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Improving Medical Handover Using a Structured Handover Algorithm

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ABSTRACT

Introduction:
Handover is an important part of clinical practice and its failure is a major preventable cause of patient harm. With increasingly varied work patterns for all healthcare professionals, ensuring good and effective handover is paramount. Guidance has been created to highlight key handover principles. However, clinical surveys show wide variability between hospitals with limited or no defined handover processes.

Materials and Methods:
A single-centre quality improvement project with the implementation of a structured handover algorithm was performed, over five successive Plan-Do-Study-Act (PDSA) cycles. The inclusion of key elements identified in the literature as being important for effective handover were measured. These elements were assessed and monitored after the implementation of the structured handover algorithm and further interventions, including direct algorithm demonstration and change of handover location, as part of sequential PDSA cycles, following medical team (consultants, junior doctors and specialist nurses) consensus.

Results:
The baseline assessment of the hospital's handover processes showed them to lack key handover elements. Through the introduction of the handover algorithm, the handover process improved significantly. Following the interventions all but two key handover elements were present in 100% of handovers with the two further elements present in at least 75% of handovers. These findings were sustained over five successive PDSA cycles.

Conclusion:
A structured handover algorithm improves handover practice. The structured framework of the algorithm acts as an aid, avoiding key elements from being missed and imprinting them into routine handover practice. The improvement methodologies and interventions of this study can potentially benefit further clinical settings and be adapted accordingly.

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Introduction

Handover is the system by which care is continued by transferring responsibility and information between healthcare professionals. The handover system aims to ensure patient safety and continue effective management in the out-of-hours periods. With increasingly varied work patterns and rotas for all healthcare professionals, the importance of handover is paramount. The failure of handover has been identified as a major preventable cause of patient harm (1). Poor or incomplete handover has been identified as the most common handover scenario resulting in patient incidents and this is more commonly seen at the time of shift change (2). In addition, in successive General Medical Council (GMC) national training surveys (2013, 2014) focusing on patient safety outcomes, handover was highlighted as an area of concern for junior doctors (3,4). As a result, several studies and improvement projects have been undertaken to improve handover with many focusing on improving its effectiveness, through structural changes or introducing innovation, in the out-of-hours periods, especially on weekends (5,6). Furthermore, professional bodies, including the Royal College of Physicians (RCP), have created guidance to highlight several key elements to integrate into good handover practice (1). Key elements of good and effective handover are suggested to include defining leadership responsibility, defining responsibility for ongoing care, recognition of unstable and unwell patients and improving efficiency of patient management (1).

Effective handover can reduce delayed decision-making, reduce repetition of tasks and investigations and improve treatment and communication. However, clinical surveys have highlighted that there is wide variability in the handover structures used at different hospitals and with some hospitals having no defined handover process (1). To reduce variability and standardise handover practice, standardised proformas and checklists have been suggested to complement the standardised communication between healthcare professionals (i.e., Situation, Background, Assessment, Recommendation and Read Back – SBAR-R). These standardised proformas have been developed and shown to be effective when focusing on the weekend handover (8,9). However, little evidence is available on whether standardised handover proformas used at the change of medical shifts improve handover practice.

This quality improvement project was undertaken following a clinical audit focusing on medical handover practice performed at Basildon and Thurrock University Hospital (BTUH). This audit showed a wide variation in handover procedures adopted during medical handovers and all handovers being performed at a less than acceptable standard of clinical practice, as set out in the guidance and key elements of handover highlighted.

This project aimed to improve the structure and content of the medical handover by introducing a standardised handover algorithm encompassing key elements of handover. The aim was to enable the algorithm, including all the key elements, to be used in 100% of medical handovers (mornings and evenings) within a six-month period.

