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Intended and Unintended Changes in Length of Stay Following Reconfiguration of Emergency Care Departments

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Intended and unintended changes in length of stay following reconfiguration of emergency care departments

Abstract

Background The Danish healthcare system has witnessed noticeable changes in the acute hospital care organization. The reconfiguration includes closing hospitals, centralizing acute care functions, investing in new buildings and equipment. In this study, we aim to examine the impact on the length of stay (LOS) and the proportion of overnight stays for hospitalized acute care patients.

Methods: This nationwide interrupted time series examined trend changes in LOS and overnight stay. Admissions were stratified based on admission time (weekdays/weekends and time of day), age, and the level of co-morbidity

Results In 2007–2016, the global average LOS declined 2.9% per year (adjusted time ratio [CI 95%] 0.971 [0.970–0.971]). The reconfiguration was overall not associated with change in trend of LOS (time ratio [CI 95%] 1.001 [1.000–1.002]). When admissions were stratified for either weekdays or weekends, the reconfiguration was associated with reduction of the underlying downward trend for weekdays (time ratio [CI 95%] 1.004 [1.003–1.005]) and increased downward trend for weekends admissions (time ratio [CI 95%] 0.996 [0.094–0.098]). Admissions at night were associated with a 0.7% trend change in LOS (time ratio [CI 95%] 0.993 [0.991–0.996]). The reconfiguration was not associated with trend changes for overnight stays.

Conclusion The nationwide reconfiguration of acute hospital care was overall not associated with change in trend for the registered LOS and no change in trend for overnight stays. However, the results varied according to hospitalization time, where admissions during weekends and nights after the reconfiguration was associated with shortened LOS.

Keyword: length of stay, hospitals, health policy

Background

The length of stay (LOS) in a hospital is regarded as an indicator of the hospital's efficiency, where a shorter stay (ceteris paribus) will reduce the cost per discharge owing to an earlier shift from in-hospital care to less expensive post-hospital care (1) or patients' own home. Different approaches and policies are used to achieve an effective health system, and the implementation of fast-track systems (2-4) or pay for performance (5, 6) has been associated with reduced LOS. Another solution is hospital closure and a concentration of resources at fewer sites, with a longer travel time and unchanged or increased mortality (7-9), readmission, and patient experiences (9).

In the past decade, the Danish healthcare system has witnessed noticeable changes in the acute hospital care organization. These changes occurred in the wake of a major reform of the administrative and political structure in 2007 (10). In short, through mergers, the reform reduced 271 municipalities to 98 and replaced

13 counties with five regions, which now are responsible for providing all hospital services. Further, the political parties behind this health reform agreed that quality, if necessary, must take precedence over proximity (11). The health reform included a reconfiguration that involved closing hospitals, centralizing specialized treatments, including acute care, to fewer hospitals, and making investments exceeding 8.45 billion euros in 2012–2025 on new buildings, new technology, and equipment to realize the objective of having a modern, sustainable hospital sector (12). The decision was based on limited scientific evidence. The few analysis of the reform and the resulting changes have concluded that this sector's performance trends are positive and that its activity and productivity levels have increased (13). With argumentation based on the volume-outcome relationship (14), as well as the presence of selected specialties throughout the day (15), acute hospital care in Denmark is expected to be of consistently high quality, providing 24/7 care to which all citizens have equal access, and to be highly efficient because of the centralization to fewer hospitals. However, these expectations are yet to be scientifically confirmed.

Aim

We aimed to examine how the nationwide reconfiguration of the hospital emergency care has affected the LOS and the proportion of overnight stays for hospitalized acute care patients. Due to the expectation of consistently high quality, at any time and day of the week as well as for all subgroups of patients, we examined the reconfiguration's impact stratified according to the time of admission (weekdays/weekends and time of day), age, and the level of co-morbidity.

