The Health Foundation
Inspiring Improvement

Evidence scan:

Global trigger tools

April 2010

Identify Innovate Demonstrate Encourage

Contents

Health Foundation evidence scans provide information to help those involved in improving the quality of healthcare understand what research is available on particular topics.

Evidence scans provide a rapid collation of empirical research about a topic relevant to the Health Foundation's work. Although all of the evidence is sourced and compiled systematically, they are not systematic reviews. They do not seek to summarise theoretical literature or to explore in any depth the concepts covered by the scan or those arising from it.

This evidence scan was prepared by The Evidence Centre on behalf of the Health Foundation.

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1 Introduction

1.1 What are trigger tools?

Trigger tools help identify adverse effects and areas for improvement by auditing a small sample of patient notes regularly. This research scan signposts published evidence about the benefits and challenges with this approach.

Traditionally, healthcare teams and managers have sought to detect adverse events or safety incidents using voluntary reporting methods. However, it is estimated that only 10% to 20% of errors are reported this way and of those, about nine out of 10 cause no harm to patients. A more effective method is needed to identify adverse events so teams can prioritise areas for improvement.

The term 'trigger tool' was first coined in the USA in the early 1990s to describe a method used to detect potential adverse drug events. The US Institute of Healthcare Improvement (IHI) refined this process and developed the global trigger tool to quantify adverse events more generally using a simple and replicable process. This tool has been adapted for use in the UK and in other countries and is promoted by the NHS Institute for Innovation and Improvement and various national and regional patient safety campaigns. It has also been adapted to be more relevant to specific clinical areas such as paediatrics and maternity services. Most information about global trigger tools focuses on hospitals, but tools have also been developed for use in primary care.

Global trigger tools help teams rapidly review a small sample of patient notes to identify 'triggers' that may signal harm from the patient's point of view.

When anything that may have harmed a patient is identified, teams are encouraged to take steps to improve care processes and continue rapid audit cycles regularly to monitor changes over time.

Global trigger tools list a range of possible triggers and harms. A multidisciplinary team or pair of reviewers randomly selects a small sample of patient notes, such as 10 case notes every two weeks or 20 case notes every month. The reviewers are asked to set a 20-minute time period per case note review and to rapidly scan the notes to identify triggers or clues for potential harm.

Any events identified are categorised by severity and type and used to inform safety improvement efforts. For all patient records reviewed, the length of stay is recorded, including admission and discharge days. This allows calculation of the number of adverse events per 1,000 patient days or per 100 patients. The aim is to track changes over time and demonstrate a reduction in monthly adverse events identified. See the 'descriptions of global trigger tools' in the Key References section for more details.

1.2 Why is this important?

The global trigger tool is being used throughout the UK and is promoted by campaigns sponsored by the Health Foundation such as Patient Safety First. However some trusts and teams may be using the tool as evidence that they are providing 'safe' healthcare. The tool wasn't necessarily designed for this purpose or to be comparative. It was developed for use as part of a broader package of collaborative improvement initiatives and scans only a small sample of records.

This reserch scan was undertaken to identify situations in which it is appropriate to use global trigger tools. It is not the task of this document to identify whether such tools are being used appropriately by NHS organisations and teams.

1.3 Scanning evidence

Topic scans are designed to rapidly compile published research about a particular topic. They are not designed to be exhaustive and collate all evidence, but rather to quickly collate readily available empirical research.

To compile research about how trigger tools have been used, we searched MEDLINE, Ovid, Embase, ERIC, the Cochrane Library and Controlled Trials Register, PsychLit, HealthStar, the WHO library, IHI, Health Management Information Consortium, Sigal, reference lists of identified articles and the websites of relevant agencies for information available as at April 2010.

A total of 27 relevant articles were identified. The main findings from each article are summarised in the Key References section.

1.4 What is the evidence?

Given that global trigger tools are being prioritised nationally and internationally, there is a surprising lack of published evidence about the effectiveness and utility of these tools. A lack of published evidence does not indicate a lack of effectiveness. It is possible much of the evidence remains as unpublished internal documents.

The evidence that does exist tends to describe global trigger tools in general terms and in some cases to outline how these tools have been applied in different contexts. Most of the studies about utility are based on relatively large samples drawn from multiple hospitals, usually in the USA. This means that the literature most commonly describes how the tools have been used to generate overall average adverse event rates for a large population, rather than documenting small scale use of the tool at individual organisations over time. Small scale usage at individual organisations is how the tool tends to be applied in the UK.

2 Identifying adverse events

A number of studies have outlined how global trigger tools have been used in hospital, and more recently, primary care contexts (see examples of using trigger tools in the Key References section). Most of these tools were developed by or adapted from material prepared by the US Institute for Healthcare Improvement. The objective of this literature is not to test and improve the predictive value of any individual trigger, but rather to estimate rates of adverse events within the system (Mull et al 2008).

Both manual and computerised trigger tools have been tested (see 'examples of novel implementation methods' in the Key References section). Researchers have suggested that manual approaches are lower cost and less complex than computerised approaches (Rozich et al 2003). Researchers have also found that computerised systems could save time and potentially identify triggers on a larger scale (Snow 2008). Manual and computerised systems both require staff time and commitment (Pravinkumar et al 2009).

