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ORIGINAL ARTICLE

Evaluation of intravenous administration practices, patient safety and expenditure on saline products in a tertiary hospital

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INTRODUCTION

The 2011–2012 Queensland Health budget resulted in a significant reduction in funding to most hospitals. Budgetary constraints created an environment where efficiencies without compromise to quality patient care were required. As part of a detailed review of high-cost pharmaceuticals undertaken by the Drug Use Evaluation pharmacist, intravenous (IV) saline products were identified as contributing a significant proportion of the hospital pharmacy budget.

Detailed analysis of the trend in use leading up to 2011–12 revealed an unexpected change in the pattern of use of saline products, where 1000 mL saline IV fluid bags had been superseded by 100 mL saline IV fluid bags (minibags): both infused though an IV infusion pump. By 2011–12 minibags accounted for more than 70% of the total saline spend. At the time minibags were $2.53 per unit and 1000 mL bags $1.48.

Driving the change in usage and subsequent expenditure pattern was an observed change in nursing practice where several 100 mL bags of saline were being used to administer each intermittent dose of medication in preference to a continuous infusion with a burette, which requires the patient to be connected to an IV fluid administration set. In some cases, up to three minibags were used for administration of one dose of medication: one to prime the administration set, one to administer the medication, and one to flush the administration set, all without a medical order. This practice was identified when the pharmacist highlighted an excessive usage of 100 mL bags, which triggered an investigation into the cost of consumables.

This practice had evolved over several years outside of normal governance processes. Many nurses believed that it was easier to maintain an intermittent rather than continuous infusion for patient activities of daily living[1]. They also believed that continuous infusions had the potential to contribute to falls and did not believe that disconnecting and reconnecting IV fluid administration sets placed the patient at increased risk of blood stream infection (BSI). This change in practice was not supported in the literature and highlighted deviation from hospital policy and procedure, increased expenditure and potential patient harm (fluid overload)[2]. It should be noted that there is evidence in relation to continuous versus intermittent antibiotic administration in relation to efficacy of the drug but little is known about continuous versus intermittent fluid administration[3].

In terms of governance, mapping of practices at the time revealed that in many instances no medical officer or nurse-initiated order for the IV saline was documented (contrary to hospital procedure), nor was the volume administered being captured on the patient fluid order or fluid balance charts. This practice was widespread on medical and surgical wards. Of particular clinical importance were patients with a diagnosis of renal or cardiac failure who required fluid restriction. There were also inconsistencies in how the IV administration sets were being managed between doses. In many cases, a new IV administration set ($12.29 per set) was being opened for each dose of medication, resulting in up to four sets being used each day in the case of six-hourly doses. In a minority of cases, hospital infection control staff during surveillance activities observed the administration set being disconnected at the completion of the dose and the end of the set covered with an end cap and left to hang at the patient bedside until the next dose. This practice of reconnecting a used administration set is in breach of standard local infection control procedures and increases the risk of BSI[4].

INTERVENTION

A standard protocol for administering intermittent medication by continuous infusion was developed by nursing, pharmacy and medical staff and endorsed through the Drug and Therapeutics Committee. The ‘minibag free’ strategy was introduced and trialled in four adult inpatient wards (three medical and one infectious diseases ward). In addition to the standard protocol, a procedure enabling nursing staff to initiate a fluid bag to ‘keep vein open’ (KVO) at a rate of 5 mL/hour when medications were not being administered was developed (supported by approved hospital procedure). Ward imprest holdings of minibags were reduced and access restricted by pharmacy, education sessions were provided to nursing and medical staff, posters were developed, and the hospital IV Drug Administration Guidelines were revised to

reflect the use of burettes and smaller volumes. The Safety and Quality Committee and Nursing Executive Committee endorsed the entire initiative in late 2011. Implementation on the trial wards commenced in January 2012.

Barriers to implementation of the intervention included: sufficient number of infusion pumps to support the proposed infusion set-up; the potential for increased patient falls with a permanently attached infusion pump; a potential decrease in patient mobility; and difficulty maintaining the continuous infusion in those with cognitive impairment. These barriers were overcome by: engaging clinical staff; ensuring a sufficient number of infusion pumps were available (redistribution of pumps, no additional purchase was required); and exclusion of patients with cognitive impairment from the new procedure. A risk assessment of this group of patients was undertaken and the risk of harm though falls and dislodgement of the IV cannula was considered greater than the risk of BSI. Perceived issues with hygiene and mobility requirements of the patient were assisted by changing the administration set 24 hourly after the first dose of medication for the day, leaving the patient free of the administration set in the morning for these activities.

METHOD

A retrospective review of pre- and post-implementation expenditure (fluids and associated consumables), barriers to implementation of a streamlined process for administration of intermittent parenteral medication (equipment, falls potential), and BSI rates was undertaken in 2015. Saline usage and expenditure data was sourced from pharmacy records, consumables usage and costing information was sourced from Finance and Materials Management Information System, and BSI data was provided by Infection Management Services who have responsibility for investigating all BSI. Catheters and implantable ports were excluded from the data set as they were not generally utilised for IV fluids and medications in the trial wards.

A Poisson regression was used to compare the counts of adverse events pre- and post-intervention. A segmented regression using a generalised additive model was conducted on the saline usage and expenditure data. Cost savings were estimated by assuming the average monthly expenditure pre-intervention would have continued. All statistical analysis was conducted in R statistical software V3.1.3.[5]. A p-value of < 0.05 was considered statistically significant.