Methods

Context and the reconfiguration of the acute care setting

All 5.6 million inhabitants of Denmark have free access to public hospitals (16), with no copayment at the point of utilization of the hospital and general practitioner services. Denmark is divided into five administrative regions governed by democratically elected councils responsible for managing, planning, and delivering healthcare services (17). The national government required the reconfiguration of acute hospital care but was scheduled and executed by each region. The reconfiguration requires all acute patients, except for a few specified types, to be examined and treated at the joint emergency department. An essential argument for pooling resources in a joint emergency department is to move some of the treatment volume from the specialty departments to the emergency area, thus discharging a larger proportion (>70%) of patients without subsequent admission to the specialist departments (12).

The centralization of functions was the key element in the reform, and it has resulted in fewer but better-equipped acute care hospitals at which specialized doctors are always available and which can treat a higher volume of patients. Due to the reconfiguration, the number of emergency patients per year per hospital

increased, on average, from about 25,000 (2007) to 58,000 (2016). The underlying assumption motivating the reform was that the centralization, with increased patient volume per site, would allow staff to gain experience and provide more specialized care at an earlier stage of their care pathway, leading to better, more efficient patient care. The National Board of Health gave several recommendations for the new emergency department, which the hospitals were to implement.

Insert Box 1

Mandatory patient referral to hospital emergency departments was decided by the government and implemented across all hospitals from 2011 to April 2014. Before the mandatory referral, walk-in access to emergency departments was possible, but a doctor's referral, out-of-hours medical services, or emergency medical services have been required since then. In Denmark, general practitioners offer out-of-hours primary medical services through either home visits or phone consultations or in centralized clinics. In 2014, the Capital Region of Denmark changed the out-of-hours system, and thus, currently, all clinics are emergency department-based, which has led to changes in hospitalization pattern (18).

Study sample and data source

We conducted a longitudinal, nationwide evaluation of changes in the LOS for acute hospital contacts (aged ≥18 years) at public, non-psychiatric hospitals in Denmark. Planned inpatient admissions, outpatient visits, and all patients in labor (ICD-10: O10-O99) were excluded. All Danish hospitals report all inpatient and outpatient contacts to The Danish National Registry of Patients (DNRP). The DNRP includes information on admissions and discharges, and we used it to extract the study population. If a patient had several contacts with less than three hours' time difference, we treated it as one contact. The study population from DNRP was merged with data on income (Income Statistics Register), education level (The Danish Education Register), and country of origin, marital status, and age (The Danish Civil Registration System), using the unique personal identification number given to all residents.

Study design and outcome

An interrupted time-series design was employed using the study period January 2007 to December 2016 in which all acute care patients at public non-psychiatric hospitals were included and divided into two phases; before and after the reconfiguration of acute care. The two phases were defined according to establishing a joint emergency department at the individual hospital, leading to individual timelines for each hospital. The hospital's actual cut-off date was based on interviews, reports, and administrative data codes changes. Three hospitals had not changed their setup during the study period, so their timelines consist of only one period, and they thus act as controls throughout the study. The gradual roll-out of the reconfiguration created a naturally occurring non-randomized stepped-wedge configuration. The division of the periods is illustrated in appendix 1.

The outcome variables of interest were LOS and overnight stay. We used data at the individual patient level; their date of admission defined the study phase to which they belonged. The LOS was calculated from the date of the inpatient's first contact in the study period to the date of discharge. Contacts whose LOS exceeded 365 days (n = 1240) were excluded. A stay was considered an overnight stay if the contact had different admission and discharge dates.

