Admission medical records made at night time have the same quality as day and evening time records

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ABSTRACT

INTRODUCTION: A thorough and accurate admission medical record is an important tool in ensuring patient safety during the hospital stay. Surgeons' performance might be affected during night shifts due to sleep deprivation. The aim of the study was to assess the quality of admission medical records during day, evening and night time.
MATERIAL AND METHODS: A total of 1,000 admission medical records were collected from 2009 to 2013 based equally on four diagnoses: mechanical bowel obstruction, appendicitis, gallstone disease and gastrointestinal bleeding. The records were reviewed for errors by a pre-defined checklist based on Danish standards for admission medical records. The time of dictation for the medical record was registered.
RESULTS: A total of 1,183 errors were found in 778 admission medical records made during day- and evening time, and 322 errors in 222 admission medical records from night time shifts. No significant overall difference in error was found in the admission medical records when day and evening values were compared to night values. Subgroup analyses made for all four diagnoses showed no difference in day and evening values compared with night time values.
CONCLUSION: Night time deterioration was not seen in the quality of the medical records.
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TRIAL REGISTRATION: not relevant.

The admission medical record is a standardised tool for communication between medical personnel concerning important information on patients' previous and current medical status, and the medical plan during the current admission. Moreover, a thorough and accurate admission medical record is an important tool in ensuring patient safety during the hospital stay. Leaving information out or adding incorrect information to the medical record may result in adverse events affecting patients. This has especially been examined for medication documentation, where the agreement of medication lists between primary medical charts and pharmacy records was found to be as low as 64%, which resulted in potentially harmful adverse events [1, 2]. In addition, in malpractice complaints, insufficient medical recording has been the subject of criticism from the National Board of Patients' Complaints (NBPC) in Denmark [3].

Several studies have shown that residents working extended shifts (≥ 24 hours) are chronically sleep deprived and thus make more medical errors and have more attentional lapses at night [4, 5]. Furthermore, they propose a safety hazard to themselves by having increased percutaneous injuries at night [6] and as they are at risk of motor vehicle accidents on their way home from work after shifts [7]. Surgeons' performance has also been assessed after 24 hours of sleep deprivation, showing a marked deterioration post call [8, 9]. Other studies have found no difference in psychomotor performance after a night shift [10], and some even showed improved skills after a night shift [11, 12]. Yet, measuring performance after a night shift, when the surgeons have finished their clinical duty, does not appear relevant, as the on call performance is more important for the patients. To our knowledge, no previous systematic evaluation of the quality of admission medical records has been performed depending the on time of day. The aim of this study was to assess interns' performance in a surgical unit, specifically focusing on the drafting of admission medical records during night shifts in order to evaluate if their quality was maintained when compared with daytime drafting of such records.

