in the EDs at Haukeland University Hospital (orange, N=305 904) and St Olav's Hospital (blue, N=230 940) in the period

2012–21, distributed by age (16–66 years, 67–79 years and ≥ 80 years). Incomplete data for Haukeland University Hospital in 2018 are indicated by dashed lines.

The proportion of patient visits at Haukeland University Hospital that resulted in admission was 82 % in 2012 and 74 % in 2021, while at St Olav's Hospital the corresponding proportions were 87 % in 2012 and 61 % in 2021, respectively (Figure 4). The median age (interquartile range) for patient visits resulting in admission to the hospital versus those discharged directly from the ED was 65 years (46–78) and 48 years (30–68), respectively, at Haukeland University Hospital and 65 years (44–78) and 52 years (33–71) at St Olav's Hospital.

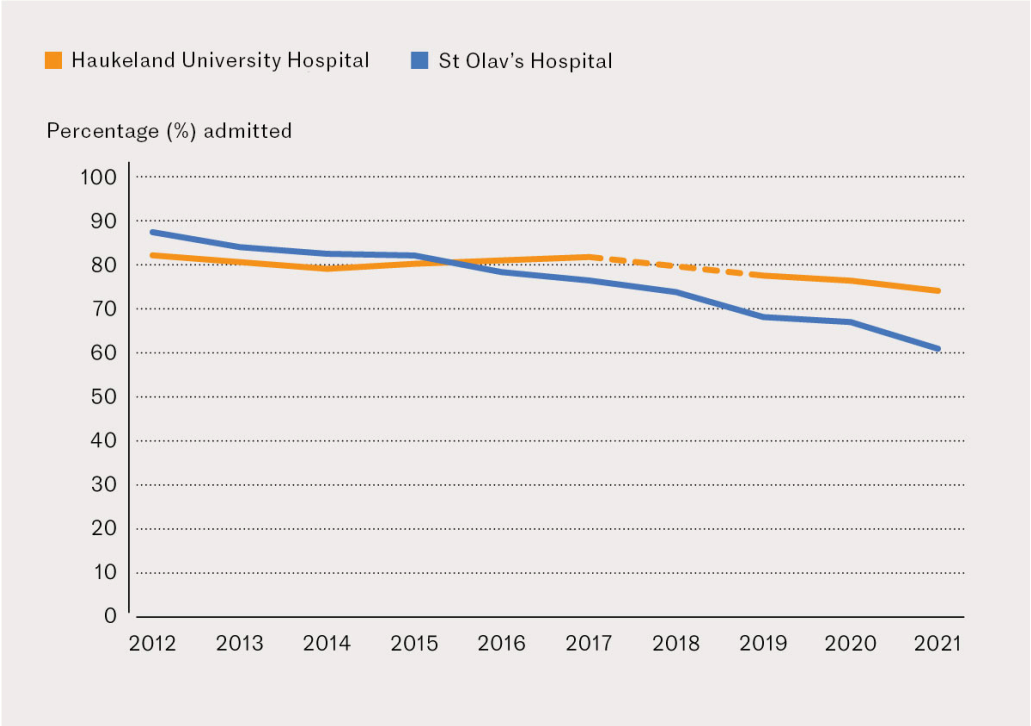

Figure 4 Percentage of ED admissions at Haukeland University Hospital (orange, N=308 163) and St Olav's Hospital (blue, N=235 800) in the period 2012–21. Incomplete data for Haukeland University Hospital in 2018 are indicated with a dashed line.

The median length of stay (interquartile range) in the ED for patients admitted to the hospital and discharged from the ED at Haukeland University Hospital was 2 h and 24 mins (1 h and 34 mins–

3 h and 31 mins) and 2 h and 53 mins (1 h and 50 mins–4 h and 13 mins), respectively. At St Olav's hospital, the corresponding durations were 2 h and 33 mins (1 h and 41 mins–3 h and 47 mins) and 3 h and 12 mins (2 h and 4 mins–4 h and 45 mins), respectively.

The ED at Haukeland University Hospital (2012–17) and St Olav's Hospital had 0–1 and 0–3 deaths per year, respectively. Mortality per 1 000 patients in the ED at Haukeland University Hospital (2012–17) was 3 after 24 hours, 6 after 7 days and 11 after 30 days. The corresponding figures for St Olav's Hospital were 5, 8 and 18.