The IHI suggests that these tools can be used to estimate the frequency of adverse events in an organisation and to determine the impact of interventions that focus on reducing adverse events (Griffin & Classen 2008). This is supported by studies suggesting that trigger tools can track changes in adverse event rates over time (Cohen et al 2005).

The IHI emphasises that global trigger tools are not designed to identify every adverse event in a patient record. However, they believe that the approach is robust enough to identify a significant proportion of adverse events, particularly in hospital contexts (Griffin & Resar 2009). Training reviewers has been found to enhance inter-rater reliability (Classen et al 2008).

Compilation of data submitted by many organisations suggests that the average number of adverse events identified by trigger tools is 90 per 1,000 patient days or 40 adverse events per 100 admissions. About 30% of all admissions experience an adverse event (Resar 2008).

3 Validity

Studies of individual items (triggers) within tools suggest that a small number may be more valid for predicting adverse events. For example, a study of a 39-item trigger tool for ambulatory primary care found that most triggers had very low positive predictive values (the ability to identify adverse events). Nine of the 39 triggers accounted for 94% of adverse drug events detected which suggests that a much shorter tool could be used (Singh et al 2009).

Some research has compared the value of trigger tools with other methods for identifying adverse events. Generally trigger tools have been found to compare well to other approaches, to be relatively sensitive and to identify significantly more adverse events compared to self report or other chart audit approaches (Pinney et al 2010, Takata et al 2008).

However, there are exceptions. One UK surgical ward found that trigger tools identified few adverse events compared to other methods such as prospective detection and retrospective review (Franklin et al 2009).

Another US study found that different assessment methods are likely to identify varying types of adverse events. The authors highlighted issues with the methods which may limit their applicability for wider public reporting and organisational comparisons including potential inconsistencies, low association with documented harm and differences in reporting across organisations (Naessens et al 2009).

On the other hand, others have concluded that because there are relatively good levels of agreement within and between review teams at different sites, the global trigger tool could be used as a measure of harm both for individual organisations and nationally (Sharek 2009).

4 Summary of findings

Overall, there is a relatively small amount of published evidence about the use and benefits of global trigger tools. Much of the available material is descriptive; making statements about the potential value and use of trigger tools but not necessarily supporting these statements with empirical evidence.

The Health Foundation is interested in what global trigger tools have and should be used for. Research has described the use of trigger tools to:

- identify adverse event rates in hospital and primary care
- monitor changes in adverse event rates over time
- estimate whether an improvement initiative has helped to reduce adverse events.

However, there is insufficient evidence to draw conclusions about the relative effectiveness of such tools for these activities.

Much of the published evidence uses trigger tools to examine a large sample of patient notes and to draw conclusions about the overall incidence of adverse events. A smaller number of studies have suggested that the tool may have some validity for making comparisons between organisations or as a broader audit of institutional safety but there is a limited evidence base for this.

Comparative studies note that global trigger tools may identify different types of adverse events to other assessment methods. Whilst some studies suggest that global trigger tools identify a larger number of events, others suggest that global trigger tools may be less effective than other assessment methods. The most common recommendation in the literature is to use a range of tools to assess adverse events and track changes rather than relying solely on global trigger tools.

5 Key references

5.1 Descriptions of trigger tools

Institute for Healthcare Improvement (undated). IHI Global Trigger Tool for Measuring Adverse Events. www.ihi.org

The IHI website describes how using triggers or 'clues' to identify adverse events may be an 'effective method for measuring the overall level of harm in a healthcare organisation.' The website provides copies of a simple trigger tool template, a detailed description of the methodology and instructions for training reviewers in how to conduct a retrospective review of patient records using triggers to identify possible adverse events. Instructions and forms are provided for collecting the data needed to track three measures: adverse events per 1,000 patient days, adverse events per 100 admissions, percent of admissions with an adverse event.

See more at:

http://www.ihi.org/IHI/Topics/PatientSafety/SafetyGeneral/Tools/IHIGlobalTriggerToolforMeasuringAEs.htm

Griffin FA, Resar RK (2009). IHI Global Trigger Tool for Measuring Adverse Events (second edition). IHI Innovation Series white paper. Cambridge, MA: Institute for Healthcare Improvement.

The IHI global trigger tool for Measuring Adverse Events provides an easy-to-use method for 'accurately identifying adverse events (harm) and measuring the rate of adverse events over time.'

In 2000, a group of 30 physicians, pharmacists, nurses, statisticians, and other professionals was established in the USA to design a medication system that is safer and more cost effective than current systems. This group developed the Trigger Tool for Measuring Adverse Drug Events which was used as a basis for developing subsequent, more generic, tools.

The authors of this white paper state that tracking adverse events over time is a useful way to tell if any changes being made are improving the safety of care. However they note that the IHI global trigger tool is not designed to identify every adverse event in a patient record. Using random sampling and a time limit aims to produce a sampling approach that is sufficient for the design of safety work in hospitals.

See more at:

http://www.IHI.org

Resar R (2008). Reflections on the Institute for Healthcare Improvement (IHI) Global Trigger Tool. AHRQ.

Without believable information about the level of harm in healthcare, it is difficult to motivate professionals and systems to change or to assess whether patient safety initiatives have any long-term effect. The global trigger tool helps organisations gain evidence for improvement.

Based on more than a decade of testing and experience in acute hospitals, a systematic method was developed. The aim is to establish a baseline level of harm (adverse events) in an organisation and then, using statistical process control rules, collect data points over time to determine improvement.