Statistical analysis

We compared the characteristics of the patients in the two periods using Pearson's chi-squared test. The reconfiguration impact was estimated as changes in the trend between the two periods and is considered the primary outcome. A downward underlying trend, as reflected by a Time Ratio below 1.00, means that LOS is shortened over time. A positive change in trend, as reflected by a Time Ratio above 1.00, will then imply that the underlying downwards trend is slowed down and will be interpreted as that the reorganization has contributed to an increased LOS. Unadjusted and adjusted analyses were conducted. Both analyses accounted for contacts from a hospital as clusters (since several hospital closures and mergers occurred, the hospital status after the reconfiguration was used). The adjusted analyses were adjusted for variations due to seasonality, changes in the hospitalization pattern due to change in the out-of-hours system in the Capital Region, and the implementation of referral to emergency care. See Appendix 2 for an illustration of the impact model. Since the demographics of acute hospital contacts have changed over time with patients becoming progressively older and with more co-morbidity, analyses were adjusted for patient characteristics. In secondary analyses, we stratified data according to the time of admission (weekday/weekend and time of day (7 am – 3 pm, 3–11 pm, and 11–7 am)), age (18–49, 50–64, 65–79, >80 years), and co-morbidity (Charlson Comorbidity Index score 0 = low, Index score 1–2 = moderate, Index score >2 = high (19)). We tested models with variables for periodic intercept changes, but since they did not contribute to the model, we excluded these. We used monthly time points in the models, which meets the recommendations for the number of time points and the data per point (20). The impact model included a continuous-time variable throughout the study period and a continuous-time variable from the reconfiguration date and later. Parametric time-to-event analyses with Weibull distribution were conducted on the LOS, in which death during hospitalization was considered censoring. We used logistic regression to analyze the data on overnight stays. Data management and analyses were performed using Stata 15 (Stata Corp LP, College Station, TX), and a significance level of 5% was applied.

Ethics

The Danish Data Protection Agency has approved the project (file no. 17/18411), and no further approvals are necessary according to Danish law (21).

Insert table 1 here

Results

This study included 11,366,992 acute hospital care contacts, divided into 4,717,745 contacts before, and 6,649,247 contacts after, the reconfiguration. The univariate analysis showed significant differences in patient characteristics between the two study periods (see Table 1). The unadjusted analyses presented in Figure 1 show that the median LOS varied from 4.8 hours in 2007 to a peak of 6.1 hours in 2013 and ended at 5.1 hours in 2016. The mean LOS in 2007 was 2.9 days and decreased steadily to 2.2 days in 2016 (figure 1B).

Insert figure 1 here

Length of stay

The overall underlying trend in the LOS showed a decrease of 2.9% per year (time ratio [CI 95%] 0.971 [0.970–0.971]) in the full-adjusted model (Table 2). The reconfiguration was overall not associated with any trend change (time ratio [CI 95%] 1.001 [1.000–1.002]) in the LOS. Weekdays were associated with 0.4% (time ratio [CI 95%] 1.004 [1.003–1.005]) reduction of the underlying downward trend, whereas weekends were associated with 0.4% (time ratio [CI 95%] 0.996 [0.994–0.998]) change in the opposite direction. For admissions between 7 am to 3 pm, the reconfiguration slowed the downward LOS trend by 0.4% per year (time ratio [CI 95%] 1.004 [1.003–1.006]). No change in the LOS trend was observed for admissions in the time span 3–11 pm (time ratio [CI 95%] 0.999 [0.997–1.001]), whereas a 0.7% yearly change (time ratio [CI 95%] 0.993 [0.991-0.996]) in the LOS trend was found for admissions in the time span 11 pm – 7 am. The 18–49 years age group was the only group associated with a stronger downward trend (time ratio [CI 95%] 0.991 [0.990–0.993]). Both the 65-79 age group and the >80 age group were both associated with changes fading the trend after the reconfiguration (time ratio [CI 95%] 1.016 [1.013–1.018]; 1.012 [1.009–1.015]), respectively). For admissions with low co-morbidity, the reconfiguration was associated with a strengthened downward LOS trend (time ratio [CI 95%] 0.997 [0.996–0.999]), while admissions with medium and high both were associated with a change slowing the LOS trend (time ratio [CI 95%] 1.004 [1.001–1.006]; 1.009 [1.007–1.012]), respectively).

