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Improving wound swab collection in paediatric patients: a quality improvement project

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ABSTRACT

Microbiology sample swabs may be unsuccessful or rejected for a variety of reasons. Typically, errors occur in the preanalytical phase of sample collection. Errors with collection, handling and transport can lead to the need to repeat specimen collection. Unsuccessful specimens contribute to delays in diagnosis, increased patient stress and increased healthcare costs. An audit of sample swabs from London Health Sciences Centre Children's Hospital from August through October 2021 yielded complete success rates of 100% for ear and eye culture swabs, 98.1% for methicillin-resistant *Staphylococcus aureus* swabs and 88.9% for wound swabs. This project aimed to improve wound swab success to 95% on the paediatric inpatient and paediatric emergency departments by May 2022.

Stakeholders from paediatric clinical services including physicians, nurses and the laboratory medicine team at our centre were engaged to guide quality improvement interventions to improve specimen success rate. Based on feedback, we implemented visual aids to our electronic laboratory test information guide. Additionally, visual reminders of correct sample collection equipment were placed in high traffic areas for nursing staff.

After the interventions were implemented, a three-month follow-up showed that wound swab success rate rose to 95.3%. This study achieved its aim of improving wound swab success rate to 95%. It adds to the growing pool of evidence that preanalytical phase intervention such as visual aids can increase swab success rates, in healthcare settings.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Specimen swabs collected from patients and sent to the microbiology lab may be rejected for various reasons, the majority of which involve preanalytical errors. This leads to the need to repeat swab collection, delays diagnosis and increases patient stress and healthcare costs.

WHAT THIS STUDY ADDS

⇒ This study shows that simple interventions aimed at improving visual reminders of the correct swabs and transport media to use can increase the success rate of wound swabs sent to the microbiology lab.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study adds to the growing pool of evidence that preanalytical phase interventions can increase success rates of specimen swabs, and that simple interventions, like those outlined in this study, may be replicated at other centres to improve their specimen swab success rates.

PROBLEM

Bacterial swab specimens from the paediatric population are frequently reported as 'incomplete' or 'unable to be performed' due to inappropriate specimen collection at our centre. Incorrectly ordered, performed or processed bacterial swabs lead to diagnostic delays, inconvenience and stress for patients, and increased costs.[1] To understand the extent of the problem and its causes, we audited the failure/success rate of swabs collected from paediatric patients on the inpatient ward and emergency department at London Health Sciences Centre Children's Hospital: a tertiary care paediatric centre, serving a population of approximately 1.5 million children in southwestern Ontario, Canada. An audit performed at our centre between August and October 2021 yielded 683 eye, ear, methicillin-resistant *Staphylococcus aureus* (MRSA) and wound swabs. During that time, success rates of 100% for ear and eye culture, 98.1% for MRSA and 88.9% for wound swabs were noted. Given these numbers, wound swabs were, therefore, identified as an area of improvement.

The aim of this study was to improve wound swab success to 95% on the paediatric inpatient and emergency departments by May 2022. To achieve this aim, we created a process map for swab sample collection and testing, then conducted a root-cause analysis to identify drivers for swab sample rejection. The most frequent reasons for specimen rejection were preanalytical phase errors including incorrect swabs used, improper labelling, transporting issues such as specimen leakage, lost specimen and poor specimen collection

quality. For this study, we defined 'successful' as a specimen sample that was received and accessioned by the laboratory without any poor-quality report comments, and all tests ordered performed and reported.

Preintervention data

A total of 683 swabs were collected during the initial three-month audit period (209 in August, 175 in September and 299 in October). The audit yielded an ear culture success rate of 100% (n=7) and an eye culture success rate of 100% (n=8). MRSA swab culture success rate was 98.1% (n=596). Of those, five were unsuccessful due to incorrect transport medium used,[1] improper labelling,[1] no specimen received by the lab,[2] and two swabs that were received in the same container.[2] Six MRSA swabs were reported as partially successful due to the poor quality of specimen collection, allowing for a reduced number of bacteria eligible to be screened. Wound swab culture success rate was 88.9% (n=72). Of those, no swabs were fully unsuccessful, yet eight were reported as partially successful due to poor specimen collection practices, as outlined above.