The trigger tool has unearthed greater levels of harm than were previously reported. High levels of inter-rater agreement have been found but the developers emphasise that the triggers themselves are only tools to help reviewers quickly scan and assess medical charts. In themselves they may not have a high level of statistical robustness, but they can be identified quickly during chart, review and the more triggers are identified in a chart the more likely that harm may have occurred.

Most organisations report about 90 adverse events per 1,000 patient days and 40 adverse events per 100 admissions. About 30% of all admissions experience an adverse event. These figures are not benchmarks against which hospitals should compare themselves, but rather provide an indication of the consistency with which the review method is applied.

See more at:

http://www.ahrq.gov/qual/triggers/triggers4.htm

Resar RK, Rozich JD, Classen D (2003). 'Methodology and rationale for the measurement of harm with trigger tools.' Qual Saf Health Care 12 Suppl 2: ii39-45.

Traditional approaches to identifying and quantifying harm include individual chart audits, incident reports and voluntary administrative reporting. However, these are not usually successful in improving the detection of adverse events. This article described the history, application and impact of trigger tools for identifying harm. The authors suggest that key strengths of this approach are that it is easy to train people to do and allows consistent and accurate measurement of harm.

See more at:

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1765771/?tool=pubmed

Classen DC, Lloyd RC, Provost L, Griffin F, Resar R (2008). 'Development and Evaluation of the Institute for Healthcare Improvement Global Trigger Tool.' J Patient Safety 4(3): 169-177.

This article describes refinements to the IHI global trigger tool. An initial review was undertaken by four clinicians followed by a second review by two physicians and a consensus process. The researchers measured agreement between all reviewers for the presence and severity of adverse events.

Initially, the level of agreement between the six reviewers ranged from 38% to 77%. After training, agreement between reviewers ranged from 67% to 94%. The authors concluded that training reviewers increases reliability of the trigger tool.

See more at:

http://journals.lww.com/journalpatientsafety/Abstract/2008/09000/Development_and_Evaluation_of_the_Institute_for.6.aspx

Mull HJ, Shimada S, Nebeker J, Rosen A (2008). Review of the Trigger Literature: Adverse Events Targeted and Gaps in Detection. AHRQ website.

This review summarises literature published about trigger tools up until December 2007. Forty five references were identified but some were about the process for identifying triggers or other broad topics rather than global trigger tools.

Trigger tools use patient data to look for patterns that may signal an adverse event.[1-4] When a trigger flags a record, there should be a method to further examine whether an adverse event has occurred and to plan improvements for the future. Trigger tools have been used in hospital settings to detect the rate of adverse events and to help healthcare providers investigate a possible adverse event in real time.[5-7,11] Such tools have also been applied in particular settings, such as emergency departments[8] or neonatal intensive care units,[7] or among specific patient groups, such as paediatric populations.[7-10]

Some triggers are designed to be used together as a trigger system, known as 'accounting trigger systems.[3,6,12-17] Most of these tools were developed by or adapted from IHI materials.[16] The objective of these systems is not to test and improve the predictive value of any individual trigger, but rather to estimate rates of adverse events within the system.

Other tools have been designed to identify specific adverse events or their causes,[18-23] including the cause of medical mismanagement.[25-26]

The review found that the majority of triggers and trigger tools described in the published literature are related to medications.[24] However, there are few triggers for several drugs that cause high rates of adverse events in the outpatient setting, such as contraceptives and medications for skin, eye, and dental problems.[24] Another potential gap is in triggers for outpatient surgery. Some tools are being developed specific to inpatient surgery.[22-23]

5.2 Citations referred to in this section

1 Rozich JD, Haraden CR, Resar RK (2003). 'Adverse drug event trigger tool: a practical methodology for measuring medication related harm.' Qual Saf Health Care 12(3):194-200.

2 Resar RK, Rozich JD, Classen D (2003). 'Methodology and rationale for the measurement of harm with trigger tools.' Qual Saf Health Care 12 Suppl 2:ii39-45.

3 Resar R (2006). Outpatient Adverse Event Trigger Tool v4. Cambridge, MA: IHI.

4 Classen DC, Pestotnik SL, Evans RS, Burke JP (1991). 'Computerized surveillance of adverse drug events in hospital patients. JAMA 266(20):2847-2851.

5 Penz JF, Wilcox AB, Hurdle JF (2007). 'Automated identification of adverse events related to central venous catheters.' J Biomed Inform 40(2): 174-182.

6 Resar RK, Rozich JD, Simmonds T, Haraden CR (2006). 'A trigger tool to identify adverse events in the intensive care unit.' Jt Comm J Qual Patient Saf 32(10): 585-590.

7 Sharek PJ, Horbar JD, Mason W et al (2006). 'Adverse events in the neonatal intensive care unit: development, testing, and findings of an NICU-focused trigger tool to identify harm in North American NICUs.' Pediatrics 118(4): 1332-1340.

8 Hefflin BJ, Gross TP, Schroeder TJ (2004). 'Estimates of medical device-associated adverse events from emergency departments.' Am J Prev Med 27(3): 246-253.

9 Ferranti J, Horvath MM, Cozart H, et al (2008). 'Reevaluating the safety profile of pediatrics: a comparison of computerized adverse drug event surveillance and voluntary reporting in the pediatric environment.' Pediatrics 121(5): e1201-1207.