Material and Methods

Study setting, design and participant characteristics

This quality improvement project was undertaken at Basildon and Thurrock University Hospital (BTUH), a district general hospital located in Essex, UK. It has 637 inpatient beds and around 62,000 medical admissions per year. There is a wide variety of medical specialties and specialist services provided by the hospital. This leads to a busy working environment for the general medicine division. The medical team has a morning and evening handover which is attended by all junior doctors working the on-call shifts covering new medical admissions and the medical wards. It is also attended by the critical care outreach team/nurses (CCOT) to aid earlier identification of unwell patients who have been highlighted to them separately. The morning handover was performed in the acute medical unit office at 8am and the evening handover was performed at 8.30pm in a meeting room in the accident and emergency (A&E) department. The

handover was traditionally led by the on-call medical registrar and involved the handover of duties and tasks from one on-call team to the next. The quality improvement team consisted of two junior doctors and two lead consultants who had previously been involved in handover interventions at the Trust. A baseline clinical audit of the handover structure was performed in July 2019 by a single assessor, prior to the quality improvement intervention. This audit evaluated the handover content and structure and key elements identified in the literature for good and effective handover which were defined as team introduction, review of cardiac arrests and acute presentations, handover of patients from the admission team and remaining admissions to clerk and handover of remaining tasks from medical admissions team and ward teams. Following the baseline audit, the quality improvement team initially met weekly to develop the handover algorithm, encompassing the key elements previously highlighted. After the handover algorithm was implemented in September 2019, successive Plan-Do-Study-Act (PDSA) cycles were undertaken every month to evaluate the integration of these elements from the interventions discussed in detail below. The quality improvement team met fortnightly to monitor the outcomes from the PDSA cycles and to pool together the feedback and ideas generated by the medical team, which included the medical consultants, junior doctors and specialist nurses (critical care outreach team – CCOT), and to plan subsequent interventions, as detailed below. Summaries of the outcomes regarding the integration of important handover elements from PDSA cycle interventions were provided as feedback to the on-call medical team enabling two-way feedback to plan further interventions. These were circulated electronically (by email) to all members of the medical team in the hospital. This feedback, together with on-call medical team feedback, was also integrated as part of planning the intervention strategy. Furthermore, when reporting this manuscript, the Standards for Quality Improvement Reporting Excellence 2.0 guidelines were followed (10).

Interventions

The structured handover algorithm was developed using knowledge of the current on-call teams involved in medical handover and the key elements identified in the literature. This intervention, as part of the first PDSA cycle, involved introducing a structured handover algorithm to be used in the morning and evening handovers (Fig1).