Insert table 2 here

Overnight stay

The analysis results of the overnight stay data are presented in Table 3. The adjusted results reveal that the overnight stay tended to decrease (odds ratio [95% CI] 0.977 [0.962–0.992]) and that the reconfiguration was not associated with any change (odds ratio [95% CI] 0.998 [0.970–1.015]) the likelihood of overnight stays. When stratified by weekday vs. weekend, the likelihood of an overnight stay during weekdays showed a 2.8 % yearly underlying decrease during the study period (odds ratio [95% CI] 0.972 [0.956–0.988]), whereas

the likelihood of overnight stay during weekends did not statistical change. The underlying trend decreased for the time-span 7 am – 3 pm (odds ratio [95% CI] 0.958 [0.939–0.978]) and was stable for the time-spans 11 pm – 7 am and 3-11 pm. When stratified according to age and co-morbidity, only the age group 18-49 and admissions with low co-morbidity did not statistically significant have an underlying decreasing trend throughout the study period. The reconfiguration was not associated with trend changes when stratified according to weekday–weekend, time of the day, age groups, or co-morbidity. The only exception was the 18-49 age group. These admissions were associated with a downward change in trend after the reconfiguration (odds ratio [95% CI] 0.976 [0.957–0.996]).

Insert table 3 here

Discussion

Statement of principal findings

This study suggests that neither the LOS nor the proportion of overnight stays overall was affected by the reconfiguration. However, admissions during *normal business hours* (weekdays from 7 am to 3 pm) were associated with increased LOS, and *off-hours* (weekend and 11 pm to 7 am) were associated with a decreased LOS trend. At the patient level, the 18–49 years age group and the low co-morbidity group stood out as the only patient groups associated with a decreased change in the LOS trend. The older and the more co-morbidity, the more associated they were with increased LOS change.

Interpretation within the context of the wider literature

Although the effect sizes was relatively small, it contrasts with the expectation that the reconfiguration during *normal business hours* was associated with an increase in the LOS trend. This increased change has occurred while the average LOS in the study period decreased from 2.9 to 2.2 days. After the reconfiguration, more equipment and testing became available, which may increase the number of procedures and, thus the time in hospital, which may have clinical benefits beyond the outcomes measured in this study. However, if this was the case, it should also apply for *off-hours*, where an associated decrease in LOS trends was shown. The research literature on the so-called "weekend-effect" suggests that weekends and on weekday evenings and night shifts have potential for improvement (22, 23), which could be part of the explanation for the stratified differences. An explanation could be that centralization, thereby reducing resources at fewer sites, making it possible to improve specialized and experienced doctors' staffing. If this was the case, a further decrease in the LOS could be expected since several hospitals reported in 2012 that they still have not achieved the 24/7 presence of the recommended specialties (24). Additional physicians at work in off-hours would probably also reduce the LOS (31) due to the centralization of resources. This explanation is in line with a newly published study showing that reconfiguration is associated with fewer claims about staff competencies, indicating higher presence of specialist care (25).

Changes outside the hospitals may also have affected the results. If the way municipal services receive patients has changed, it could have affected the results both ways. Also, hospitals may have implemented internal changes (e.g., providing training for professional development, such as increasing clinical skills, improving workflows, and ensuring more effective management) to improve efficiency. In this regard, Christiansen and Vrangbæk found that productivity had increased and waiting time for surgery had decreased from 2007 to 2015, considered somatic hospitals as a whole and not acute hospital care alone (13). Thus, it is difficult to make a one-to-one comparison with their results, and the results are not, as such, contradictory. The reconfiguration management has been diverse and has previously been subdivided into different organizational models (26) that have been linked to variation in mortality (27). Variation in results between regions and hospitals is likely to be present in our analyses, but this topic is beyond this paper's scope.