10 Takata GS, Mason W, Taketomo C, et al (2008). 'Development, testing, and findings of a pediatric-focused trigger tool to identify medication-related harm in US children's hospitals.' Pediatrics 121(4): e927-935.

11 Rosen AK, Nebeker JR, Shimada S, et al (2007). Development and Use of Ambulatory Adverse Event Trigger Tools. Rockville MD: Agency for Healthcare Research and Quality.

12 Institute for Healthcare Improvement (2002). IHI ICU Adverse Event Trigger Tool v1. Cambridge MA: IHI.

13 Institute for Healthcare Improvement (2004). IHI Trigger Tool for Measuring Adverse Drug Events. Cambridge MA: IHI.

14 Institute for Healthcare Improvement (2006). IHI Surgical Trigger Toolkit v2. Cambridge MA: IHI.

15 Child Health Corporation of America (2006). Trigger Tool for Measuring Adverse Events in the Neonatal Intensive Care Unit. Cambridge MA: IHI.

16 Griffin FA, Resar R (2007). IHI Global Trigger Tool for Measuring Adverse Events. Cambridge MA: IHI.

17 Matlow A, Flintoft V, Orrbine E et al (2005). 'The development of the Canadian paediatric trigger tool for identifying potential adverse events.' Healthc Q 8 Spec No: 90-93.

18 Handler SM, Altman RL, Perera S et al (2007). 'A systematic review of the performance characteristics of clinical event monitor signals used to detect adverse drug events in the hospital setting.' J Am Med Inform Assoc 14(4): 451-458.

19 Bruce J, Russell EM, Mollison J, Krukowski ZH (2001). The measurement and monitoring of surgical adverse events. Health Technol Assess 5(22): 1-194.

20 Johnson RG, Arozullah AM, Neumayer L et al (2007). 'Multivariable predictors of postoperative respiratory failure after general and vascular surgery: results from the patient safety in surgery study.' J Am Coll Surg 204(6): 1188-1198.

21 Neumayer L, Hosokawa P, Itani K et al (2007). 'Multivariable predictors of postoperative surgical site infection after general and vascular surgery: results from the patient safety in surgery study.' J Am Coll Surg 204(6): 1178-1187.

22 Murff HJ, Forster AJ, Peterson JF et al (2003). 'Electronically screening discharge summaries for adverse medical events.' J Am Med Inform Assoc 10(4): 339-350.

23 Melton GB, Hripcsak G (2005). 'Automated detection of adverse events using natural language processing of discharge summaries.' J Am Med Inform Assoc 12(4): 448-457.

24 Thomsen LA, Winterstein AG, Sondergaard B, et al (2007). 'Systematic review of the incidence and characteristics of preventable adverse drug events in ambulatory care.' Ann Pharmacother 41(9): 1411-1426.

25 Mackinnon NJ, Hepler CD (2002). 'Preventable drug-related morbidity in older adults, 1. Indicator development.' J Manag Care Pharm 8(5): 365-371.

26 Singh H, Thomas EJ, Khan MM, Petersen LA (2007). 'Identifying diagnostic errors in primary care using an electronic screening algorithm.' Arch Intern Med 167(3):302-308.

See more at:

www.ahrq.gov/qual/triggers/triggers1.htm

5.2 Examples of using trigger tools to identify adverse events

Hospital context - medication

Rozich JD, Haraden CR, Resar RK (2003). 'Adverse drug event trigger tool: a practical methodology for measuring medication related harm.' Qual Saf Health Care 12(3):194-200.

This article describes the initial adverse drug event trigger tool developed in the USA, upon which the more general global trigger tool is based. Medication incidents are the single most frequent source of healthcare adverse events. Assessing the safety of drug use is difficult because traditional methods such as chart audits and voluntary reporting are expensive and ineffective. Computerised methods for detecting adverse drug events have been used to search for key words or triggers in a patient's medical record. These processes have been found to be effective but expensive and may require customised software linked to pharmacy databases.

In contrast, the manual trigger tool is a relatively low cost and low tech approach. Research suggests that manual record review can increase the rate of adverse drug event detection by about 50-fold over traditional reporting methodologies.

See more at:

www.ncbi.nlm.nih.gov/pmc/articles/PMC1743719/?tool=pubmed

Cohen MM, Kimmel NL, Benage MK, Cox MJ, Sanders N, Spence D, Chen J (2005). 'Medication safety program reduces adverse drug events in a community hospital.' Qual Saf Health Care 14(3): 169-74.

This study assessed the impact of a community hospital-based programme on adverse drug events. An audit of discharged hospital patients was conducted from January 2001 to December 2003. Baseline data were collected for the first six months. Drug protocols and other interventions were then implemented on the nursing units and in the pharmacy department over the next nine months. Each month a random sample of patient charts was reviewed for adverse drug events using a trigger tool.

During the baseline period 31% of patients had one or more adverse drug events. This declined threefold during the study period ($p<0.001$). Median adverse drug events per 1,000 doses of medication dispensed declined from 2.04 to 0.65 ($p<0.001$). Median adverse drug events per 100 patient days declined from 5.07 to 1.30 ($p<0.001$).

The authors concluded that a series of low cost interventions focused on high risk medications can improve patient safety and that trigger tools can be useful for tracking changes over time.