BACKGROUND

As highlighted during the COVID-19 pandemic, the collection of microbiology samples is an extremely helpful way to accurately detect the presence of pathogens and distinguish bacterial pathogens from viral illnesses.[2] Nonetheless, even frequently used swabs, such as those used for COVID-19 testing, do not have a 100% success rate and therefore cannot be fully relied on to exclude disease or to confirm it, in certain clinical scenarios.[3] Bacterial infections should, therefore, be excluded if clinically suspected. In fact, suboptimal sample collection has been identified as an important cause of false negative COVID-19 tests.[4 5] Microbiology samples sent to the laboratory may be rejected for various reasons.[6] Some studies have shown that up to 81% of errors leading to rejected microbiology samples by the laboratory occur during the pre-analytical phase of the process.[7] In studies that look at rejection rates encompassing all samples sent to the laboratory for analysis, rejection rates of 2.5%–13.3% have been reported.[8] While the need to repeat sample collection can delay timely diagnosis, often samples do not get repeated at all if they are not processed after initial collection.[9]

MEASUREMENT

Initial data collection focused on the four types of bacterial swabs including eye, ear, MRSA and wound swabs, for which data on success and failure was available through retrospective analysis in our electronic medical record (EMR). Of the total swabs analysed (n=683), the most frequent reasons for rejections included: poor quality of specimen collected, no specimen received by the lab, multiple swabs sent in the same medium or container and incorrect transport medium used.

To measure the outcomes of this quality improvement (QI) initiative, a subsequent three-month period of sample swab data collection was conducted following the implementation of the interventions. The absolute number of swabs collected, the number of successful swabs, the number of unsuccessful/partially successful swabs and the percentage of successful swabs per type were analysed. This allowed for direct comparison with the baseline data obtained from the initial audit.

DESIGN

This project used the Revised Standards for Quality Improvement Reporting Excellence 2.0 guidelines as a framework for design.[10] Our QI team consisted of two staff physicians (hospitalist paediatrician and program head for laboratory medicine and microbiology) as well as a senior paediatrics resident. Stakeholders from paediatric nursing management and laboratory medicine teams were engaged throughout the initiative, which included the following: developing the process map, conducting root-cause analysis, developing an intervention and implementing process improvements. The team met regularly to conduct this QI initiative. This collaboration was paramount to ensure the interventions put in place become widely adopted. A process map of microbiology sample collection (figure 1) was created. Areas for improvement are shown and focus on defined roles and responsibilities, gathering of the appropriate equipment and correct sample collection. Cause-and-effect analysis was performed (figure 2) through engagement with medical residents, staff physicians, nurses and allied healthcare workers. Poor knowledge of the specific swabs to use for the various types of microbiology specimen collection was identified as a key driver of swabs incorrectly collected.

Based on this root-cause analysis, we focused on education and information availability as our main intervention for our first plan-do-study-act (PDSA) cycle. Through this stakeholder collaboration, visual aids were identified as an effective strategy to improve knowledge on which swabs to use and how to correctly collect specimens (Appendix 1 and 2). The use of visual aids in medicine has been shown to improve safety and enhance proper use of medications and equipment.[11–13]

STRATEGY

The first PDSA cycle targeted the 'poor knowledge' driver through the introduction of images of the required microbiology swabs and transport containers uploaded to the electronic laboratory test information guide (LTIG) on 20 January 2022. This guide is accessible to healthcare providers through the hospital EMR system. Prior to the intervention, the LTIG only included description of the swabs to be collected for the specific test. Our intervention was the introduction of images of the required collection tube for each specific sample in addition to the text describing the collection tube. This enabled healthcare