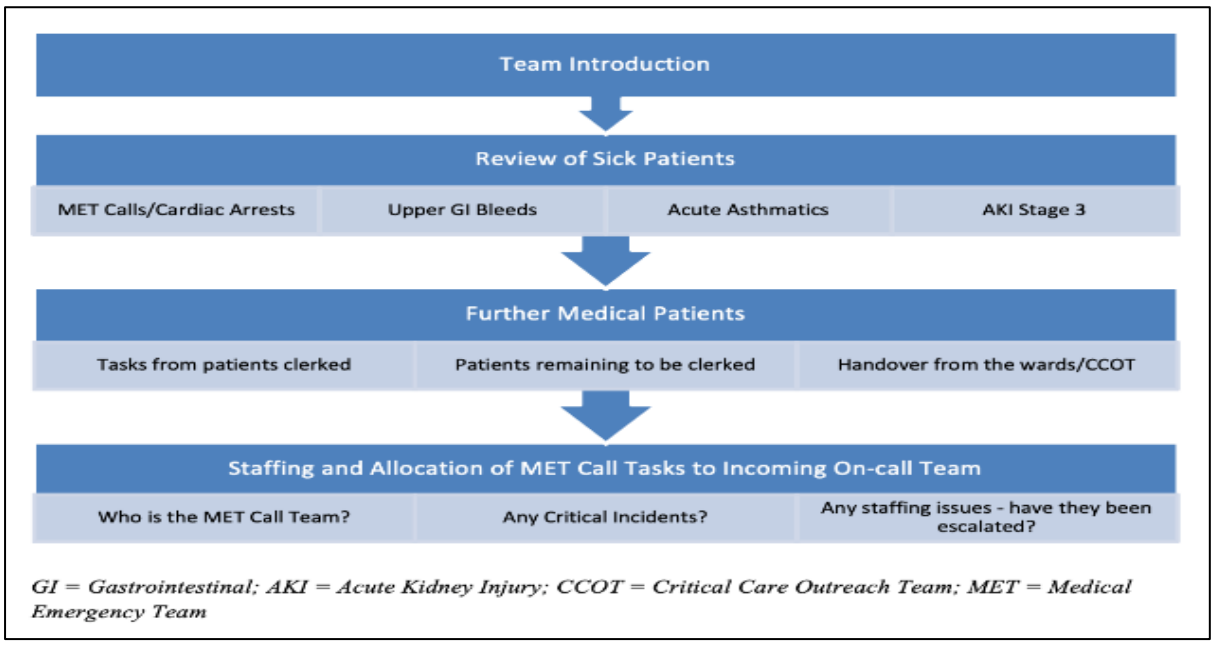

Fig 1: Standardised Handover Algorithm

This algorithm was printed and laminated in A3 size and placed in the areas where morning and evening handovers took place. This algorithm was also circulated by email to all general medicine junior doctors and consultants to increase awareness of the intervention and involve key members of the handover meetings. This was introduced after a period of consultation resulting in a month gap before implementation and prior discussions with medical registrars, who led handover routinely, being incorporated which enabled this intervention to be more likely to be embraced to improve handover practice.

In subsequent PDSA cycles, follow-up interventions to improve the effectiveness of the initial introduction of the structured handover algorithm were introduced by the quality improvement team, guided by outcomes from previous cycles and feedback received. These aimed to complement the structured handover algorithm. These are detailed below and summarised in Fig2.

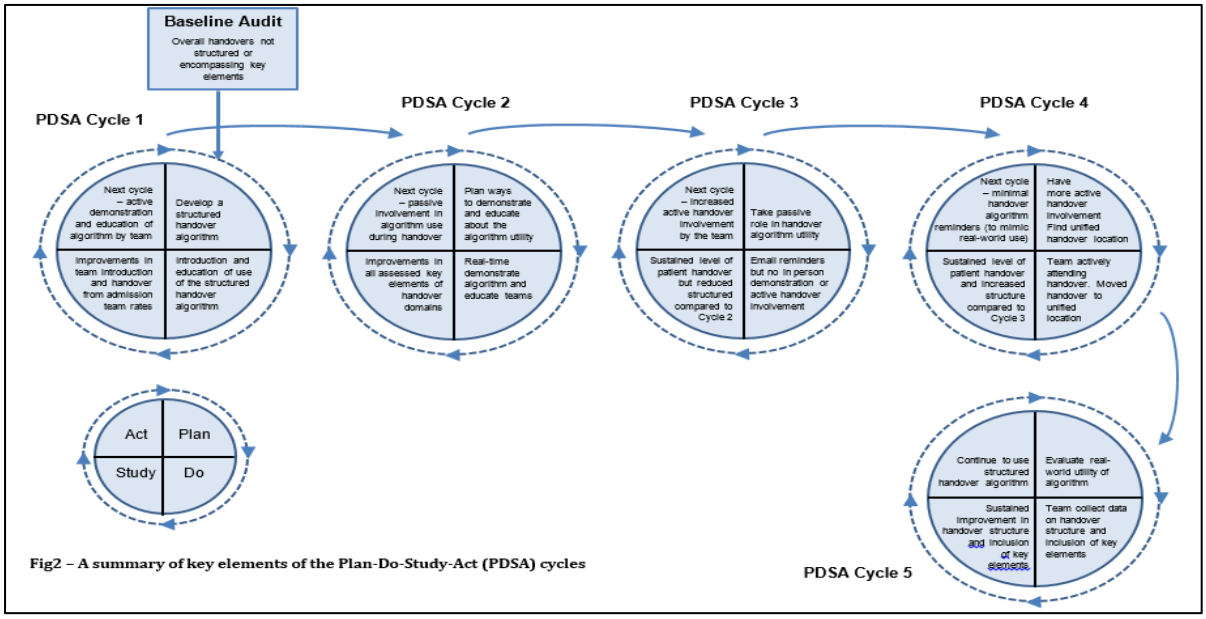

Fig 2: A summary of key elements of the Plan-Do-Study-Act (PDSA) cycles

The second PDSA cycle intervention was the active demonstration of utility of the handover algorithm during a selection of handovers performed by the quality improvement team, who subsequently led the respective handover session. These were performed in real-time during the handover session for the respective morning or evening handover sessions. This education intervention was performed outside the assessed periods. This enabled real-time troubleshooting with the on-call team and demonstration of the algorithm's utility in clinical practice. These sessions, together with active discussion with members of the on-call team, enabled intervention engagement to be assessed and generate potential ideas for further interventions, with active buy-in from the clinical team.

