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ORIGINAL

Safe intravenous administration in pediatrics: A 5-year Pediatric Intensive Care Unit experience with smart pumps☆

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KEYWORDS
Smart pumps;
Safety;
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Abstract
Objectives: To estimate the impact of smart pump implementation in a pediatric intensive care unit in terms of number and type of administration errors intercepted.
Design: Observational, prospective study carried out from January 2010 to March 2015 with syringe and great volumen infusion pumps available in the hospital.
Setting: A tertiary level hospital pediatric intensive care unit.
Participants: Infusions delivered with infusion pumps in all pediatric intensive care unit patients.
Interventions: Design of a drug library with safety limits for all intravenous drugs prescribed.
Main variables: Users' compliance with drug library as well as number and type of errors prevented were analyzed.
Results: Two hundred and eighty-three errors were intercepted during 62 months of study. A high risk drug was involved in 58% of prevented errors, such as adrenergic agonists and antagonists, sedatives, analgesics, neuromuscular blockers, opioids, potassium and insulin. Users' average compliance with the safety software was 84%.
Conclusions: Smart pumps implementation has proven effective in intercepting high risk drugs programming errors. These results might be exportable to other critical care units, involving pediatric or adult patients. Interdisciplinary colaboration is key to succeed in this process.

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PALABRAS CLAVE
Bombas inteligentes;
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Administración intravenosa

Administración segura de medicamentos intravenosos en pediatría: 5 años de experiencia de una Unidad de Cuidados Intensivos Pediátricos con bombas de infusión inteligentes

Resumen
Objetivos: Estimar el impacto de la implantación de bombas de infusión inteligentes en una unidad de cuidados intensivos pediátricos en cuanto al número y tipo de errores de administración interceptados.
Diseño: Estudio observacional, prospectivo, realizado de enero de 2010 a marzo de 2015 con las bombas volumétricas y de jeringa disponibles en el hospital.
Ámbito: Unidad de Cuidados Intensivos Pediátricos de un hospital general de tercer nivel.
Participantes: Todas las infusiones programadas con bomba de infusión en los pacientes ingresados en la Unidad de Cuidados Intensivos Pediátricos.
Intervenciones: Elaboración de una biblioteca de fármacos con límites de seguridad a través de la cual se programarían todas las infusiones intravenosas prescritas.
Variables principales: Se analizó la adherencia a la biblioteca de fármacos y el número y tipo de errores evitados según las alarmas generadas en el sistema.
Resultados: Se interceptaron 283 errores reales de programación durante los 62 meses que duró el estudio. En el 58% de los errores estuvo implicado un fármaco de alto riesgo, como agonistas y antagonistas adrenérgicos, sedantes, analgésicos, bloqueantes neuromusculares, opiáceos, potasio e insulina. Durante este período, la adherencia media de los usuarios al *software* de seguridad fue del 84%.
Conclusiones: La implantación de bombas de infusión inteligentes ha demostrado ser eficaz en la intercepción de errores de programación relacionados con fármacos de alto riesgo. Esta herramienta es susceptible de implantarse en otras unidades de pacientes críticos, tanto adultos como pediátricos. La colaboración multidisciplinar es clave para el éxito del proceso.

Introduction

The concept of safety in drug use has experienced changes in recent years. The errors that occur in any of the phases of the drug utilization circuit result in important patient morbidity–mortality.[1,2] In this regard, administration errors are the errors that prove most difficult to intercept,[3] and their potential impact upon the patient depends on the administration route involved, the drug type and dose, and the characteristics of the patient. When high risk drugs are administered via the intravenous route in critically ill pediatric patients, the likeliness of damage in the event of error is seen to multiply.[4] Guaranteeing safety in this scenario therefore should constitute a priority concern, and in this regard the use of smart infusion pumps (SIPs) may play an important role.

An intelligent (smart) infusion system is a conventional infusion system equipped with safety software that contains a drug library specific of each Unit, and which constitutes a list of drugs with concrete concentration, maximum and minimum dose, and infusion time specifications for each of them. The relationship between the dose and infusion time determines the administration rate, for which absolute and relative limits (both upper and lower) are established with the purpose of intercepting errors attributable to over- and under-dosing, respectively. In this way, if programming error breaches a relative limit, the user is alerted to the fact that the infusion rate might not be adequate for a given patient. However, the alert can be ignored and infusion can be continued, after checking that programming has indeed been correct. In contrast, the accidental breaching of an absolute limit generates an alert that cannot be obviated, and the user in this case must reprogram administration of the drug.[5]

Different organizations acknowledge the increased safety afforded by SIP technology, and advocate replacing conventional infusion systems with smart systems.[6–8]

However, the published information on the true impact of these systems in terms of the interception of programming error is still limited.[8]

The present study examines the impact of implementing SIP technology in the administration phase of intravenous drugs in a Pediatric Intensive Care Unit (PICU) in terms of the number and types of programming errors intercepted.

Patients and methods

Study design and setting

A prospective, observational interventional study with analytical components was carried out on the prevalence of programming errors. The study began in January 2010 and ended in March 2015, and was carried out in the PICU of the Maternal and Child Hospital pertaining to Gregorio Marañón University General Hospital in Madrid (Spain).

The Maternal and Child Hospital has a total of 231 beds, of which 150 correspond to pediatric patients and