RESULTS

The count of adverse events over time is displayed in Figure 1. There was no evidence of a change in occurrence of falls with harm (P = 0.18). Though not statistically significant there was a small observed decrease in catheter-related BSI (P = 0.34) during the intervention.

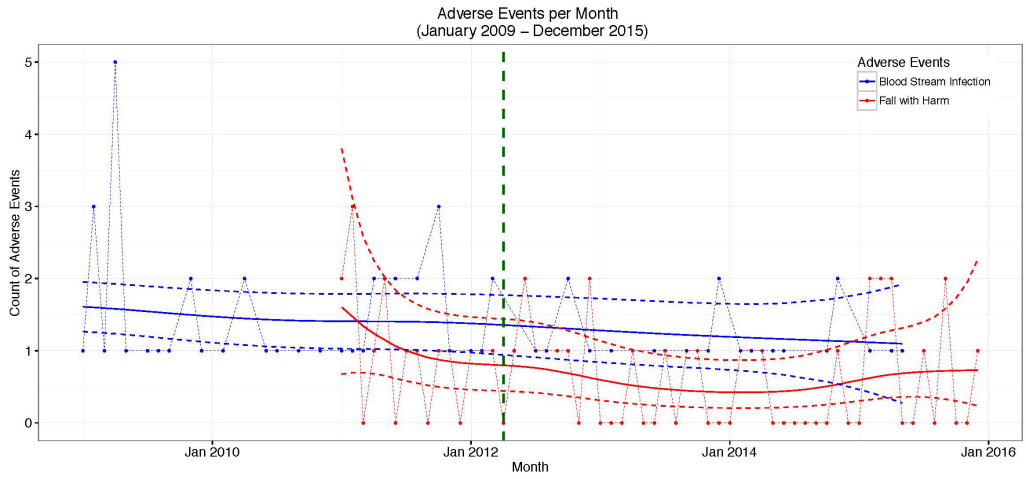

Figure 1: Adverse events. The plot displays counts of adverse events over time. Blue represents bloodstream infections and red represents falls with harm. The monthly counts are represented by small dots connected with a faint dotted line. The solid lines represent the model predictions, and the dashed lines represent the 95% confidence intervals around these predictions. The green dashed line represent the time the intervention began.

Saline usage over time for the 100 mL and 1000 mL bags is displayed in Figure 2. A substantial drop in the usage of the 100 mL bags was observed and maintained fo the 12 months following the introduction of the intervention. A gradual increase was observed in the following 2.5 years, due to staff turnover and champions to sustain the change, however, the total monthly usage remains well below the prior usage. Cost savings achieved in the 44 months after implementation in the intervention wards for both saline and consumables expenses totalled $438,000, compared to the average expenditure pre-intervention. Although there was a reduction in the cost of the 100 mL saline bags during the trial the majority of the savings (93%) was from the reduction in consumables usage (administration sets).

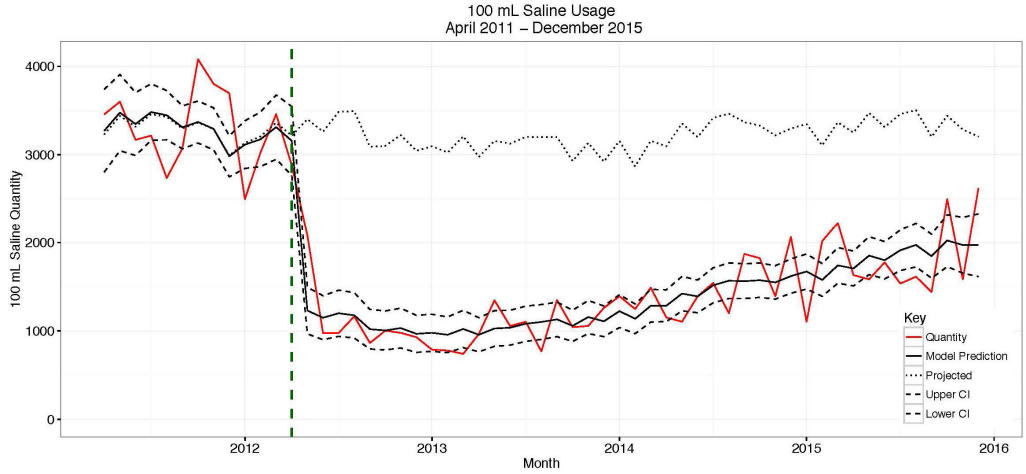

Figure 2: Saline usage. The plot displays saline usage over time for 100 mL and 1000 mL bags adjusted for hospital activity (occupied bed days). Red represents the 100 mL bags and blue represents the 1000 mL bags. The solid black line represents the model predictions, and the dashed lines represent the 95% confidence

intervals around these predictions. The dotted line represents the prediction in 100 mL usage if the intervention did not occur, given the prior usage.

CONCLUSION

This practice change of implementing a nurse-initiated order to allow nursing staff to prescribe KVO fluids has resulted in enormous cost savings from the reduction in use of small volume saline bags and associated IV administration sets. There is no evidence of an increase in falls with harm or BSI associated with vascular access devices. The minibag-free procedure has formalised the process for nurses to initiate standing IV fluid orders (as per hospital procedure) and has improved practices of documentation of fluid administration. This intervention provides some evidence that has been lacking in the literature to support the use of standardised practice in selecting large volume bags with a burette and administration set over the perceived convenience of small volume bags for intermittent parenteral medication administration.

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Conflict of interest for each author
All authors declare no known conflict of interest.

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