Elaboration of a risk map in a paediatric Emergency Department of a teaching hospital

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ABSTRACT

Objective To develop a risk map in a paediatric ED of a tertiary teaching hospital, combining proactive and reactive strategies.

Methods Between June and December 2013, a multidisciplinary committee in a paediatric Emergency Department (ED) in Bilbao (Basque Country of Spain) mapped the patient’s journey and identified potential risks to patients (proactive strategy). The researchers also analysed incidents reported by professionals and caregivers (mainly parents) in the paediatric ED from November 2004–December 2013 (reactive strategies). Combining the results of both strategies, we applied the ‘Failure mode and effects analysis’ tool to identify and prioritise high or very high-risk situations and apply them to the risk map.

Results Using proactive strategies, 49 opportunities for failures, 60 effects and 252 causes were identified. The most common failures were related to the discharge of the patient; the most common effects were complaints by parents, long stay in the ED, delay in diagnosis/treatment and unnecessary treatment. Main causes were not including the family in the process, shift change, incorrect identification of the patient and computer errors. Using reactive strategies, 1795 reported incidents were analysed. The most common incidents were related to medical equipment (38%), resources/organisation of staff (17%), clinical process (15%), facilities (12%) and medication errors (5%). Proactive strategies identified risks in tests, treatment and discharge. The reactive strategy added risks concerning prehospital transfer, triage, medical care, tests, treatment and discharge.

Conclusions Proactive and reactive strategies, involving professionals and caregivers, can complement each other in identifying potential patient safety risks in a paediatric ED.

BACKGROUND

The paediatric ED provides acute medical care for the emergency medical or surgical needs of children. The safety of patients is one of the elements of quality of emergency care.1,2

The ED is an area of the hospital where ill or injured patients arrive without an appointment; there is no finite number of patients or medical problems. Typically, several patients are managed simultaneously, some of them with underlying pathologies which are not always known by the physician in charge. Furthermore, on occasion, the ED gets crowded, making it difficult to offer an appropriate quality of care to the incoming patients.3

The challenges that face paediatric emergency medicine are mostly similar to those faced by other EDs, but some additional challenges can increase error, for example, weight-based medication dosing or age-related vital signs. In addition, children possess distinct anatomical, physiological and developmental characteristics, and may present conditions that are unique to specific paediatric age groups.4

Given all this, it is easy to understand that medical errors and other types of safety incidents may happen in the paediatric ED. Nevertheless, many of these events can be avoided, and the identification of potential risks is key to making this possible. Both proactive and reactive strategies can be used to identify risks. Proactive tools aim to prevent incidents before they happen, by putting barriers or detection systems in place to avoid the incidents or to reduce their impact or severity. Proactive tools such as brainstorming have already been used to elaborate risk maps in adult EDs.5 Reactive strategies identify risks based on the incidents previously recorded in a department. Liberal notification and registration of incidents are deemed essential to this process.6

The combination of both proactive strategies and reactive strategies can facilitate the design of the risk map of an ED. A risk map is a data visualisation tool for communicating specific risks an organisation faces. The risk map helps to organise the information related to the risks and allows users to set appropriate policies for their prevention and management. From the point of view of patient safety, a risk map helps to identify incidents before they become adverse events for the patients. Mapping the risks can improve both safety and

Key messages

What is already known on this subject?
Risk mapping is increasingly used commercially to identify and monitor enterprise-wide risks. It has only rarely been used in healthcare. While risk maps have been developed for the adult ED, there are no prior studies producing risk maps for paediatric EDs.

What might this study add?
We describe a method for mapping the risks in the different phases of care in a paediatric ED using proactive strategies (mapping the patient’s journey) and reactive strategies (analysis of incidents). Combining these approaches allowed us to obtain a full picture of potential failures, effects and causes.
quality of care provided to children brought to the paediatric ED.