Strengths and limitations

When evaluating a political and structural intervention in a real-world setting, such as the current reconfiguration, the results should be interpreted with caution owing to certain limitations. It was a challenge to determine the actual date for establishing the new organization, and one could argue that considering a single date as the cut-off date to demarcate the periods before and after such establishment is arbitrary. The cut-off dates are based on interviews conducted at each site and were confirmed by the data structure when possible. The individual reconfiguration timelines contained several landmarks (e.g., hospital merger, shared management, new facilities, and training), and their course was homogeneous in nature; hence, a two-period design with a change in trend was selected as the most appropriate impact model for this study. The interrupted time series is a robust quasi-experimental design to evaluate longitudinal effects (20). However, the model establishes an underlying linear trend and does not fully account for a non-linear trend or an accelerated trend. Further, the existence of conflicting results between hospitals is possible. We aimed to examine the nationwide impact; thus, the results should not be interpreted as representative of the individual hospitals. The analysis was based on monthly time points, consisting of a considerable amount of individual data, and thereby formed the basis for the results' excellent precision. Further, changes in the registration practice of hospitalization should be mentioned as a possible limitation. However, we are not aware of whether such changes have been performed systematically. The design we used is generally unaffected by time-stable confounders (28) and combined with the occurring stepped-wedge inclusion, the adjustment for other known interventions, and the inclusion of control hospitals, it reduces the risk that unknown time-varied confounders affect the observed results. The nationwide design, the inclusion of all patients with acute hospital contact, and the use of the Danish personal identification number to link each patient between registries are the strengths of this study.

Implications for policy, practice and research

This study's implications are currently difficult to assess since a change in the LOS should be observed along

with patient outcomes such as mortality and readmissions. For example, a small increase in the LOS can be justified if the extra time is used on diagnostics and the patient outcome correspondingly improves. In this regard, research is merited to shed light on such mechanisms.

Conclusion

In conclusion, our results indicated that the nationwide reconfiguration of acute hospital care in Denmark, on average, has not led to a change in the LOS registered. The results varied according to the time of hospitalization. During nights and weekends, admissions were associated with a decreased change in the LOS, which suggested that the reconfiguration may have affected the hospital's efficiency, especially for admissions within these times.

Contributorship

All authors made a substantial contribution to the work's conception or design; or the acquisition, analysis or interpretation of data. Specifically, SBB, CBM, MBr, and MF conceived the study, SBB and MF processed and analyzed the data, and all authors were involved in the design and interpretation of the data. SBB, MF, and SM designed the statistical analysis plan. SBB drafted the paper, and all authors revised it critically and gave the final approval for publication.

Ethics and other permissions

Under Danish law, observational studies do not require ethical approval (29). The study was approved by The Danish Data Protection Agency (18/31604).

Funding

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Conflict of interests

None

Data availability

According to Danish law, data cannot be shared. The data sources are available for other researchers pending approval from the Danish Health Data Authority.

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Tables:

Table 1 Baseline characteristics comparing acute care patients before vs. after the structural changes in the hospital system

		Total	Before	After	p-value[a]
Number of observations		11,366,992	4,717,745	6,649,247	
Age, median (IQR)		53.0 (34.0, 71.0)	51.0 (33.0, 69.0)	54.0 (36.0, 72.0)	<0.001
Gender	Female	5,554,914 (48.9%)	2,279,234 (48.3%)	3,275,680 (49.3%)	<0.001
	Male	5,812,078 (51.1%)	2,438,511 (51.7%)	3,373,567 (50.7%)	
Of Danish origin	No	1,121,769 (9.9%)	497,761 (10.6%)	624,008 (9.4%)	<0.001

