

Contents lists available at [ScienceDirect](http://ScienceDirect.com)

International Journal of Surgery

journal homepage: www.theijs.com

Original Research

Impact of a new electronic handover system in surgery

S. Ryan, J.M. O'Riordan, S. Tierney, K.C. Conlon, P.F. Ridgway*

Department of Surgery, University of Dublin, Trinity College, Adelaide & Meath Hospital Incorporating National Children's Hospital, Tallaght, Dublin 24, Ireland

ARTICLE INFO

Article history:

Received 9 June 2010

Received in revised form

29 October 2010

Accepted 23 November 2010

Available online 1 December 2010

Keywords:

Electronic handover

Efficacy

Signout

Surgery

Safety

ABSTRACT

Accurate handover of clinical information is imperative to ensure continuity of patient care, patient safety and reduction in clinical errors. Verbal and paper-based handovers are common practice in many institutions but the potential for clinical errors and inefficiency is significant. We have recently introduced an electronic templated signout to improve clarity of transfer of patient details post-surgical take.

The aim of this study was to prospectively audit the introduction of this new electronic handover in our hospital with particular emphasis regarding efficacy and efficiency. The primary surrogate chosen to assess efficacy and efficiency was length of stay for those patients admitted through the emergency department. To do this we compared two separate, two-week periods before and after the introduction of this new electronic signout format. Users were not informed of the study. Information recorded on the signout included details of the emergency admissions, consults received on call and any issues with regard to inpatients. ASA grade, time to first intervention and admission diagnosis were also recorded. Our results show that introduction of this electronic signout significantly reduced median length of stay from five to four days ($P = 0.047$). No significant difference in ASA grades, time to first intervention or overall admission diagnosis was obtained between the two time periods. In conclusion, this is the first study to show that the introduction of electronic signout post-call was associated with a significant reduction in patient length of stay and provided better continuity of care than the previously used paper-based handover.

© 2010 Surgical Associates Ltd. Published by Elsevier Ltd. All rights reserved.

1. Introduction

Changing patterns of workflow in the hospital setting have highlighted the need for improvements in effective and safe handover of patient details. Financial constraints mean that hospitals are under increasing pressure to maximise efficiency and reduce length of stay of patients in hospitals and to reduce overtime bills for junior doctors. The European Working Time Directive (EWTD) for junior doctors also requires hospitals to comply with the 48 h working week. This means the introduction of a shift-based work practice for junior doctors and subsequently an increased number of handovers between surgical on-call teams.

Continuity of information is imperative in order to reduce clinical risk and maintain high standards of patient safety. Effective handover requires that sufficient and relevant information is transferred appropriately. In 2007, the Royal College of Surgeons in England (RCSE) published guidelines regarding safe handover of patient details.¹ Verbal and paper-based handovers are still

common practice in many institutions but the potential for clinical errors is significant. Electronic handover systems, on the other hand, are suggested to provide better continuity of care than paper-based handover.^{2,3}

To help improve clarity and efficiency of transfer of patient details between surgical teams during handover post-call, we recently introduced a bespoke, low-tech, standardised template that could be used to record necessary patient information and then emailed through the hospital's secure intranet to all relevant staff members. The aim of this study was to prospectively audit the introduction of this new electronic handover approach with particular emphasis regarding its efficacy and efficiency. The primary surrogate chosen to assess efficacy and efficiency was length of stay for those patients admitted through the emergency department. To do this we compared two separate, two-week periods before and after its introduction.

2. Methods

We analysed details of patient admissions through accident and emergency during two separate time periods, each of two week duration, the first corresponding to a period where written paper handover was used ($n = 47$) and the second following the introduction of an electronic handover ($n = 41$). The particular time periods coincided with the changeover of new interns to all surgical teams.

* Corresponding author. Tel.: +353 1 4142213; fax: +353 1 414 2218.

E-mail address: paul.ridgway@amnch.ie (P.F. Ridgway).