Currently, risk mapping is increasingly used by both financial and non-financial companies to identify and monitor enterprise-wide risks. However, it is not commonly applied to healthcare systems. Furthermore, to our knowledge, there are no published studies analysing strategies to identify potential risks in the care of the patients or risk maps drawn in a paediatric ED.

We hypothesised that the combination of proactive and reactive strategies would complement each other to design the risk map of an ED.

OBJECTIVES
Main objective
To develop a risk map in a paediatric ED of a tertiary teaching hospital, combining proactive and reactive strategies.

Secondary objective
To describe a method for mapping the risks in the different phases of the care of patients in the paediatric ED of a tertiary teaching hospital.

METHODS
Our hospital is a tertiary level teaching hospital in Bilbao (Basque Country of Spain) that offers its services to an area with over 370,000 inhabitants. In addition, our hospital's area of influence goes beyond this area geographically, attending to many other people with a need for complex healthcare for which the hospital acts as a referral centre. In the paediatric ED, we register around 53,000 visits/year of children less than 14 years of age.

Since 2004, the quality manager of the paediatric ED registers all the incidents reported by professionals and caregivers (mostly parents) and their management. Different written and online reporting systems have been available for healthcare professionals and caregivers. During the initial years, most of the online incidents were registered using a separate system not related to the patients’ management system programme. During the latter years, we integrated a system for notification into the patients’ management system programme. Online reporting systems were mainly used by professionals and written reporting systems by caregivers. These incidents are presented in the meetings of the Quality Committee (QC), which is composed of the head of department, the quality manager, the nursing supervisor and representatives of paediatric emergency physicians, nurses, residents, nurses’ assistants and ancillary staff. The committee holds quarterly meetings and reviews incidents reported to the quality manager, and when needed, suggests and implements improvement strategies. Multidisciplinary teams, under the coordination of the QC, promote interventions that can lead to quality improvement, targeted at various areas such as triage, critically ill patients, safety, trauma care, sedation and analgesia and medical registries.

We designed the risk map using the following strategies:
1. Identification of risks using proactive strategies
   A multidisciplinary team was formed consisting of the Quality and Patient Safety Committee and experts from the Quality Unit of the hospital. This team conducted a risk assessment of the different phases of the care provided in the paediatric ED. The multidisciplinary team conducted a series of brainstorming sessions with a 2-hour maximum for any meeting. In the first meeting, we reviewed the phases of the care of patients in the paediatric ED, and attendees were asked to draw up a list of different potential failures related to every phase of the care of patients. In the second meeting, we discussed and agreed on different potential failures related to every phase of the care of patients and we identified the consequences and causes of these failures. Finally, we held a third meeting with representatives of the paediatric ED’s staff and the QC of the paediatric ED to add or change ideas and agree on a final document.

2. Identification of risks using reactive strategies
   We performed a retrospective analysis of all the reported incidents and their management between 2004 and 2013. First, we classified the incidents using the International Classification for Patient Safety published by WHO (see online supplementary eTable 1). This system categorises the incidents in relation to the timing and circumstances of the care of the patient they occurred to. Later, we assigned the classified incidents to the phase of the care of patients.

   Statistical analysis was carried out using the SPSS V.21 (IBM, Chicago, IL, USA). Each variable was described using frequency distributions for categorical variables.

3. Risk stratification
   We hypothesised that the combination of proactive and reactive strategies would complement each other to design the risk map. Finally, it was shown to the QC of the paediatric ED for the final validation.

The study was reviewed by the Ethical Committee of the Hospital.

RESULTS
Identification of risks using proactive strategies
The multidisciplinary team identified 49 potential failures with 60 effects and 252 related causes. The distribution of potential failures, their causes and effects in different phases of the medical care is shown in table 1.