In the third PDSA cycle, the quality improvement team had a passive role in handover with email reminders of the structured handover algorithm to be used but no active demonstration and involvement in handover. In the fourth PDSA cycle, the intervention involved the active involvement of the quality improvement team in handovers to remind the team of the use of the structured handover algorithm. The relocation of the handover meeting to a single room for both morning and evening handovers was undertaken as a further complementary intervention. This change in location was a change from two separate rooms in different parts of the hospital being used for the morning and evening handover sessions to a single unified location for both handover sessions. The use of a quiet room with appropriate IT resources and capacity for all the on-call team was an important aspect of the intervention and improved resources and facilities from the previously

used handover rooms. In the fifth and final PDSA cycle, the real-world utilisation of the handover algorithm was assessed with the quality improvement team passively collecting data on the key elements of handover, as performed in all PDSA cycles, with no involvement in processes or reminders of the use of the handover algorithm.

Data collection, outcome measures and analysis

To standardise measurements for the quality improvement project, key elements of handover were stipulated prior to the baseline measurement being collected and these were carried throughout the quality improvement project. The key elements were based on important areas identified in the literature and were included in a proforma to evaluate handover practice.

These key elements were team introduction, review of cardiac arrests, review of acute presentations (i.e., acute upper gastrointestinal bleed, acute asthma exacerbation and acute kidney injury stage 3), handover of patients and tasks from those reviewed by the on-call admissions team, handover of patients remaining to be clerked, handover from the on-call ward team and allocation of the medical emergency team (MET) call tasks. The proforma enabled real-time recording in both morning and evening handovers and to determine whether these key elements were included in the handover process. These were recorded as either 'performed' or 'not performed'. Additional observations and remarks were noted in a comments section on the proforma to help guide further improvement.

Furthermore, after the interventions, an anonymous questionnaire was completed by participants of the medical handovers to evaluate the perception of the interventions and identify further areas to drive improvement. A baseline measurement was performed over seven successive days in July 2019 to gain an understanding of the handover procedure and elements encompassed within it, prior to intervention. Subsequent data for the quality improvement project was collected from September 2019 in PDSA cycles performed at monthly intervals during predetermined periods set out by the project team. The general medical teams involved in handovers were blinded to the data collection. The data was collected using the proforma created to evaluate handover practice. All handover data collection was performed by a single assessor. Analysis of the data was performed by a single assessor who had not partaken in data collection within handover sessions. Data was collected on separate run-charts for each of the key elements identified and hence outcomes were tracked against the baseline and subsequent PDSA cycle outcomes. The presence of each key element was included as a proportion of the number of both morning and evening handover sessions in that period of data collection.

Results

Following the introduction of the structured medical on-call handover algorithm significant improvements were noted in the elements identified as key to effective handover. The findings are summarised in Table 1 and Fig 3.

Table 1: The proportion of handovers encompassing key elements

Handover Element	**Baseline (n = 14)**	**Cycle 1 (n = 8)**	**Cycle 2 (n = 8)**	**Cycle 3 (n = 8)**	**Cycle 4 (n = 8)**	**Cycle 5 (n = 8)**
Team Introduction	0%	50%	100%	75%	88%	100%
Review of Cardiac Arrests	7%	0%	75%	63%	100%	75%
Review of Acute Presentations*	0%	0%	100%	63%	75%	75%
Handover of Patients from On-call Admissions Team	93%	100%	100%	100%	100%	100%
Handover of Patients Remaining to Clerk	71%	100%	100%	100%	100%	100%
Handover of Remaining Tasks from Patients seen by Medical Admissions Team	79%	100%	75%	100%	100%	100%
Handover from Ward Team	86%	75%	100%	100%	100%	100%
*Acute presentations included upper gastrointestinal bleed, acute asthma exacerbation or acute kidney injury stage 3 as set out in the standardised handover algorithm. n = number of handovers (including morning and evening handover sessions)						