	Yes	10,209,342 (89.8%)	4,203,430 (89.1%)	6,005,912 (90.3%)	
	Missing	35,881 (0.3%)	16,554 (0.4%)	19,327 (0.3%)	
Married	No	6,575,705 (57.8%)	2,759,686 (58.5%)	3,816,019 (57.4%)	<0.001
	Yes	4,755,406 (41.8%)	1,941,505 (41.2%)	2,813,901 (42.3%)	
	Missing	35,881 (0.3%)	16,554 (0.4%)	19,327 (0.3%)	
Income 1000 Euro[c], median (IQR)		28.5 (20.9, 43.4)	28.3 (19.8, 43.4)	28.6 (20.0, 43.4)	<0.001
Education[d]	Low	43,726 (0.4%)	22,152 (0.5%)	21,574 (0.3%)	<0.001
	Medium	8,594,350 (75.6%)	3,583,851 (76.0%)	5,010,499 (75.4%)	
	High	2,089,572 (18.4%)	799,837 (17.0%)	1,289,735 (19.4%)	
	Missing	639,344 (5.6%)	311,905 (6.6%)	327,439 (4.9%)	
Co-morbidity[e]	Low	6,811,854 (59.9%)	2,865,617 (60.7%)	3,946,237 (59.3%)	<0.001
	Medium	3,025,558 (26.6%)	1,234,278 (26.2%)	1,791,280 (26.9%)	
	High	1,529,580 (13.5%)	617,850 (13.1%)	911,730 (13.7%)	

[a] Based on Pearson chi-squared test or Wilcoxon rank-sum test; [c] Include salary, retirement benefits, welfare payments, remuneration, and company profits. The income is price indexed (2015) and converted into euros at a rate of 0.13 euros per Danish krone; [d] Highest completed education: basic school = low, vocational or upper secondary education = medium, greater than upper secondary education and vocational training education = high; [e] Charlson co-morbidity index: Index score 0= low, Index score 1-2=moderate, Index score >2 = high

Table 2 Time ratios for length of stay for the underlying trend, and change in trends related to the reconfiguration of the Danish hospital system and for the mandatory referral period

	Obs.	Unadjusted analyses				Adjusted analyses[b]			
		Time Ratio	95% CI		P-value	Time Ratio	95% CI		P-value
Overall	11,366,992								
Underlying trend		0.968	0.968	0.969	<0.001	0.971	0.970	0.971	<0.001
Change in trend		1.011	1.010	1.013	<0.001	1.001	1.000	1.002	0.10
Weekday/ weekend									
Weekday	7,649,539								
Underlying trend		0.971	0.970	0.972	<0.001	0.966	0.965	0.967	<0.001
Change in trend		1.011	1.010	1.013	<0.001	1.004	1.003	1.005	<0.001
Weekend	3,717,453								
Underlying trend		0.965	0.964	0.967	<0.001	0.980	0.979	0.982	<0.001
Change in trend		1.014	1.012	1.015	<0.001	0.996	0.994	0.998	<0.001
Time of admission									
7 am to 3 pm	5,629,583								
Underlying trend		0.966	0.965	0.967	<0.001	0.962	0.961	0.963	<0.001
Change in trend		1.014	1.012	1.015	<0.001	1.004	1.003	1.006	<0.001
3 pm to11 pm	4,415,989								
Underlying trend		0.961	0.960	0.962	<0.001	0.974	0.972	0.975	<0.001
Change in trend		1.014	1.012	1.016	0.01	0.999	0.997	1.001	0.27
11 pm to 7 am	1,321,420								
Underlying trend		1.003	1.000	1.005	0.026	0.999	0.996	1.001	<0.001
Change in trend		0.999	0.996	1.002	0.437	0.993	0.991	0.996	0.011
Age groups									
18-49 years	5,116,649								
Underlying trend		0.987	0.985	0.988	<0.001	0.988	0.987	0.990	0.654
Change in trend		1.000	0.998	1.001	0,826	0.991	0.990	0.993	<0.001
50-64 year	2,361,771								