<table>
<thead>
<tr>
<th>Table 1 Number and distribution of failures, causes and effects in different phases of the medical care provided in the paediatric ED</th>
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<tbody>
<tr>
<td><strong>Phases of the medical care</strong></td>
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<tr>
<td><strong>Triage</strong></td>
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<td><strong>Medical care</strong></td>
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<td><strong>Complementary tests</strong></td>
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<tr>
<td><strong>Treatment</strong></td>
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<tr>
<td><strong>Admission to the short stay unit</strong></td>
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<td><strong>Discharge</strong></td>
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<tr>
<td><strong>Home</strong></td>
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<tr>
<td><strong>Paediatric intensive care unit</strong></td>
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<tr>
<td><strong>Ward</strong></td>
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<tr>
<td><strong>Neonatal Intensive Care Unit</strong></td>
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<td><strong>Total</strong></td>
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Globally, the most frequent failures were related to errors in the identification of the patient and the delay in performing different procedures in the paediatric ED. These failures occurred in virtually all the phases of medical care. Proactive strategies uniquely identified potential failures in triage regarding identification of the patient and errors of the computer system and potential failures in the discharge of the patients from the ED, mainly when transferred to other units. These largely concerned worsening of a patient while being transferred to the Paediatric Intensive Care Unit (PICU), or admitting infants with out-of-hospital acquired infections to the Neonatal Intensive Care Unit (NICU) instead of a unit (such as the PICU) with less vulnerable patients. Proactive strategies also identified failures in the other phases of the care, but trend to fit better with the reactive strategies.

More common effects were ‘complaints of the caregivers’ (mainly parents), ‘prolonged stay in the paediatric ED’ (mostly during the admission to ward), ‘delay in diagnosis/treatment’ (in all the phases of care, except for triage) and ‘unnecessary treatment’ (in both ‘treatment’ and ‘admission to ward’ phases of care and related commonly to misidentification of the patient or absence of written medical orders).

The most frequent causes of these failures were not including the family in the process of care, the shift change of physician and nurses, the incorrect identification of the patient and computer errors.

The detailed distribution of failures, their causes and effects in different phases of the medical care provided in the paediatric ED identified by proactive strategies are shown in the online supplementary appendix 1.

Identification of risks using reactive strategies
We registered 1795 incidences in the paediatric ED (one notification every 2 days). Of these, 1351 were made by healthcare professionals (75.2%) and 444 by the caregivers (24.7%, nearly all of them by the parents) using a suggestion box in the waiting room. A summary of all the reported incidents and the relationship with the group of professionals who recorded them is shown in online supplementary appendix 2. Globally, most commonly reported incidents were associated with ‘medical device/equipment of the paediatric ED’ (690, 38.5%), especially associated with a failure or malfunction of medical equipment. Those related to ‘resources/organizational management’ (309, 16.7%) were mainly associated with insufficient staffing and delay in getting care from an emergency physician or other doctors (surgeon, orthopaedist, etc) or performing radiology tests. ‘Clinical process/procedure’ incidents were 14% of the reports, (266, 14.8%) and ‘infrastructure/building/fixtures’ were 12.2%. Of note, there were reports of 99 medication errors, (‘medication/IV fluids’) consisting only 5.5% of incidents.

As seen in online supplementary appendix 2, the distribution of these notifications was different from those coming from health workers. Caregivers underlined the importance of the prehospital care, organisation of the medical team, the relationship with orthopaedists and the adequacy and safety of the waiting room. No adverse outcomes could be attributed to these incidents.

During the study period, we noted a decrease in the rate of incident reporting, due to different interventions developed by the QC. Thus, several failures related to the medical devices, organisation of the medical staff and the conditions of the waiting room significantly decreased.

The reactive strategies identified several failures at multiple stages not identified by the proactive strategy, for example, those related to prehospital care. Failures identified at this stage included inadequate transfer (lack of ALS ambulance for an unstable patient), disorganisation of the staff during crowding and risk situations related to the waiting room. Reactive strategies also identified additional risks in triage, medical care, tests, treatment and discharge.

The detailed distribution of the reported incident type and the related problems identified are shown in the online supplementary appendix 3.

Risk stratification
Using the Risk Matrix recommended by the Ministry of Health Social Services and Equality, we prioritised high or very high-risk situations to be included in the map (table 2).