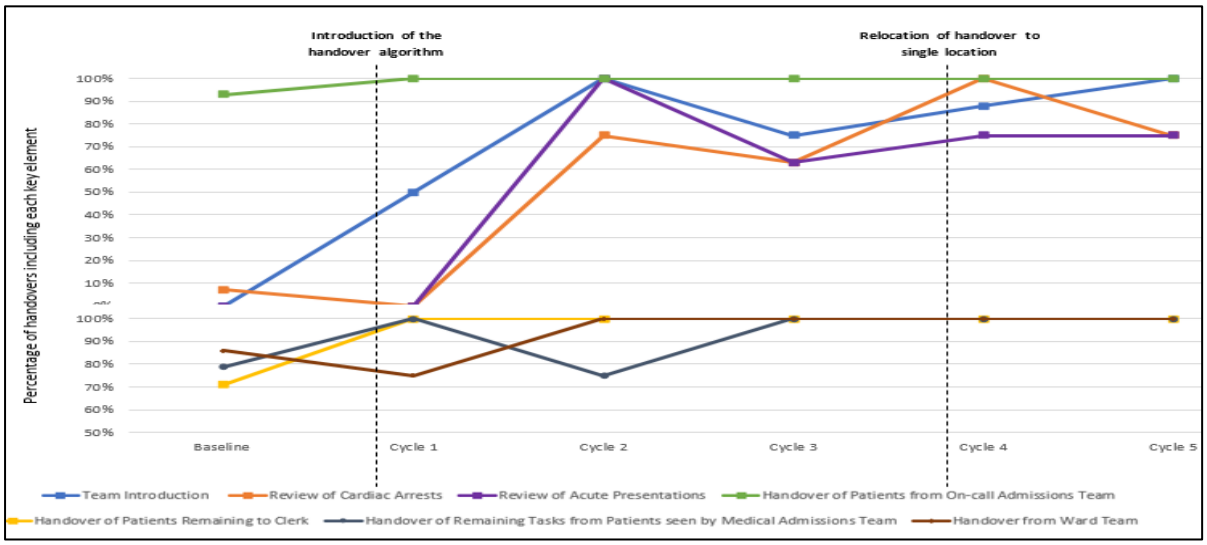

Fig 3: Run Charts of Inclusion of Key Handover Elements with Key Interventions Highlighted

The most significant improvement noted was team introductions being performed at the start of medical on-call handovers.

Before the algorithm was introduced none of the handovers, both mornings and evenings, had formal team introductions performed (with names and roles), but post-intervention all the handovers had team introductions performed. This was initially improved with the introduction of the structured handover algorithm and improved further with reinforcement from the quality improvement team in PDSA cycle 2. This improvement was maintained throughout the subsequent PDSA cycles and sustained in PDSA Cycle 5 when there was limited quality improvement team input, aiming to mimic the real-world use of the handover algorithm. Prior to the intervention, elements of formal handover from the medical admissions team and wards were noted to occur in nearly all handover meetings, 93% and 86% of handovers, respectively. However, as observed these were not structured or complete. On the breakdown of handover content, 71% of patients remaining to clerk and 79% of remaining tasks for patients seen by the medical admissions team were handed over. A reduced proportion of morning handovers (57%) incorporated handover of remaining tasks from the medical take. Handovers from the wards occurred in 71% of the morning and 100% of the night handovers. After the introduction of the handover algorithm, all handovers included the handover of patients from medical take and wards with no variation between morning and evening handovers. These findings were seen in the outcomes from PDSA cycle 1 and cycle 2 and were maintained in subsequent PDSA cycles. There were notable differences between morning and evening handovers including the key elements highlighted (Fig4).