See more at:

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1744034/?tool=pubmed

Hospital context - surgery

Griffin FA, Classen DC (2008). 'Detection of adverse events in surgical patients using the Trigger Tool approach.' Qual Saf Health Care 17(4):253-8.

It is estimated that surgical adverse events account for half to three quarters of all adverse healthcare events. This study reports on the development and testing of a trigger tool to detect adverse events among people undergoing surgery in hospital.

During a 12-month IHI Perioperative Safety Collaborative, 11 hospitals submitted data from surgical inpatient record reviews. In 854 patients, 138 surgical adverse events were detected, providing a rate of 16 surgical adverse events per 100 patients or 15% of patients. Of these events, 44% contributed to increased length of stay or readmission and 9% required life-saving intervention or resulted in permanent harm or death. Hospital review teams reported that most of the events identified using the trigger tool had not

been detected or reported via any other existing mechanism. The researchers concluded that the IHI Surgical Trigger Tool may be an easy-to-use approach to detecting safety incidents and 'can be the basis not only for estimating the frequency of adverse events in an organisation, but also determining the impact of interventions that focus on reducing adverse events in surgical patients.'

See more at:

www.ncbi.nlm.nih.gov/pubmed/18678721

Pinney D, Pearce DJ, Feldman SR (2010). 'Detecting adverse events in dermatologic surgery.' Dermatol Surg 36(1): 8-14.

There is little research about how adverse events can or should be monitored in dermatologic surgery. This literature review summarises strategies for detecting adverse outcomes of dermatologic surgical procedures, based on a Medline search.

Common methods identified include:

- morbidity and mortality conference
- retrospective medical record review
- retrospective trigger tools
- anonymous electronic reporting

Trigger tools were among the most sensitive approaches.

The authors concluded that there is no current standard for reporting adverse events in dermatological surgery and that there is a lack of high quality data about different reporting methods.

See more at:

www.ncbi.nlm.nih.gov/pubmed/19968691

Hospital context – maternity services

Wrightington, Wigan and Leigh Foundation Trust have adapted the tool for use in maternity services:

See more at:

www.institute.nhs.uk/hia_-_other_submissions/other_submissions/global-trigger-tool-in-obstetrics.html

Hospital context – intensive care

Pravinkumar SE, Warren ML, Bruno JJ, Nwankwo C, Finch CG, Ghosh S, Price KJ (2009). 'Implementation of the Institute for Healthcare Improvement global trigger tool in an oncological ICU: pilot data.' Chest (published online November 2009).

It has been suggested that only 10% to 20% of errors are identified using voluntary reporting methods and that nine out of 10 of these cause no harm to patients. Researchers have tested the value of the global trigger tool for identifying adverse events in an oncology intensive care unit (ICU).

Ten ICU patient discharges were randomly selected over a period of one month; five from the medical ICU and five from the surgical ICU. Patient charts were reviewed by a multidisciplinary critical care team following IHI guidelines. A total of 41 adverse event triggers and three adverse events were identified; two of which related to infection and one was related to medication. The median time taken for chart review was 30 minutes (range 10 to 45 minutes).

The median ICU length of stay was 1.65 days (range: one day to 7.3 days). Increased length of stay was associated with increased triggers and time for chart review but not an increase in adverse events. The authors concluded that the global trigger tool is effective for identifying adverse events but that successful implementation requires a dedicated multidisciplinary team and an effective data collection process.

See more at:

http://meeting.chestpubs.org/cgi/content/abstract/136/4/27S-b

Resar RK, Rozich JD, Simmonds T, Haraden CR (2006). 'A trigger tool to identify adverse events in the intensive care unit.' Jt Comm J Qual Patient Saf 32(10): 585-90.

The US Institute for Healthcare Improvement has tested a variety of global trigger tools, including those for adverse medication events, neonatal intensive care events, and a general tool for measuring all event categories in a hospital. The trigger tools are meant to be used as an adjunct to voluntary reporting.

This study describes how the trigger tool was used to identify the rate of adverse events in intensive care units (ICU). Sixty-two ICUs in 54 hospitals taking part in IHI critical care collaboratives between 2001 and late 2004 took part. Charts were selected at random for review.

Out of 12,074 ICU admissions, there were 11.3 adverse events per 100 patient days. A subset of 1,294 charts from 13 ICUs were reviewed in detail. Here, the prevalence was 16.4 events per 100 ICU days. Fifty-five per cent of the charts in this subset contained at least one adverse event.

The authors concluded that the trigger tool is a practical approach to increase the detection of adverse events in ICU patients which can in turn be used to guide improvement priorities.

See more at:

www.ncbi.nlm.nih.gov/pubmed/17066996

Agarwal S, Classen D, Larsen G, Tofil NM, Hayes LW, Sullivan JE, Storgion SA, Coopes BJ, Craig V, Jaderlund C, Bisarya H, Parast L, Sharek P (2010). 'Prevalence of adverse events in pediatric ICUs in the United States.' Pediatr Crit Care Med 2010 (published online March 2010).

This study examined the rates of adverse events and adverse drug events in paediatric ICUs by developing a trigger tool specific to this environment.

The research involved retrospective, cross-sectional review of 734 randomly selected patient records for children discharged from 15 US paediatric intensive care units between September and December 2005.