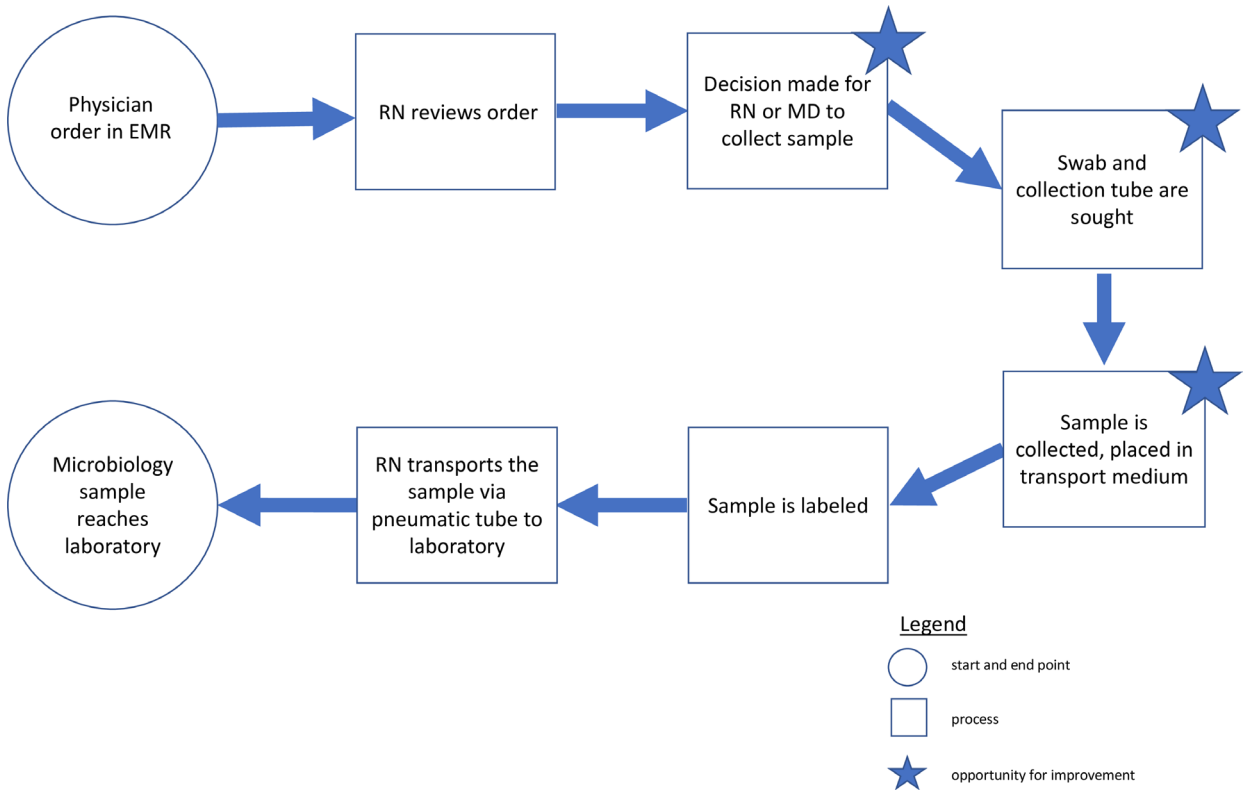

Figure 1 Process map. EMR, electronic medical record; RN, reigstered nurse; MD, medical doctor.

providers to easily confirm which collection medium and container to use. In addition, visual reminders of these collection tubes were placed in high traffic areas at nursing stations in the paediatric emergency department and paediatric inpatient ward. These visual reminders included a list of specimen types, how specimen should be collected and an image of the collection tube to be used for this specimen. The information on these visual aids matched the information on the LTIG. Additionally, news of the updated LTIG and the visual aids posted were provided to the nursing teams (who are responsible for specimen collection) via a regular newsletter that is

