

‘Smart’ IV pumps – how smart are they?

Smart pumps, incorporating dose error reduction software, are widely promoted as a patient safety intervention.[1-2] This software checks programmed intravenous infusion rates against pre-set limits for each drug in the pump’s ‘drug library’ with the aim of reducing the risk of infusion rates that are too high or too low. Smart pumps were reported to be in use in 68% of US hospitals in 2011,[3] although this figure does not tell us about how they are used nor in which clinical areas. A study of their use in the UK suggests that their use is less widespread, and that although smart pumps may be in use within an organization, they may only be used in some clinical areas or for some kinds of infusion.[4]

Although widely advocated, as with many other patient safety interventions [5,6,7] the evidence for smart pumps’ benefit is not clear-cut. There is no conclusive evidence that smart pump use does indeed prevent medication errors and adverse drug events, and little is known about the kinds of errors that still occur with their use. [8,9]

In this issue, Schnock et al [10] aim to shed light on some of these issues by documenting the prevalence and types of errors associated with intravenous infusions in ten US hospitals using smart pumps. Pairs of observers visited participating clinical areas and identified any discrepancies between each infusion and its corresponding medication order plus relevant organizational policies. This method can reveal only errors that can be identified visually from an infusion in progress; any errors in the preparation of the infusion, such as the wrong concentration being prepared, will not be identified unless the corresponding label is also incorrect. This approach also focuses on errors in medication administration and does not include prescribing errors involving incorrect infusion rates, which smart pumps may also have a role in preventing. Even so, the paper suggests a very high rate of errors, with 60% of 1,164 observed infusions reported as having one or more errors. At face value, this figure seems very high, but it does include procedural violations as well as what would usually be considered to be medication administration errors, and as the authors point out, very few (five) were judged to be potentially harmful.

The five potentially significant medication administration errors comprised four judged to be “errors that would have required increased monitoring to preclude harm” (category D) and one “error likely to cause temporary harm” (category E). The four Category D errors were two wrong rate errors, one omission error and one expired drug error; the Category E error was an omission error. The error rate based on these five more serious errors is just 0.4% of infusions, and thus much lower than the headline figure of 60%.

This hundredfold discrepancy highlights one of the challenges in interpreting the literature in this field: different researchers and practitioners are likely to have different views on what should be included and excluded as errors. For quantitative studies of medication administration error rates, this is particularly important.[11] In

particular, Schnock et al [10] included as errors many examples of procedural violations. These may be important indicators of underlying culture but would not be included as errors in many other studies in this field. One study has shown evidence of an association between a particular procedural violation (not checking patient identification) and medication administration errors. [12] However, Schnock et al included as errors other procedural issues, such as discontinued infusions being disconnected from the patient but still connected to the pump; these are unlikely to be considered important by many healthcare professionals. Caution is therefore needed when interpreting and comparing different quantitative studies, even where the same data collection methods are used.

The paper also reveals some important differences among the ten participating hospitals. There was wide variation in non-adherence to smart pump use (ranging from 0 to 38% of infusions for which the smart pump was not used at all or the drug library bypassed, negating any benefits of dose range checking) and other types of medication administration error (ranging from 6% to 60% infusions, excluding those relating to smart pump non-adherence). This ten-fold difference in medication administration error rates is largely accounted for by variation in the prevalence of medications being administered without an accompanying medication order, mainly the infusion of fluids at a low rate to keep the vein open, which ranged from 3% to 53% of observed infusions across the ten sites. As well as events considered to be medication administration errors, there was also wide variation in adherence to other procedural issues. Policy violations were defined based on the policy in place at each organization, and the prevalence and types of violation will therefore depend on the policy. For example, if a hospital policy stipulates a large number of requirements for the information on an infusion bag label, there are more opportunities for violation of these requirements than in a hospital that requires only the patient's name and identification number.

Schnock et al [10] also highlight how policies may be no longer fit for purpose in the context of computerised prescriber order entry and barcode medication administration systems. Specifically, some policies require the time at which an infusion was started to be documented on the infusion label, but this information will be captured automatically in organisations using barcode medication administration systems and electronic medication administration records. In this context, adding this information by hand to the label can be viewed as a redundant step, leading to staff ignoring this part of the policy. Perhaps importantly, the ten study hospitals were also a convenience sample, selected from attendees at a healthcare technology safety meeting who volunteered to participate. Infusion practices may therefore be even more diverse beyond this self-selected sample.

In relation to the role of smart pumps, it seems that the picture is still not clear. Smart pumps are likely to be only as smart as the rest of the system in which they operate. As with many healthcare technologies, their benefits are likely to depend on how they are used, how they are integrated within practice, and the interface between humans and technology. Qualitative as well as quantitative methods are likely to be needed to explore these issues.[13] Even when used as part of a closed

loop system, integrated with computerised prescriber order entry and barcode medication administration systems, smart pumps are unlikely to affect adherence to other procedures relating to the safe administration of intravenous infusions. It is important that we do not regard smart pumps as a 'plug and play' technology to be added into existing systems for intravenous medication administration; instead they should be used as an opportunity for transformation of the whole system.

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