The sample size and study time periods were chosen for *pilot* validation. The Accident and Emergency Department in our hospital is a tertiary referral centre seeing over 77,000 patients per year. The department of Surgery comprises six surgical specialities including paediatrics. The total number of surgical emergency admissions per year is 1700.

A standardised template for the electronic handover of patient details was used with recent guidelines regarding safe handover in mind.¹ A mock example is given below (Fig. 1). Specifically, patient name, hospital number, location, age, consultant in charge, time of referral, brief past medical history, presenting complaint, investigation results available, examination findings, differential diagnosis and management plan were detailed. Transfer of information to other surgical staff was achieved using a secure email on the hospitals intranet service. Each participating doctor had their own hospital email account (based only on the hospitals intranet) which was easily accessible. This helped ensure patient confidentiality was upheld. A nominated individual within the department was appointed as account administrator and was able to add or remove group members accounting for the periodic staff changes. The on-call team during each 24-h period (8am–8am) includes a consultant, registrar and SHO. The SHO remains in house throughout the night admitting patients from the emergency department. The registrar is available on call on-site during normal daily working hours and from home after hours. The Senior House Officer (SHO) on call compiled the details of all patients admitted during a full 24 h period on-call into the standardised template as detailed above. This was then emailed to all surgical staff before commencement of the next days shift so that all members of staff were informed prior to start of the next working day. In addition a verbal handover also took place at the start of the next working day to discuss all handover details. The SHO on call was not required to attend the post take ward round. No other formal handover was performed.

The length of stay for all patients admitted during each two-week period was calculated. In addition we compared differences in ASA grades and admission diagnosis to ensure that there were no significant differences in the type or complexity of admissions during the two time periods studied. Finally, we also analysed time to first intervention post admission. We chose CT scanning as the intervention as it was possible to calculate in hours from time of admission to time of scan with accuracy. This radiological investigation is generally available throughout the week as compared to ultrasound for example which is not routinely available during weekends in our hospital. To limit the possibility of Hawthorne effect⁴ influencing our findings on length of stay, such that participants in the study might have improved an aspect of their behaviour being experimentally measured in response to the fact that they were being studied and not in response to any particular experimental manipulation, participating doctors were unaware of the proposed audit intention following the introduction of this electronic handover format in our department.

The particular time periods studied coincided with the changeover of new interns to all surgical teams. Data collated from patients admitted while written paper handover was still used was obtained during the first two weeks of April three months prior to the introduction of electronic handover. We are mindful that a potential bias against the introduction of the electronic handover may have occurred as a result of the timing of its introduction however. Specifically, this took

place during the first week of July, a time period which coincides with introduction of new junior doctors unfamiliar with the hospital so that we may have expected longer patient hospital stay. Nevertheless, the two week control period where verbal/written handover was investigated also coincided with a change of staff. In particular, this involved changeover of intern doctors in the team.

Non-parametric data were analysed using Fisher's exact test for 2 by 2 contingency tables and the Mann–Whitney *U*-test. For parametric data, an unpaired *t* test was used for comparison of differences between means in two groups. Statistical significance was ascribed to a *p*-value of less than 0.05. All data are reported as medians and interquartile ranges unless otherwise stated.

3. Results

We found that following the introduction of the electronic handover there was a significant reduction in median length of stay (Fig. 2, $P = 0.047$) compared with patients admitted during a separate time period where paper handover was used. The median length of stay was reduced from five to four days.

There was no significant confounding difference in patient ASA grade ($P > 0.05$). The admission case mix was also analysed for confounders. We separated admissions into 6 categories. These included gastrointestinal (GI) neoplasms, appendicitis, Upper/Lower GI conditions (pancreatitis, acute cholecystitis, biliary colic, diverticulitis, bowel obstruction/perforation), vascular, trauma, and others (gynaecology, non-specific abdominal pain (NSAP), abscess/cellulitis). The only significant difference between admission diagnosis was that for gastrointestinal (GI) cancers where there was a significantly greater number admitted during the period where paper handover was still being utilised compared to that following the introduction of electronic handover (Fig. 3, $P < 0.05$). However when these patients were removed from the data interpretation, median length of stay remained significantly shorter following introduction of electronic handover.