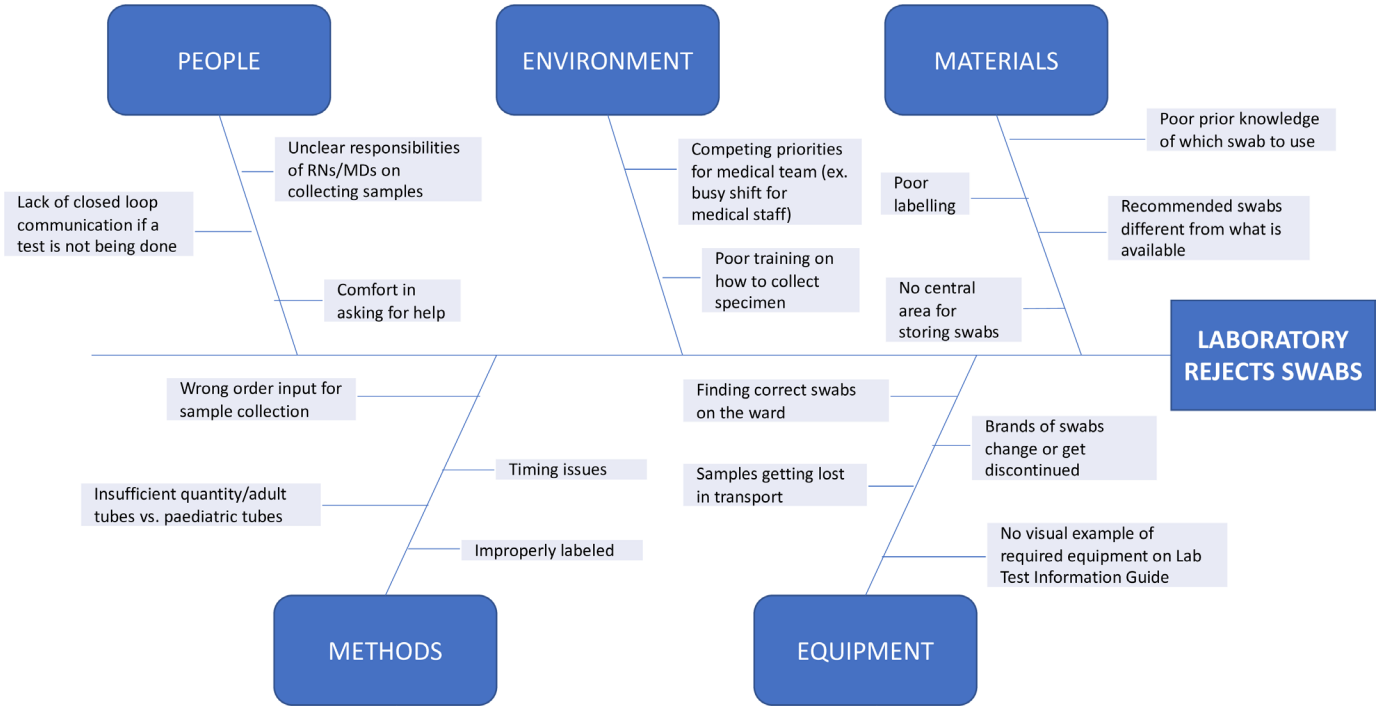

Figure 2 Fishbone diagram. RN, registered nurse; MD, medical doctor.

electronically sent through the nursing education team. The process involved is that the nursing team (those who are unfamiliar with a sample collection) would access LTIG prior to collecting a sample. In addition, as the nursing team member is gathering the collection top, they are faced with the visual aid posted beside the collection tubes to remind them of which tube to use for which specimen (Appendix 1 and 2).

RESULTS

A total of 497 swabs were collected during the thr-month data collection period following the implementation of the QI interventions on 20 January 2022 (116 in February, 164 in March and 216 in April). Ear culture success rate was 100% (n=3) and eye culture success rate was 100% (n=11). MRSA swab culture success rate was 95.0% (n=419). Of those, 19 were unsuccessful due to incorrect transport medium used (3), improper labelling (4), no specimen received by the laboratory (3), two swabs sent in the same container (7) and the specimen broken/leaking on arrival to the laboratory (2). No MRSA swabs were reported as partially successful. Wound swab culture success rate was 95.3% (n=64). Of these, no swabs were fully unsuccessful, yet three were reported as partially successful.

Both pre-intervention and post-intervention, the eye and ear culture swab success rate remained 100%. Wound swab success rate rose from a rate of 88.9% pre-intervention to 95.3% post-intervention (figure 3). MRSA swab success rate fell from 98.2% to 95.5% after the interventions were implemented.

LESSONS AND LIMITATIONS

The project aim was to improve the specimen laboratory success rate for wound swabs to 95%. To achieve this, the focus was on knowledge dissemination and accessible information for those involved in specimen collection. This QI initiative achieved its goal of improving wound swab success rate from 88.9% to 95.3%. Verbal feedback from nursing management to our team revealed that having visual aids on the LTIG was a significant help for lessening confusion when a microbiology specimen swab is ordered. Based on the results of this three-month intervention, the LTIG contributed to the increased success rate seen for the wound swabs. However, MRSA swab success rate decreased after the interventions were implemented, this was identified as a balance measure for our interventions. After reviewing our results and our interventions, we noted that our visual aids had the information on the MRSA dual swab (the one most used) on the second page, while the other specimens had their collection information on the first page.

This QI initiative highlights the potential benefit that a simple intervention can have on improving the rates of successful swab specimen collection and subsequent processing. Visual aids have been shown to improve medication safety when used with patients with healthcare workers.[12] Ensuring visual reminders are placed alongside written instructions is a simple intervention many hospitals could, therefore, undertake to increase the success of their microbiology specimen collection. In terms of limitations, while the information required for successful specimen collection was made available, it is not clear whether all the nursing team members became aware of the intervention. In addition, no formal pre-intervention or post-intervention knowledge assessment was completed for this project, we only collected verbal feedback from the nursing staff or our team.