Several high or very high-risk situations were found in multiple stages of the process: Disorganisation of the staff, breakdown of the medical equipment, medication errors and delay in getting care.

Combination of both strategies and development of the risk map
We designed a first draft using the risk identified with the proactive strategies, added those identified with the reactive strategies and the finally the map was validated by the multidisciplinary team (figure 1).

DISCUSSION
Improving the quality of care and reducing risk can be especially challenging in the ED setting. The risk map identifies areas for improvement in the paediatric ED and proactive and reactive strategies complemented each other in designing it. A combination of both strategies is a better approach than either strategy alone to develop an ED risk map. Although many failures may be detected with either strategy, some of them are identified or prioritised with only one of them. In addition, the information obtained from the notifications is different depending on those who register the incident, mainly when considering caregivers. The notifications of the caregivers differed substantially from those made by other groups. Of note, risks related to organisation of the medical staff and ‘prehospital care’ were mostly identified by caregivers.

A risk map is a data visualisation tool for communicating specific risks an organisation faces and it is often used outside of the healthcare services. Regarding healthcare, various studies have been carried out analysing medical errors, patient safety and their impact on the quality of care provided. Even so, studies about risk maps are quite rare, although the FMEA and brainstorming are widely used to identify risks.

In addition, those published studies about risk maps have been carried out using only proactive strategies or considering only the incidents reported by the healthcare professionals. To date, none has also taken into account the notifications made by the users, mostly parents, in the context of the paediatric ED. The inclusion of the information obtained by the reactive tools makes our study different from others.

The inclusion of the caregivers has been useful to highlight different risks.

We identified several opportunities for failures in the area of triage, some of which were very significant. Triage in paediatric emergency care is an important tool to prioritise seriously ill children. Triage is used to identify patients who do not need urgent care and who can safely wait.

The risks related to the ‘treatment’ phase of care were commonly associated with administering medications and these
were identified mainly when using proactive strategies. In our paediatric ED, the delivery of emergency care to children occurs in the presence of parents and other key family members, as has been recommended. The presence of parents can reduce the number of medication errors (ie, dosage errors or identifying children with any drug allergies) and may explain that these risks are identified using proactive tools but are quite uncommon in the notifications. Child and family centred medicine is key to promoting best patient outcomes, care satisfaction and patient safety. This situation is different in some general EDs, in which these risks are much more common.

Discharge from the paediatric ED was the phase of healthcare with more failures when using proactive tools, and they were mostly associated with computer errors. Nevertheless, notifications were very few, as has been reported in general EDs. It is also remarkable that both ‘hospitalization in the PICU’ and ‘hospitalization in the NICU’ had very few incidents registered. Although not specifically analysed, our multidisciplinary working team for the critically ill patient, which includes staff from the paediatric ED and PICU working specifically in this phase of care, may explain this discrepancy.

In other phases of the process of care (‘medical care’ and ‘complementary tests’), the proactive tools fit well with the reactive ones, as has been reported in studies about risk maps in general EDs. In the latter studies, these phases of the process of care were associated with higher risk.

Proactive and reactive strategies complement each other in obtaining a full picture of potential failures, effects and causes. The proactive tools do not consider the incidents that occur in a healthcare service. Our study highlights that the incidents registered can be a way to improve the quality of care and to identify risk areas. Thus, it is very important to develop notification tools which are easy to use by the healthcare workers and also by caregivers. The inclusion of the incidents reported by parents has alerted us to the importance of several specific aspects of our medical care, and particularly a breakdown of the care process during periods of crowding. As has been noted previously, overcrowding may alter the quality of care provided in a paediatric ED.

The risk map shows the most significant problems in order to solve them or to create barriers to minimise them. Once remedies have been put into place, the risk map can be adapted. Inevitably, the risk map has to be periodically evaluated and adapted to the situation of the paediatric ED because it may change over time. Furthermore, the type of the incidents may vary depending on what is happening in the ED or the hospital (eg, construction work in the paediatric ED, high inpatient census, strikes, etc).