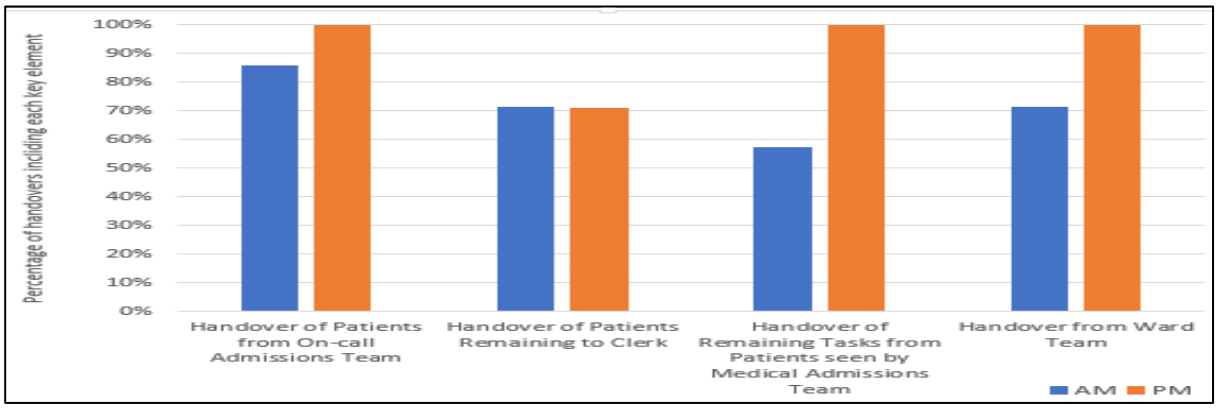

Fig 4: Graph showing some notable differences between morning and evening handover at baseline

The evening handovers were found to maintain sustained improvement compared to morning handovers. This was notable as from PDSA cycle 3 and onwards all the domains were included except for team introduction for two of the handovers in PDSA cycle 4. This contrasted morning handovers where there were significant improvements from baseline, but this improvement fluctuated between 25% and 100% in early PDSA cycles. Subsequently, at the end of the period studied all but two domains had achieved inclusion in 100% of morning handovers. The two domains which did not achieve this were the review of cardiac arrests and the review of acute presentations. There was an initial focus on optimising night handovers which may attribute to these discrepancies and the morning and evening handovers being performed in the same location appears to have a role in the improvement.

A larger proportion of patients at risk of deterioration were highlighted with the use of the new algorithm. These included patients presenting to the hospital or on the hospital wards with upper gastrointestinal bleeding, acute asthma exacerbation, acute kidney injury stage 3 or medical emergency call (including cardiac arrest). At the last data collection period, 75% of handovers included the handover of these clinically important patients. However, there was limited engagement noted in allocating medical emergency tasks between members of the on-call team with some periods of improvement noted but not sustained.

The post-intervention survey received 18 responses reflecting all parts of the medical on-call team, including foundation doctors, core medical trainees, specialty doctors and medical registrars. It found 94% of respondents expressed a preference for the new handover system. Furthermore, on evaluation of Likert scale responses in the survey, 67% of respondents expressed the structured handover algorithm to be 'very useful' and 27% of respondents expressed it to be 'useful'.

It was also noted that 94% of respondents expressed a preference for morning and evening handovers to be performed in the same room with appropriate resources available.

Discussion

This project aimed to ensure key elements were included in handovers and for this, the project was successful in achieving its aims. Providing a structure to the handovers ensured these elements were covered in turn, significantly reducing handover content variability and enabling all members of the medical on-call team to contribute accordingly. It was embraced by the junior doctor cohort and 94% of all junior doctors across all training grades expressed a preference for the structured handover algorithm implemented. Furthermore, the interventions implemented during the project appear to have had a synergistic impact to achieve the aim of improving handovers. In addition to the structured algorithm introduced, ensuring the location for morning and evening handovers was unified was important and showed a positive impact in the subsequent PDSA cycles (PDSA cycle 4 and 5), particularly in morning handovers. This change in location to a designated room, which was quiet, had appropriate IT resources available and capacity for all the on-call team and allowed for a better environment and setup from which to conduct the handover. Following the change in handover location, 94% of junior doctors surveyed expressed a preference for the new handover location. As a result, it is important to choose an appropriate designated handover location to enable an effective handover system to be implemented.