Finally, there was no significant difference in the time taken to obtain the first intervention (Fig. 4) when both time periods were analysed before and after the introduction of the electronic handover ($P = 0.059$, 21.2 ± 10.3 versus 28.2 ± 7.8 h (mean \pm SEM)). Of the 47 admissions pre-introduction of the electronic handover, eight patients required CT scans (17%) whereas 24% obtained a CT scan following its introduction (10 of 41 patients).

| | |
|---|---|
| DATE: 21/12/12 | |
| TEAMS On Call: | |
| General Consultant Surgeon: Mr PFR | |
| Vascular Consultant Surgeon: Prof ST | |
| Senior Registrar: Mr M S | |
| SHO: Dr S R | |
| STATS: | |
| Patients brought to Theatre: | 2 |
| A&E admissions: | 7 |
| Consults In-house: | 5 |
| Ward issues: | 4 |
| A&E ADMISSIONS: | |
| 1. J Smith , 82yr old, MRN: 666110, Ward: Gogarty Bed: 4-4, Consultant: Mr PFR | |
| Paged 17:45, Seen 18:15, Plan 19:20 | |
| Background: dementia, Hx of diverticulosis. | |
| Presenting Complaint: Transferred from nursing home for knee and abdominal pain of unclear duration. | |
| Investigations: CXR read by staff radiologist as ?free air. WCC 43, CRP 230. | |
| On Examination: hypotensive, Abdomen rigid. | |
| Impression: Bowel Perforation | |
| PLAN: Resuss, Theatre, cipro/flagyl iv antibiotics. | |

Fig. 1. Mock example of templated email handover details.

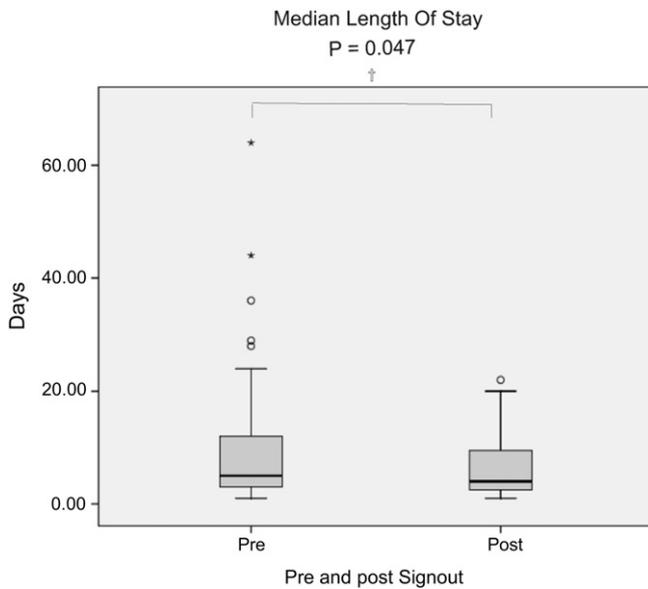


Fig. 2. Box-plot graph and quartile ranges for median length of stay. Graph shows the median length of stay (horizontal shaded bar) and quartile range together with outliers in each group for the two week period paper handover was used (pre-signout) and that during a second two week period in July following the introduction of electronic handover (post-signout). († indicates a statistically significant difference).

4. Discussion

The results from this study support the use of electronic handover to improve efficiency of patient information transferred between doctors. Furthermore, it supports the continued use and development of this electronic format for handover particularly as it serves as a user-friendly, low-cost, efficient means of transfer of patient details among staff post-call leading to better continuity of care for patients. Importantly, this is the first study to show that use of electronic handover is associated with a significant reduction in patient length of stay. This is despite the pilot nature of this investigation.