MATERIAL AND METHODS

The four diagnoses chosen for the data extraction were mechanical bowel obstruction (including mechanical bowel obstruction due to adhesions), appendicitis, gallstone disease (including cholecystitis and cholangitis) and gastrointestinal bleeding (acute and chronic). We chose these four diagnoses as they are common admission diagnoses at the Department of Surgery and represent the various patient groups at the surgical unit. Patients' medical records were extracted electronically by the discharge diagnosis. The diagnoses were registered in the system with the patients' discharge summary and would represent the primary diagnosis causing the admission. Medical records were extracted for patients over the age of 18 years admitted through the emergency room. Medical records from 2009 were collected prospectively to 2013 until 250 records were included in each category, giving a total of 1,000 medical records. The medical records were not standardised checklists but based on standards and recommendations for ad-
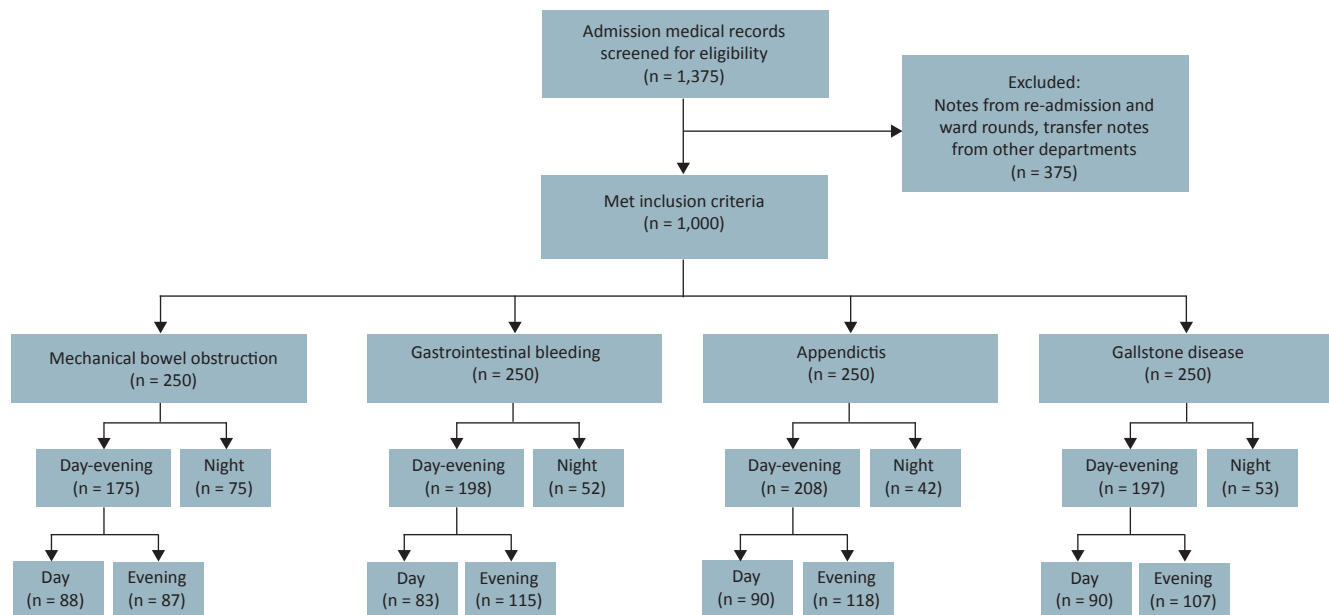
A flow chart showing the inclusion and distribution of admission medical records.


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                    Admission medical records
                     screened for eligibility
                          (n = 1,375)
                               |
                               |──────────────────────►  Excluded:
                               |                          Notes from re-admission and
                               |                          ward rounds, transfer notes
                               |                          from other departments
                               |                              (n = 375)
                               ▼
                      Met inclusion criteria
                          (n = 1,000)
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Mechanical bowel obstruction (n = 250)		Gastrointestinal bleeding (n = 250)		Appendictis (n = 250)		Gallstone disease (n = 250)	
Day-evening (n = 175)	Night (n = 75)	Day-evening (n = 198)	Night (n = 52)	Day-evening (n = 208)	Night (n = 42)	Day-evening (n = 197)	Night (n = 53)
Day (n = 88)	Evening (n = 87)	Day (n = 83)	Evening (n = 115)	Day (n = 90)	Evening (n = 118)	Day (n = 90)	Evening (n = 107)

mission medical records for medical doctors in Denmark [13]. Only full admission medical records were included, whereas notes from re-admissions, ward rounds or admissions to the surgical department of other departments were excluded. The admission medical records were as a standard written by interns.

The admission medical records were reviewed for "error" by a pre-defined checklist, based on typical Danish standards for a full admission medical record [13]. The checklist was used for a dichotomous (yes/no)

The errors in the admission medical records were more likely related to poor education of the interns than to sleep deprivation during night shifts.