62% of patients had at least one adverse event, equating to a rate of 28.6 adverse events and 4.9 adverse drug events per 100 patient days. The adjusted cumulative risk of an adverse event per patient day was 5.3%, or 1.6% for an adverse drug event alone. The risk of adverse drug events increased by 4% with each extra year in age.

The most common types of adverse events were catheter complications, uncontrolled pain and endotracheal tube malposition. 10% of adverse events were classified as life-threatening or permanent and 45% were judged preventable. Children undergoing surgery had higher rates of adverse events as did those intubated at some point during their stay.

The authors concluded that adverse events and adverse drug events occur frequently in the paediatric intensive care setting and that a trigger tool can be useful for identifying risk in this environment.

See more at:

www.ncbi.nlm.nih.gov/pubmed/20308932

Larsen GY, Donaldson AE, Parker HB, Grant MJ (2007). 'Preventable harm occurring to critically ill children.' Pediatr Crit Care Med 8(4):331-6.

This study describes using a trigger tool to identify adverse events in critically ill paediatric patients. The study took place in a US paediatric intensive care unit within a tertiary, university-affiliated hospital. Records were reviewed for a random sample of 259 children over one year.

There were 0.19 preventable adverse events per patient-day. 78% were minor, 19% were moderate and 3% were serious. Patients who experienced preventable adverse events tended to be younger, had longer lengths of stay, had more complex conditions and were likely to have undergone surgery. The authors concluded that preventable adverse events occurred fairly frequently in the paediatric intensive care unit, but serious harm was rare.

See more at:

www.ncbi.nlm.nih.gov/pubmed/17417126

Primary care context

The NHS Institute for Innovation and Improvement has tested a global trigger tool for primary care, suggesting that the tool can identify potential patient harm.

See more at:

http://internationalforum.bmj.com/2010-forum/international-forum-posters/poster-files/1804%20NHS%20Safer%20Care%20A4%20Flyer.pdf

de Wet C, Bowie P (2009). 'The preliminary development and testing of a global trigger tool to detect error and patient harm in primary care records.' Postgrad Med J 85(1002): 176-80.

This study outlines the development of a global trigger tool to detect adverse events in primary care records in the UK. The primary care trigger tool was informed by previous research and content validated by experts. The tool was tested by trained reviewers who worked in pairs to conduct chart reviews of 100 randomly selected electronic patient records in each of five urban general practices in Scotland.

A review of 500 records revealed 2,251 consultations and 730 triggers. The findings suggest that harm occurred at a rate of one event per 48 consultations. Of these, 27 were judged to be preventable (42%). Harm severity was low to moderate for most people (83%). Adverse event rates were higher among those older than 60 years and most were medication-related (59%).

The trigger tool successfully identified previously undetected patient harm in primary care records. However, the feasibility of its routine application is open to question because it is time and resource intensive. The trigger tool may be useful for research rather than as an audit technique.

See more at:

www.ncbi.nlm.nih.gov/pubmed/19417164

Singh R, McLean-Plunckett EA, Kee R, Wisniewski A, Cadzow R, Okazaki S, Fox C, Singh G (2009). 'Experience with a trigger tool for identifying adverse drug events among older adults in ambulatory primary care.' Qual Saf Health Care 18: 199-204.

Trigger tools have been used to identify adverse drug events among older adults in ambulatory primary care practices. Six primary care practices used a 39-item trigger tool to undertake a retrospective 12-month chart review for people aged 65 or older with cardiovascular diagnoses. Charts with triggers underwent detailed review by a doctor and a pharmacist.

Of 1,289 charts reviewed, 645 (50%) had at least one trigger. A random sample of 383 of these charts underwent further review (an average of 64 charts per practice). Among the 908 triggers in these charts, 232 were deemed to represent adverse drug events (26%), of which 92 were deemed preventable and 30% of these were severe.

The researchers concluded that trigger tools may have a role in supporting quality improvement in ambulatory primary care. However, of the 39 items in the trigger tool, most triggers had very low positive predictive values (the ability to identify adverse drug events). Nine of the 39 triggers accounted for 94% of adverse drug events detected, which suggests that a much shorter tool could be used.

See more at:

http://qshc.bmj.com/content/18/3/199.abstract

5.3 Effectiveness for identifying events and tracking change

Franklin BD, Birch S, Savage I, Wong I, Woloshynowych M, Jacklin A, Barber N (2009).'Methodological variability in detecting prescribing errors and consequences for the evaluation of interventions.' Pharmacoepidemiol Drug Saf 18(11): 992-9.

This study compared four methods for detecting prescribing adverse events in the same patient cohorts before and after an intervention (computerised order entry system). The aim was to test whether the impact of the intervention was identified consistently by all methods. The study was conducted in one surgical ward in a UK teaching hospital.

Detection methods included:

- prospective detection by a ward pharmacist
- retrospective health record review
- retrospective use of a trigger tool
- spontaneous reporting over two separate four-week periods

Nonety-three patient records were reviewed before the intervention and 114 were reviewed afterwards. Using all four methods, prescribing adverse events were identified in 10.7% of all medication orders before the intervention and 7.9% afterwards. However there was little overlap in the adverse events detected by the different methods.

Prospective detection identified 36% of all adverse events before the intervention and 24% afterwards. Retrospective review revealed 69% of adverse events before the intervention and 83% afterwards. The trigger tool identified zero adverse events before the intervention and 2% afterwards. Spontaneous reporting identified 1% of adverse events before the intervention and 1% afterwards.