Traditionally, verbal communication of handover details has been common practice often supported with the use of hand-written

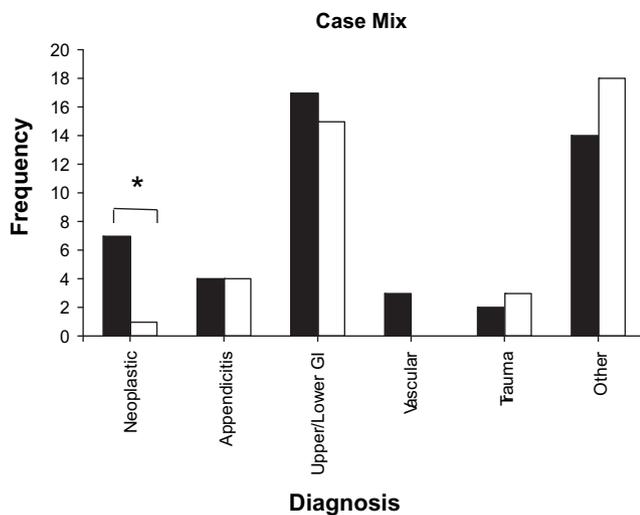


Fig. 3. Case mix of admissions pre- and post-signout. Graph showing case mix of admissions from the emergency department. The open columns represent admissions during a two week period in July following introduction of the electronic handover. The filled columns represent admissions during a two week period in April during which paper handover was used. * indicates statistically significant difference ($P < 0.05$).

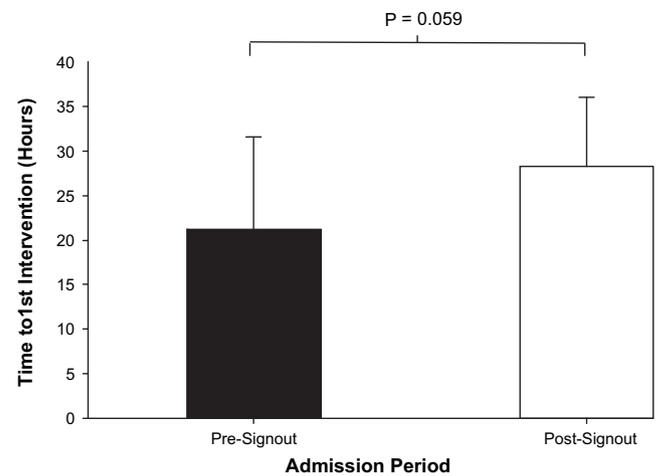


Fig. 4. Time to first intervention pre- and post-signout. Graph illustrating the time in hours (mean \pm SEM) to CT scan post admission. The open columns represent admissions during a two week period in April during which paper handover was used. The filled columns represent admissions during the first two weeks following introduction of the electronic handover.

notes. Many of us would accept that this mechanism is far from ideal as important information may not be transmitted consistently or legibly and represents a real risk to our patients' quality of care. An electronic handover system represents a potential solution. The Royal College of Surgeons of England recently published guidelines¹ with regards minimum handover requirements in order to convey high quality clinical information and allow for the safe transfer of responsibility for patients. Following the 2004 Hospital at Night pilot studies covering four NHS trusts⁵ it was recommended that handover could be enhanced if it was more IT driven. In support of this, Raptis et al¹ demonstrated that electronic handover provides better continuity of care than paper-based handover. Stimpson et al³ showed that the introduction of electronic handover using secure email resulted in improved handover consistency and helped to prevent miscommunication. Others have shown, however, that electronic handover using a system requiring input of free text entry was associated with occasional deficiencies in important handover information and recommended that the use of prompts or pre-defined fields for information provision may further minimise inadequate information transfer.⁵ We feel our templated format is a good medium between the rigid nature of prompted entries and the loose nature of free text. The delivery to the care practitioner is an essential point. We feel that without this the system would not be used. Therefore, login sites where the practitioner has to go to search for the information would negatively bias this form of information transfer.