evaluation of notes on the following paragraphs in the medical record: allergies, current medication, medical history, systems' review (a review for all organ systems), blood pressure and pulse rate, auscultation of the lungs, cardiac auscultation, evaluation of the abdomen, rectal exploration, and palpation of distal pulses. For all female patients, it was also evaluated if a gynaecological examination was documented in the medical record. For fertile women (defined as women between 18 and 45 years of age), it was evaluated if Human Chorionic Gonadotropin (HCG) in urine was documented in the admission record. If it was noted in the medical record that a woman under the age of 45 was menopausal, she was not considered fertile. We chose the fertile age to be 18 to 45 years as we only wished to include adult patients. Patients under the age of 18 are admitted to a paediatric unit where the standards for admission medical records differ from those used in adults. For medical records registered under the diagnosis of gastrointestinal bleeding, it was registered whether the doctor had decided to do a test for haemoglobin or had noted the actual haemoglobin level. All of the above-mentioned variables had to be mentioned in the medical record as either prescribed or executed variables. Only variables that were not mentioned in the medical record were registered as error; the evaluations were not based on the execution of examinations. If an examination was not relevant, it would be coded as such; for example, it would be irrelevant to measure HCG in women over the age of 45, and

HCG on that particular patient would be coded as not relevant. Additionally, the following data were registered for all medical records: the time of dictation (hourly intervals), weekday of admission, length of admission (number of days) and patient's sex and age.

Ethics and permissions

The Danish Regional Ethics Committee on Biomedical Research evaluated the study and found that it was exempt from approval. The Danish Data Protection Agency approved the collection, analysis and storage of data (ID-number: 2007-58-0015/HEH.750.89-40).

Statistical analyses

The IBM statistical package for social sciences (SPSS, Chicago, IL, USA) version 19.0 was used for statistical analyses. Data were tested for normality using the Kolmogorov-Smirnov test, and were found to be non-normally distributed. Values are presented as median and number (percentages) of errors. We used the Fisher's exact test and the χ^2-test for comparison of dichotomous variables. The Mann-Whitney test was used for comparison between two groups. The Kruskal-Wallis test was used for intergroup comparison. Statistical significance was set at a p-value ≤ 0.05.

Trial registration: not relevant.

RESULTS

In total, 1,375 medical records were scanned for inclusion, of which 1,000 met the inclusion criteria. The included medical records consisted of 250 of each of the four diagnoses: mechanical bowel obstruction, gastrointestinal bleeding, appendicitis and gallstone disease. The medical records were divided into two groups (day- and evening time and night time, respectively) based on time of dictation. Day- and evening-time was defined as 08:00 to 23:59 hours, and night-time was defined as 24:00 to 07:59 hours. A flowchart of the inclusion and distribution of admission medical records is presented in **Figure 1**.

The median patient age was 64 years (573 women). Overall, patients were admitted for a median of two days. The demography of the patients grouped by diagnosis and time of dictation is illustrated in **Table 1**. Errors were presented as the number (percentage) in the categories of the medical records and grouped by the time of dictation in **Table 2**. For blood samples, a significant difference in error was found when day- and evening time values were compared with night time values (p = 0.023). As the total number of medical records (n) differed for the categories gynaecological examination (all women, n = 573), HCG (only fertile women, n = 158) and haemoglobin (n = 250), these data

were presented separately (**Table 3**). However, no significant difference was found when errors in day- and evening time were compared with night time errors.

DISCUSSION

Our study showed that medical records made at night

TABLE 1

Demographic details of the patients grouped by the time of dictation and diagnosis. Values for subgroup analyses age and days of admission are presented as medians. The Mann-Whitney test was used for inter-group comparison, and Fisher's exact test was used for comparison of dichotomous variables.

	08:00-23:59	24:00-07:59	p-value
Medical records in total, n	778	222	–
Mechanical bowel obstruction			
Patients, n	175	75	–
Median age, yrs	70	73	0.081
Female/male, n	92/83	49/26	0.071
Days of admission, n	5	3	0.004
Gastrointestinal bleeding			
Patients, n	198	52	–
Median age, yrs	73	78	0.818
Female/male, n	108/90	27/25	0.757
Days of admission, n	3	3	0.129
Appendicitis			
Patients, n	208	42	–
Median age, yrs	42	44	0.810
Female/male, n	110/98	27/15	0.234
Days of admission, n	2	2	0.202
Gallstone disease			
Patients, n	197	53	–
Median age, yrs	57	50	0.031
Female/male, n	127/70	33/20	0.872
Days of admission, n	1	1	0.293

TABLE 2

Errors in the categories of the medical records on admission, grouped by the time of dictation. The values are n (%).