Initially, some resistance was met regarding following a 'prescribed' structure and this was reflected in the PDSA cycle 1 results. With the further engagement with the individuals leading handovers, particularly medical registrars, this was reduced. The resistance is often due to junior doctors coming from a range of different hospitals and having personal preferences on how handovers should be conducted and hence resulting in handover leader-to-leader variation. One notable finding in the baseline measurements reflecting this was a distinction between the patient being handed over and the task specific to that patient being handed over, for example, follow-up of pending chest x-ray for an unwell patient. This was often due to

different junior doctors taking handover for different elements of patient care and had the potential to increase the chances of the task being missed. These were subsequently combined in the algorithm and no distinction was noted after this intervention. It was important to engage these individuals to explore concerns and explain the aim to create a standardised system, rather than limit the personalisation of handovers. Additionally, junior doctors tend to rotate more and hence having more senior doctors conducting and engaging in the handover enables greater implementation and sustainability of changes. As noted in handovers during this project, the key elements were core to the handovers, but individual elements were added depending on the handover leader, for example, reviewing the hospital observation system to identify and highlight unwell patients in the hospital.

A further lesson noted through successive PDSA cycles was the importance of active algorithm implementation initially to aid education and demonstrate utility. It was noted through consecutive cycles that it took a few cycles for the intervention to become imprinted and 'second nature', especially if different from previous operational procedures. However, once this was achieved the improvement team could take a more passive role and monitor the outcomes of the interventions and the success of implementing the key handover elements.

An interesting observation was noting the differences in morning and evening handovers adopting elements included in the structured algorithm. This has similarly been observed in a Canadian study where it was reported that 40.4% of clinically important issues were omitted when handing over to the daytime team (11).

Traditionally, night handovers have been more structured with greater time spent on them. Through intervention, there was an improvement in morning handover structure and content, but this was less than that for corresponding night handovers. This is potentially due to there being a short time period (1 hour) between morning handovers and the 'regular' ward teams being available to manage potential issues on the wards and this concept needs to be further explored and addressed in future PDSA cycles. Nevertheless, this study highlights that the structured framework of the algorithm removes the inter-user variability enabling consistent content between handovers.

One element which met resistance was the allocation of medical emergency roles. This may be because traditionally in the hospital these roles are being allocated at the time of the medical emergency (including cardiac arrest). This role allocation has been shown to be one of the elements of top-performing resuscitation teams and emphasised in national resuscitation guidelines and this will need to be further explored to enable continued improvement of the handover system (12,13). A limitation of this project is that a small sample size of 8 handovers (4 mornings and 4 evenings) was evaluated over each 1-month period. Despite the consecutive days chosen and the handover teams being blinded, the number of handovers is a small fraction of the total number of handovers undertaken during the assessment period. A further limitation is that a single site was used for this study and evaluation at further sites in the future would be beneficial. This quality improvement project reflects the findings in previous publications of interventions to improve weekend handovers in which new systems or interventions were implemented (6,8). However, so far there have been a limited number of projects demonstrating the utility of a structured handover, with an example that can be translated easily to other hospitals or medical environments until now (5).

Conclusion

Handover is an essential part of medical practice and if ineffective it has the potential to cause patient harm. As a result, guidance has been created to highlight key principles to ensure a good and effective handover. This project demonstrates that a structured handover algorithm is a practical way to integrate and uphold these key principles of handover in clinical practice and ensure effective and accurate handover. In this project, repeated PDSA cycles demonstrated this handover algorithm was easily integrated into routine handover practice, the improvements were sustained and

handover-to-handover variations were reduced. These significant findings have been shared throughout the hospital and the algorithm has become integral to handover practice in the hospital and continued to be used throughout the Coronavirus Disease 2019 (COVID-19) pandemic. These improvements to methodologies and interventions could benefit further clinical settings and could be adapted accordingly. Further work is required to assess the algorithm's wider potential. To sustain the improvement, a handover champion has been appointed to monitor handover effectiveness and continue to drive improvements in the handover process.

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