Table 2 Risks prioritised in both strategies related to the phase of care

<table>
<thead>
<tr>
<th>Phase of care</th>
<th>Proactive strategies</th>
<th>Reactive strategies</th>
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<tbody>
<tr>
<td>Triage</td>
<td>Performing a wrong triage</td>
<td>Disorganisation of the medical team</td>
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<tr>
<td></td>
<td></td>
<td>Breakdown of the medical equipment</td>
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<tr>
<td></td>
<td></td>
<td>Prehospital transport: high-risk patients transported to the ED in a non-correct way</td>
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<tr>
<td>Medical care</td>
<td>Consultation to the trauma service (ie, delay, adequacy of the sedation when a reduction is needed)</td>
<td>Breakdown of the medical equipment</td>
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<tr>
<td></td>
<td>Administration of medication (ie, dosage errors)</td>
<td>Inadequate or incomplete realisation of the process of clinical care</td>
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<tr>
<td></td>
<td>Not carrying out proper medical care (ie, non-realisation of X-ray of the chest at the time of the inquiry, detecting pneumonia in unscheduled revisits to the ED)</td>
<td>Disorganisation of the medical team in situations of overcrowding</td>
</tr>
<tr>
<td>Complementary tests</td>
<td>Performing the test wrongly (ie, the sample does not arrive properly at the laboratory by either loss of sample, bad tagging, etc.)</td>
<td>Disorganisation of the medical team</td>
</tr>
<tr>
<td></td>
<td>Worsening of the patient when transferring or staying at the radiology setting (ie, inadequacy of the medical devices of the radiology setting to provide adequate care if the child gets worse)</td>
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</tr>
<tr>
<td>Treatment</td>
<td>Most of the problems were associated with a significant risk, highlighting the medication errors (ie, wrong time, wrong rate, omission of a medication)</td>
<td>Medication errors (ie, wrong drug, wrong dose, wrong patient)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disorganisation of the medical team</td>
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<tr>
<td></td>
<td></td>
<td>Malfunction of medical equipment</td>
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<tr>
<td></td>
<td></td>
<td>The administration of wrong diet</td>
</tr>
<tr>
<td>Admission to the short stay unit</td>
<td>Wrong diet</td>
<td>Breakdown of medical equipment (ie, monitors)</td>
</tr>
<tr>
<td>Admission to ward</td>
<td>Incomplete discharge report</td>
<td>Not associated to major risks, especially given the low frequency of incidents</td>
</tr>
<tr>
<td>Admission to PICU and NICU</td>
<td>Virtually all problems were associated with a high risk</td>
<td>Not associated with major risks, especially given the low frequency of incidents</td>
</tr>
</tbody>
</table>

NICU, Neonatal Intensive Care Unit; PICU, Paediatric Intensive Care Unit.
patient safety risks in a paediatric ED and that the involvement of different professionals and parents enables the risk map to accurately reflect the real situation of the paediatric ED.

Figure 1 Definite risk map of the paediatric ED using proactive and reactive strategies. Risks identified by reactive strategies appear in italics and bold type. *proactive methods, †reactive methods.

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Contributors All the authors have contributed to the analysis of data and the brainstorming process, participated in the coordination of the study and have seen
and approved the final draft. EM conceptualised and designed the study, designed the data collection instruments, conducted the brainstorming, coordinated data collection, analysed results from brainstorming and incidents, drafted the initial manuscript and approved the final manuscript as submitted. SM conceptualised and designed the study, participated in the brainstorming, supervised data collection, supervised the analysis of data, drafted the initial manuscript and approved the final manuscript as submitted. MG revised the design of the study, participated in the brainstorming, analysed results from incidents, revised the initial manuscript and approved the final manuscript as submitted. EA revised the design of the study, participated in the brainstorming, revised the initial manuscript as submitted. EI revised the design of the study, participated in the brainstorming, analysed results from incidents, revised the initial manuscript and approved the final manuscript as submitted.

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