	08:00-23:59	24:00-07:59	p-value[a]
n[b]	778	222	–
Allergies	12 (2)	4 (2)	1.000
Current medication	28 (4)	5 (2)	0.399
Medical history	18 (2)	5 (2)	1.000
Systems' review	86 (11)	20 (9)	0.392
Blood pressure/pulse rate	42 (5)	11 (5)	0.867
Auscultation of lungs	14 (2)	2 (1)	0.395
Cardiac auscultation	12 (2)	3 (1)	1.000
Abdomen	7 (1)	2 (1)	1.000
Rectal exploration	130 (17)	34 (15)	0.682
Distal pulses	296 (38)	74 (33)	0.208
Blood samples	53 (7)	26 (12)	0.023

a) Calculated by Fisher's exact test.
b) Represents the total number of medical records in the given time intervals.

📋 **TABLE 3**

Errors in the categories gynaecological examination, human chorionic gonadotropin and haemoglobin the medical records, grouped by the time of dictation. The values are n/Nª (%)[b].

	08:00-23:59	24:00-07:59	p-value[c]
Gynaecological examination	351/437 (80)	101/136 (74)	0.149
Human chorionic gonadotropin	84/124 (68)	24/34 (71)	0.837
Haemoglobin	50/198 (25)	11/52 (21)	0.591

a) Represents the total number of medical records for the category in the given time intervals.
b) Presented as a percentage of error per admission in the given time slot.
c) Calculated by Fisher's exact test.

time did not contain more errors than medical records written in the day and evening time. A significant difference was found in the categories "blood samples" for day and evening hours compared with night hours, and a higher percentage of error was found at night. No overall pattern between diurnal variation and error was found.

In studies where chronic sleep deprivation in residents due to 80-100 hours of work per week was combined with extended shifts (≥ 24 hours), a deterioration in performance was seen at night time [4, 5]. In Europe, physicians work 37-48 hours a week averaged over four-week periods, and 17-24 hours consecutively in shifts; and here a similar deterioration has not been documented during night shifts. In our previous study, we found that surgeons' psychomotor performance and cognition was not negatively affected during a night shift [14]. This is supported by a study that measured neurocognitive performance in surgeons during a simulated night shift and found that the brain could compensate for less than 24 hours of sleep deprivation [15]. The present study supports our previous findings [14]. Despite that no deterioration in surgeons' performance was found at night, consistent high error rates were found for the categories rectal exploration, distal pulses, gynaecological examination, HCG and haemoglobin. This suggests that the underlying problem is more of an educational nature than due to reduced cognition following sleep deprivation.

A British study developed a simulated surgical ward environment in order to assess junior and senior surgical trainees [16]. They made three patient scenarios presenting common problems that they expected the surgeons to be familiar with and scenarios were played by professional medical actors. The study concluded that the senior trainees were more thorough in their assessment of the patients as they completed more assessment tasks, whereas junior trainees neglected to note drug prescription errors and issues regarding comorbidities more frequently. Furthermore, significantly more

senior trainees ordered appropriate imaging. In the study, 23 adverse events were identified, with the junior trainees being responsible for 15 events and the senior trainees responsible for eight. The overall results point at juniors making more errors than seniors, probably because of the difference in educational level. This relates to our findings as the admission medical records in our study were mainly written by interns. High error percentages were found in several categories; yet, without diurnal variation. This points towards a low level of education more than to an impact of fatigue during night shifts.

A limitation to this study is that errors were only noted for the admission medical records. The missing data on the patients could have been noted in the medical record by other surgeons on ward rounds; yet, we did not account for these. Additionally, the study did not include an evaluation of the quality of the assessments or examinations made in the admission medical records.

CONCLUSION

Night time deterioration was not seen in the quality of medical records; yet, consistent errors were found across day and evening time and night time in several categories. The errors were more likely related to poor education of the interns than to sleep deprivation during night shifts.

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