Discussion

This retrospective review of patient influx at two Norwegian EDs demonstrates a considerable increase in patient visits in the period 2012–21; 32 % at Haukeland University Hospital and 52 % at St Olav's Hospital. This increase appeared to be steady, apart from a temporary small decrease in 2020, which likely reflects the COVID-19 pandemic. There was no obvious difference in the distribution of age, gender, chief complaints and mortality between the two EDs.

The most common chief complaints were abdominal pain, chest pain, dyspnoea and suspected cerebral stroke. These collectively accounted for approximately one-third of the patient visits at the two EDs. Medical patients made up about half (53 %) of the total at St Olav's Hospital, with a slightly smaller proportion at Haukeland University Hospital (44 %). This difference can be attributed to the larger patient catchment area for surgical conditions compared to internal medicine, as well as the existence of medical departments at Haraldsplass Diaconal Hospital in Bergen. Additionally, patients with stroke symptoms were assigned to neurology at Haukeland University Hospital, while St Olav's Hospital assigned these patients to internal medicine.

On weekdays, a clear peak in patient influx was observed around lunchtime, while patients with the highest triage level seemed to be more evenly distributed throughout the day. The higher number of patient visits during the day without an increase in high triage level visits was an expected finding. This is because patients with less acute conditions are less likely to seek medical attention in the evening or at night, and because the primary care service mainly sees patients during the day (14). The general increase in patient visits in afternoons and evenings can pose a challenge for EDs but can potentially be reduced by giving patients with non-urgent conditions appointments for the following morning.

The population growth in Bergen municipality (8 %) and Trondheim municipality (14 %) in 2012–21 was lower than the increase in patient influx (15), which may indicate that the increase cannot be solely attributed to population growth. The age group with the greatest increase appeared to be 67–79 years, with a 57 % increase at Haukeland University Hospital and 77 % at St Olav's Hospital. The proportion of older patients (≥ 67 years) was found to be 41 % in the first part of the study period and 44 % in the second. An earlier study from St Olav's Hospital reported a similar increase in patient influx to the ED in 1992–2011 (4), and global studies show a similar trend (2).

A decreasing trend in the proportion of patient visits resulting in hospital admission has previously been demonstrated at St Olav's Hospital (4, 6) and may be related to the introduction of specialists in emergency medicine whose competence and presence makes it more likely that the patient is dealt with efficiently in the ED without the need for consultation (6). The organisational structures of the two hospitals differ slightly, and St Olav's Hospital has a

provision for outpatient treatment, which partly explains the more pronounced decrease observed at this hospital. The length of stay was also likely to be slightly longer at St Olav's Hospital than at Haukeland University Hospital.

With the projected significant increase in the population (16), particularly in the older age groups, it is reasonable to expect a continued increase in the patient influx to EDs. The fact that older patients are hospitalised more often than younger patients means that EDs will not only have to prepare for a higher patient influx but will also be faced with a patient population that requires other types of care. In 2023, the Health Personnel Commission confirmed that the specialist health service will have lower or no staff growth, with resources being directed to the primary care service instead (17). This means that EDs may face a higher demand without a corresponding increase in the supply of personnel. To prepare EDs for this future challenge, robust professional expertise and decision-making support are needed. The Norwegian Directorate of Health's guidelines for somatic EDs (8) recommend placing doctors who specialise in emergency medicine in EDs. We also argue that close collaboration with the primary care service is essential for ensuring appropriate and optimal patient pathways. Cooperation should be strengthened through uniform guidelines in primary care and the specialist health service for when and how patients should be referred to EDs and hospitals, emergency beds in the primary care service, outpatient appointments with specialists or other healthcare services. This could help ensure that patients with minor ailments receive the necessary care without hospitalisation, while enabling prompt hospital treatment for those requiring emergency care.

One of the strengths of our study was the inclusion of data from two different EDs, but data access and registration practices varied, and the introduction of a new computer system at Haukeland University Hospital during the study period may have affected data quality. In future studies, it would be helpful to distinguish between patient visits and unique patients.

This study showed changes in patient influx and population at the EDs at Haukeland University Hospital and St Olav's Hospital over a ten-year period. The age group 67–79 years appears to have had the highest annual percentage increase in patient visits. The proportion of patient visits that resulted in hospitalisation appeared to decrease. The findings of this study are significant for the planning of future emergency services.

The article has been peer-reviewed.

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