Data collected reflected the three months following the intervention. It would be prudent to review data in subsequent months to assess for sustainability of the

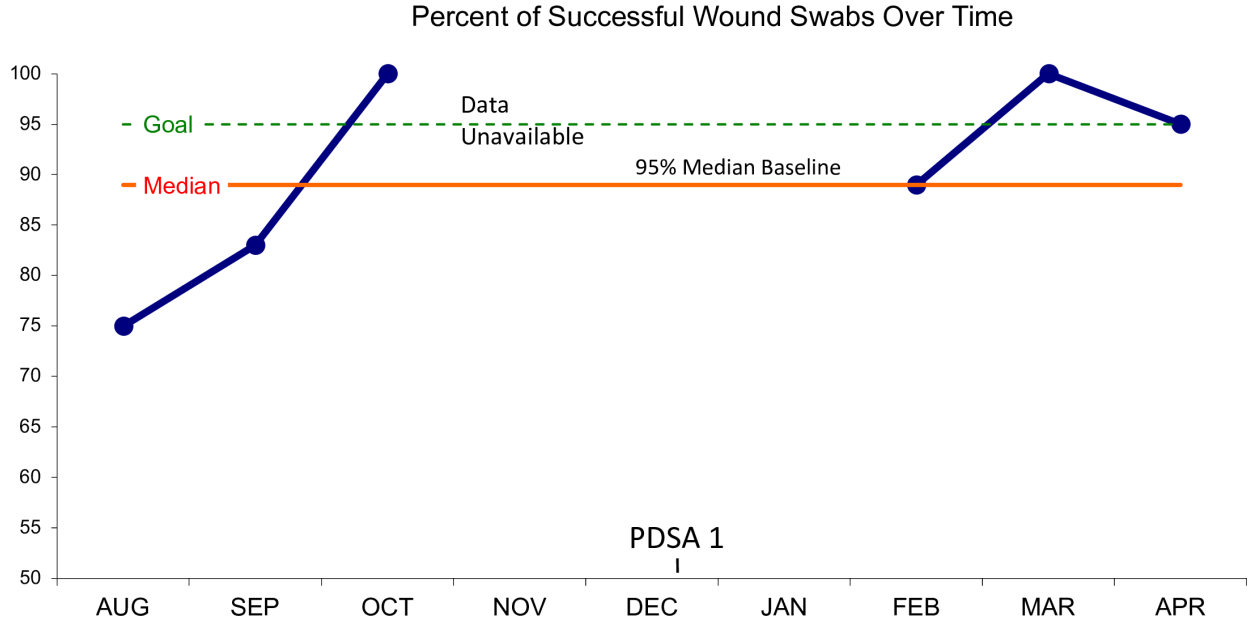

Figure 3 Run chart. PDSA, plan-do-study-act.

interventions. However, due to the current winter surge of significantly increased inpatient hospitalisation rates across the country, our laboratory personals were not able to obtain any further data for us so far. Future PDSA cycles will include ensuring regular communication between laboratory medicine teams and nursing management to address ongoing concerns about swab specimens sent to the laboratory. Furthermore, additional educational resources that focus on technique, as well as the correct identification of the required equipment, could also aid in further increasing the rates of successful specimens. Such resources could include short videos showing how to access the appropriate collection tubes and review proper specimen collection technique.

CONCLUSION

In summary, this QI initiative achieved its goal of increasing wound swab success rate to 95%. This initiative adds data to the growing pool of evidence that pre-analytical phase intervention can aid in increasing the success rate and quality of specimens sent to the laboratory for analysis in healthcare settings.[14] This project adds evidence that simple interventions may aid in improving bacterial swabs success rates.

Our future endeavours will examine the sustainability of our initiative by analysing data for the twelve months post-intervention. Demonstrating sustainability is of particular importance in teaching centres where high house-staff and nursing turnover can make this an ongoing challenge. We are hopeful, however, that similar success rates will be achieved, as the swab collection images continue to be available on the LTIG and the high traffic areas listed previously. Nursing staff continue to have access to these, and new team members are continually oriented to the LTIG as a resource. This QI initiative can be replicated within other hospital systems by capturing and uploading images to either a new or a pre-existing laboratory guide system. In addition, this project can widely be used with other specimen collections, other than swabs, by including visual aids to the guide manual.

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Patient consent for publication Not applicable.

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