The calculated relative reduction in risk of adverse events was 50% using prospective data, 12% with retrospective review and 26% using data from all four methods. In this study, the trigger tool did not identify a high proportion of events and was less useful for tracking improvements over time. The authors concluded that a combination of methods may be needed to understand the effectiveness of different interventions.

See more at:

www.ncbi.nlm.nih.gov/pubmed/19634116

Naessens JM, Campbell CR, Huddleston JM, Berg BP, Lefante JJ, Williams AR, Culbertson RA (2009). 'A comparison of hospital adverse events identified by three widely used detection methods.' Int J Qual Health Care 21(4):301-7.

This cross-sectional study in the USA aimed to examine the degree of similarity between various ways to measure adverse events. The population of interest was all inpatients discharged from Mayo Clinic Rochester hospitals in 2005 (n = 60,599).

Adverse events were identified using:

- patient safety indicators defined by the US Agency for Healthcare Research and Quality using ICD-9 diagnosis codes from administrative discharge abstracts
- provider-reported events
- IHI global trigger tool with physician confirmation.

About 4% (2,401) of hospital discharges had an adverse event identified by at least one method. Patients with adverse events identified by one method were not usually identified using another method.

Different detection methods identified different adverse events. The authors suggested that organisations should combine various approaches to measure patient safety for internal quality improvement.

They pointed out issues with the methods which may limit their applicability for wider public reporting and organisational comparisons including potential inconsistencies, low association with documented harm and differences in reporting across organisations.

See more at:

www.ncbi.nlm.nih.gov/pubmed/19617381

Takata GS, Taketomo CK, Waite S (2008). 'Characteristics of medication errors and adverse drug events in hospitals participating in the California Pediatric Patient Safety Initiative.' Am J Health Syst Pharm 65(21): 2036-44.

This study examined adverse drug events between November 2003 and April 2004 in hospitals participating in the California Paediatric Patient Safety Initiative. Data were collected using three methods:

- pharmacy identified adverse events
- paediatric trigger tool
- voluntary incident reports.

The rate of adverse events per 1,000 patient days was 2.67 for the pharmacy identified method, 22.3 for the trigger tool and 1.7 for voluntary incident reports. Each method was likely to identify different types of adverse events.

The trigger tool identified 11 times more adverse drug events than voluntary incident reports and had a positive predictive value of 16.8%. The authors concluded that it was easier to identify adverse drug events when using a trigger tool rather than relying on voluntary reporting.

See more at:

www.ncbi.nlm.nih.gov/pubmed/18945863

Takata GS, Mason W, Taketomo C, Logsdon T, Sharek PJ (2008). 'Development, testing, and findings of a pediatric-focused trigger tool to identify medication-related harm in US children's hospitals.' Pediatrics 121(4):e927-35.

This study describes the development of a paediatric-focused trigger tool for detecting adverse drug events. Eighty patients from each of 12 US hospitals were randomly selected for retrospective chart review. All adverse drug events identified using the trigger tool were evaluated for severity and preventability. Each trigger and the entire tool were evaluated for positive predictive value.

Randomly selected charts (960) revealed 2,388 triggers (2.49 per patient) and 107 unique adverse drug events. Mean adverse drug event rates were 11.1 per 100 patients, 15.7 per 1,000 patient-days, and 1.23 per 1,000 medication doses. The positive predictive value of the trigger tool was 3.7%. Only 3.7% of adverse drug events were identified in existing hospital-based occurrence reports.

22% of all adverse drug events were judged preventable, 18% could have been identified earlier and 17% could have been mitigated more effectively.

The authors concluded that adverse drug events in hospitalised children are more common than previously known and that a trigger tool is an effective way to identify adverse events.

See more at:

http://pediatrics.aappublications.org/cgi/content/full/121/4/e927

Sharek PJ, Horbar JD, Mason W, Bisarya H, Thurm CW, Suresh G, Gray JE, Edwards WH, Goldmann D, Classen D (2006). 'Adverse events in the neonatal intensive care unit: development, testing, and findings of an NICU-focused trigger tool to identify harm in North American NICUs.' Pediatrics 118(4):1332-40.

This study developed and tested a trigger tool for use in neonatal intensive care units. Fifty children with a minimum two-day stay in the intensive care unit were randomly selected from each of 15 sites. All adverse events identified using the trigger tool were evaluated for severity and preventability. Each trigger, and the entire tool, was evaluated for positive predictive value.

A review of 749 randomly selected charts found 0.74 adverse events per patient. In aggregate, chart reviewers identified 88% of all potential triggers and 92.4% of all potential adverse events. The positive predictive value of the trigger tool was 0.38. Only 8% of adverse events were identified in existing hospital-based occurrence reports.

56% of all adverse events were deemed preventable, 16% could have been identified earlier and 6% could have been mitigated more effectively. Adverse event rates were higher for younger patients.

The authors concluded that the trigger tool appears effective for identifying adverse events.

See more at:

http://pediatrics.aappublications.org/cgi/content/full/118/4/1332

Asavaroengchai S, Sriratanaban J, Hiransuthikul N, Supachutikul A (2009). 'Identifying adverse events in hospitalized patients using global trigger tool in Thailand.' Asian Biomedicine 3(5).