	Obs.								
Underlying trend		0.960	0.958	0.962	<0.001	0.966	0.964	0.968	<0.001
Change in trend		1.006	1.003	1.008	<0.001	1.002	0.999	1.004	0.182
65-79 years	2,392,527								
Underlying trend		0.946	0.945	0.948	<0.001	0.950	0.949	0.952	<0.001
Change in trend		1.014	1.012	1.017	<0.001	1.016	1.013	1.018	<0.001
>80 years	1,496,045								
Underlying trend		0.947	0.945	0.949	<0.001	0.950	0.947	0.952	<0.001
Change in trend		1.012	1.009	1.015	<0.001	1.012	1.009	1.015	<0.001
Co-morbidity									
Low 0 points	6,790,526								
Underlying trend		0.983	0.982	0.984	<0.001	0.981	0.980	0.982	<0.001
Change in trend		1.016	1.014	1.017	<0.001	0.997	0.996	0.999	<0.001
Medium 1-2 points	3,026,177								
Underlying trend		0.951	0.950	0.953	<0.001	0.955	0.953	0.957	<0.001
Change in trend		1.014	1.012	1.016	<0.001	1.004	1.001	1.006	0.001
High >2 points	1,550,289								
Underlying trend		0.955	0.953	0.956	<0.001	0.954	0.952	0.956	<0.001
Change in trend		1.010	1.008	1.012	<0.001	1.009	1.007	1.012	<0.001

Table 3 Odds ratios for an overnight stay for the underlying trend, and change in trends related to the reconfiguration of the Danish hospital system and for the mandatory referral period

		Unadjusted analyses				**Adjusted analyses[b]**			
	Obs.	Odds Ratio	95% CI		P-value	Odds Ratio	95% CI		P-value
Overall	11,366,992								
Underlying trend		0.985	0.948	1.023	0.440	0.977	0.962	0.992	0.004
Change in trend		1.001	0.949	1.056	0.978	0.988	0.970	1.005	0.173
Weekday vs. weekend									
Weekday	7,649,539								
Underlying trend		0.986	0.956	1.017	0.376	0.972	0.956	0.988	0.001
Change in trend		1.001	0.958	1.047	0.948	0.990	0.971	1.009	0.284
Weekend	3,717,453								
Underlying trend		0.985	0.936	1.036	0.550	0.988	0.973	1.003	0.104
Change in trend		1.000	0.933	1.071	0.993	0.984	0.967	1.002	0.074
Time of day									
7 am to 3 pm	5,629,583								
Underlying trend		0.974	0.939	1.010	0.150	0.958	0.939	0.978	0.000
Change in trend		1.004	0.951	1.059	0.896	0.990	0.964	1.017	0.483
3 pm to 11 pm	4,415,989								
Underlying trend		0.992	0.941	1.045	0.753	0.996	0.978	1.015	0.707
Change in trend		0.995	0.931	1.064	0.887	0.981	0.959	1.003	0.086
11 pm to 7 am	1,321,420								
Underlying trend		1.006	0.984	1.029	0.609	0.991	0.975	1.006	0.231
Change in trend		1.009	0.978	1.041	0.556	0.996	0.975	1.017	0.697
Age groups									
18-49 years	5,116,649								
Underlying trend		0.994	0.960	1.029	0.720	0.995	0.978	1.013	0.581

|									
Change in trend		0.985	0.941	1.032	0.529	0.976	0.957	0.996	0.019
50-64 year	2,361,771								
Underlying trend		0.976	0.942	1.011	0.176	0.970	0.955	0.985	0.000
Change in trend		0.990	0.941	1.042	0.698	0.991	0.971	1.010	0.348
65-79 years	2,392,527								
Underlying trend		0.966	0.929	1.004	0.077	0.959	0.942	0.976	0.000
Change in trend		0.992	0.941	1.045	0.761	0.998	0.978	1.019	0.868
>80 years	1,496,045								
Underlying trend		0.971	0.935	1.009	0.129	0.964	0.941	0.987	0.002
Change in trend		0.998	0.949	1.049	0.939	1.007	0.983	1.031	0.576
Co-morbidity									
Low 0 points	6,790,526								
Underlying trend		0.987	0.951	1.024	0.485	0.984	0.968	1.001	0.059
Change in trend		1.003	0.955	1.054	0.905	0.986	0.969	1.003	0.110
Medium 1-2 points	3,026,177								
Underlying trend		0.967	0.931	1.003	0.073	0.969	0.946	0.992	0.008
Change in trend		1.003	0.950	1.059	0.913	0.987	0.961	1.015	0.361
High >2 points	1,550,289								
Underlying trend		0.960	0.928	0.993	0.017	0.961	0.942	0.980	0.000
Change in trend		1.004	0.956	1.055	0.865	0.997	0.970	1.024	0.800