To date it has not been shown whether improvements in quality of information transfer at handover translates into more effective and efficient management of patient care. The present study is the first to demonstrate a significant reduction in patient length of stay following the introduction of electronic handover. These results could not be explained by differences in ASA grades or admission diagnosis as we found no significant difference between groups for either of these potential confounders. It is noted that our patient groups consisted of some outliers, particularly those in the GI cancer groups with associated individual longer lengths of stays. Although the reduction in length of stay remained significantly different when these patient groups were removed from the analysis, it may be warranted in future studies of this new handover system to include larger sample sizes to elucidate this point. We also examined whether improved patient handover may have resulted in quicker and more efficient planning of in-patient care.

Specifically, we assessed the time taken to obtain first radiological investigation and hypothesised that a reduction in time to first intervention may contribute to a reduction in length of stay. We found, however, no significant difference in time to first intervention between the two groups studied. It is noted that the low number of CT scans obtained in both groups may have accounted for failure to detect any significant difference and it is a limitation of the current work that results are based on a pilot study looking at a limited time period following the introduction of the electronic handover. Nevertheless, given the timing of introduction of the electronic handover during the first two weeks in July, a time period which coincides with introduction of junior doctors unfamiliar with the hospital, we may have expected longer patient hospital stay. We are also mindful that length of stay in hospital for surgical patients is impacted by many different factors such as complications, social circumstances and disease severity. With regards the latter, we have shown no significant difference in overall admission diagnosis between groups. Nevertheless, the increased clarity and consistency of handover information post-call resulted in each team member having ready access to review reliable, accurate and pertinent details regarding new patient admissions including diagnosis and management plan together with results of preliminary investigations performed already during the period of on-call and detailed on every handout post-call. This led to a clearer and early understanding of the management plan required for each patient by each member of the team. Our data thus far, however, does not allow us draw robust conclusions with regards this and further study is required to examine specifically which factors may have contributed to our findings.

The need to maintain continuity of patient care and reduce risk for potential clinical errors is particularly relevant given the recent introduction of the EWTD with the move towards shift patterns, thereby increasing the number of different individuals caring for patients and subsequently an increased potential for error. As a result of such measures, the provision of comprehensive and efficient communication of patient details at handover is increasingly important. The handover format used in the present study

required SHO doctors on call to list their differential diagnosis for each patient admitted. Although, not specifically addressed in our analysis, this requirement has the potential to be utilised as an important teaching tool whereby feedback from seniors including admitting consultant and affiliated registrars could be made to SHOs regarding their admitting diagnosis on call, how that conclusion was made, and comparing this to the actual diagnosis for each patient.

In conclusion, accurate post-call doctor-to-doctor handover is vital to protect patient safety. Our findings support the used of templated electronic handover as an enhancement of efficient transfer of patient details. To our knowledge, this is the first study to show that the introduction of electronic signout post-call was associated with a significant reduction in patient length of stay.

Conflict of interest

None declared.

Funding

None.

Ethical approval

None.

References

1. The Royal College of Surgeons of England. *Safe handover: guidance from the working time directive working party*. London: RCSE, <http://www.rcseng.ac.uk/publications/docs>; 2007.
2. Raptis DA, Fernandes C, Chua W, Boulos PB. Electronic software significantly improves quality of handover in a London teaching hospital. *Health Inform J* 2009;**15**(3):191–8.
3. Stimpson P, Joshi A, Oakley R, Simo R. Surgical Handover: aspiring to easy access without breach of patient confidentiality. *Clin Otolaryngol* 2009;**34**:83–4.
4. Adair G. The Hawthorne effect: a reconsideration of the methodological artifact. *J Appl Psychol* 1984;**69**(2):334–45.
5. Cheah LP, Amott DH, Pollard J, Watters DAK. Electronic medical handover: towards safer medical care. *Med J Aust* 2005;**183**(7):369–72.
6. MacDonald R, Eccles S. The hospital at night. *BMJ Career Focus* 2004;**328**:19.