Researchers in Thailand found that hospital incidence reporting systems might result in underreporting of adverse events. Therefore they tested the feasibility of the global trigger tool for detecting adverse events in a developing country. The tool was used to examine a large sample of records all at once.

In January 2008 a cross-sectional review of the medical records of 576 people who were hospitalised was conducted at one hospital. Teams of reviewers used the global trigger tool to identify adverse events, severity rating, and preventability and classified events according to the Patient Safety Goals of Thailand.

A total of 4,460 patient-days were included and 236 adverse events were detected, giving a mean rate of 41 events per 100 patients or 50.4 events per 1,000 patient-days. 53% of the events involved temporary harm and 52% were judged to be preventable. 32% were related to patient care processes, 20% involved surgery and 18% were linked to medication and blood safety.

The researchers concluded that the global trigger tool identified a greater number of events than other methods, but most had low severity. It was suggested that the tool needed further validation before being applied in routine medical practice in developing countries.

5.4 Validity of using trigger tools for wider audits

Sharek PJ (2009). 'The North Carolina Harm Study: Validating the IHI Global Trigger Tool (GTT) as a Potential National Harm Measure.' Research in Progress Seminar: Stanford University.

In the USA, studies have been undertaken to assess the suitability of the global trigger tool for use as a measure of patient harm at individual hospitals and whether this may be useful for informing a national harm measurement system.

Retrospective reviews were undertaken of 10 patient charts per quarter from 10 randomly selected acute care hospitals in North Carolina over a six year period (2002-07). Charts were reviewed by internal teams and those external to the hospital, and 10% of the charts were reviewed by a 'gold standard' team of reviewers from IHI. Each team applied the global trigger tool methodology and the harms identified were compared within and between teams.

Internal hospital teams found average harm rates of 22.9 per 100 patients (95% CI 21.4, 24.9). External teams found average harm rates of 17.2 per 100 patients (95% CI 15.6, 19.0) and gold standard reviewers found 36.6 per 100 people (95% CI 28.8, 46.0). There was a high level of intra-rater agreement in internal teams. Internal teams were more likely than external teams to have ratings similar to the gold standard reviewers regarding identification of harm, number of harms and severity of harm.

The researchers concluded that there were relatively good levels of agreement within and between the review teams and that this may indicate that the global trigger tool could be used as a measure of harm both for individual hospitals and nationally.

See more at:

http://healthpolicy.stanford.edu/events/the_north_carolina_harm_study_validating_the_ihi_global_trigger_tool_gtt_as_a_potential_national_harm_measure/

5.5 Examples of novel implementation methods

Snow D (2008). Trigger Tool Implementation Experiences in Kaiser Permanente. AHRQ.

Kaiser Permanente is the largest not-for-profit health plan in the USA, serving about nine million people. It has more than 30 hospitals, over 400 medical office buildings, about 13,000 doctors and more than 159,000 employees. It is well known for being an integrated system with a focus on prevention.

Kaiser Permanente tested the global trigger tool in 2006, a trigger tool for intravenous heparin therapy in 2007 and an automated adverse event monitoring programme which aims to automate the global trigger tool.

Initially the global trigger tool was pilot tested at six medical centres in California. Data from two centres found that the tool detected harm in over 30% of the charts reviewed. About half of the adverse events fell in four categories: medication events (22%), infection (15%), surgical complications (8%), blood pressure (8%).

A trigger tool focused on IV heparin therapy was piloted at one medical centre. Twenty patient charts representing 50 days of treatment were reviewed by a multidisciplinary team consisting of a hospital pharmacist, risk director, quality director and nurse. Half of all charts had triggers and 25% experienced harm.

Two of the main challenges with implementing trigger tools are resourcing and a perceived lack of actionability of the findings. Implementing paper-based trigger tools does not replace carrying out surveillance processes, so additional time is needed to use trigger tools. Medical centres have questioned the value of this because the small numbers reviewed may not provide compelling evidence to move forward with improvement activity.

Kaiser Permanente is now testing how to automate the global trigger tool using data from its electronic medical record system. A computer program has been developed to searches the electronic medical record of hospitalised patients for triggers. This is still in development but it is anticipated that automating the search for triggers across a hospitalised population will identify greater numbers of triggers to be evaluated, which in turn may be seen as a more robust evidence base for improvement.

See more at:

www.ahrq.gov/qual/triggers/triggers8.htm

Matlow A, Flintoft V, Orrbine E, Brady-Fryer B, Cronin CM, Nijssen-Jordan C, Fleming M, Hiltz MA, Lahey M, Zimmerman M, Baker GR (2005). 'The development of the Canadian paediatric trigger tool for identifying potential adverse events.' Healthc Q 8: 90-3.

This study investigated using a computerised system to identify triggers to make chart review less labour intensive and more effective. Customised software linked to the patient's electronic medical record and hospital pharmacy system was used to identify triggers that prompted more detailed chart review. Four of the six modules from the IHI trigger tool were included (care, medication, surgical and intensive care) plus an additional module on laboratory tests.

A spreadsheet was used to compare a range of trigger tools and a new tool with 94 triggers was established. It was recognised that this was too many triggers so expert review narrowed the triggers to 40. Detailed outcomes are not reported in this paper.

See more at:

www.longwoods.com/product.php?productid=17671

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