Box1: The National Board of Health gave, among others, the following recommendations for the new emergency department:

- The majority of acute hospital admissions are to be conducted through a joint emergency department at the main functional level and via trauma centers at a highly specialized level. (Some patient groups, such as those in labor and those with a stroke and acute myocardial infarction, are to be admitted directly to a special ward.)
- The following specialties should at least be presented on the matrix: internal medicine, orthopedic surgery, surgery, anesthesiology, diagnostic radiology, and clinical biochemistry. (An acute medical specialty did not exist at this time.)
- Diagnostic radiology should at least have specialist doctors on call. Advice from clinical biochemistry and internal medicine should be available: infectious medicine and clinical microbiology.
- Hospitals should secure access to the following facilities: conventional X-rays, CT scans, ultrasound and echocardiography, emergency surgery facilities, laboratory examinations, and clinical biochemistry.
- The catchment population for the new emergency departments should be 200,000–400,000 inhabitants.

Figure legends

Figure 1 (A) Length of stay categorized into five groups by year. The change in the distribution during 2013–2014 is attributed to change in the out-of-hours system in the Capital Region, which is accounted for in the

adjusted analysis. (B) Number of contacts during the study period and related admissions figures presented as median and mean.

A
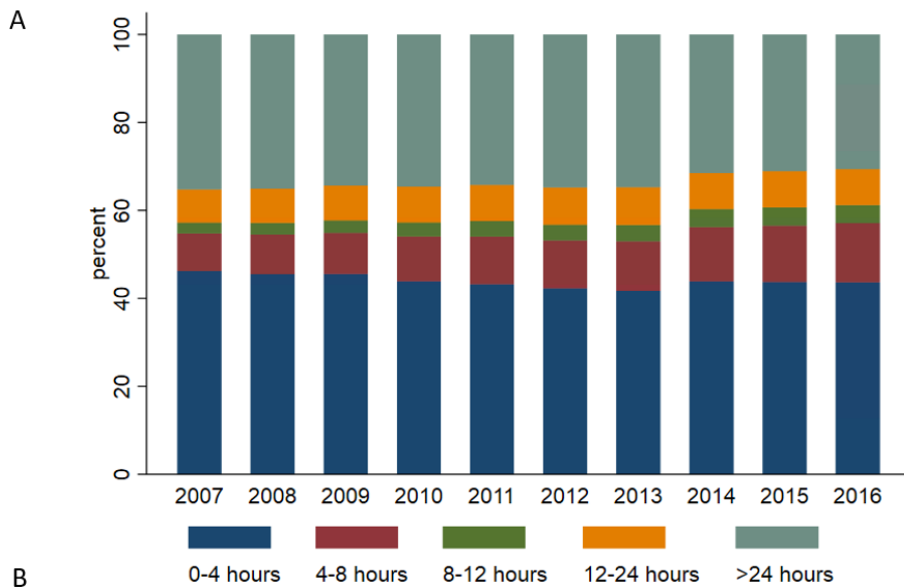
B

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Number of contacts, (thousand)	1,084	1,090	1.123	1.120	1,118	1,093	1,084	1,219	1,213	1,221
Median, (hours)	4.8	5.0	4.9	5.4	5.6	5.9	6,1	5.2	5.2	5.1
Mean, (days)	2.9	2.9	2.7	2.6	2.5	2.5	2.5	2.4	2.3	2.2

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