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The original publication is available at www.springerlink.com:

Persephone Doupi, Helge Svaar, Brian Bjorn, Ellen Deilkas, Urban Nylen and Hans Ruthberg, Use of the Global Trigger Tool in patient safety improvement efforts: Nordic experiences, 2015, Cognition, Technology & Work, (17), 1, 45-54.
http://dx.doi.org/10.1007/s10111-014-0302-2

Cogn Tech Work (2015) 17:45–54
DOI 10.1007/s10111-014-0302-2

ORIGINAL ARTICLE

# Use of the Global Trigger Tool in patient safety improvement efforts: Nordic experiences

**Persephone Doupi · Helge Svaar · Brian Bjørn · Ellen Deilkås · Urban Nylén · Hans Rutberg**

Received: 13 October 2012 / Accepted: 9 November 2013 / Published online: 12 October 2014


**Abstract** The Global Trigger Tool (GTT) developed by the Institute for Healthcare Improvement is a method for retrospective patient record review based on the use of 'triggers'—signals of potential adverse events that have caused patient harm. The method has the purpose of patient safety measurement and monitoring among adult inpatient populations and has been increasingly popular among Nordic countries. Use of the GTT in the Nordic area has been part of broader legal and policy actions and initiatives supportive of patient safety promotion and is being used to establish also national level estimates of patient safety incidents. Limitations of the method are its dependency on quality of documentation and the varying inter-rater reliability observed in many studies. Strengths of the GTT are its ability to detect larger numbers, as well as different types of adverse events when compared to other incident detection methods, hence it is a good addition to the palette of means for organizational patient safety monitoring. Research on reliability, usefulness and implementation approaches of the GTT, including its automation, is ongoing in the Nordic countries and is expected to generate useful input for the international patient safety community.

**Keywords** Patient safety monitoring · Hospitals · Global Trigger Tool · Electronic patient record · Nordic countries

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## 1 Introduction

The IHI Global Trigger Tool (GTT) is a retrospective method for monitoring patient safety levels within a healthcare provider organization. Its aim is to enable longitudinal comparisons and assessment of implemented patient safety measures and support the identification of target areas for improvement. A distinct feature of the IHI Trigger Tool methodology is its focus on actual harm (restricted to physical injury) inflicted to patients (Griffin and Resar 2009; IHI 2011). The underlying rationale is that surveillance of events that have led to harm is a more focused and hence more effective approach to developing a strategy for injury reduction (Resar et al. 2003). The method is paper-based, in other words, it does not require or depend on the use of health information systems, although many have identified the benefits of integration with the electronic patient record (Classen et al. 2011; Naessens et al. 2010). Use of the GTT seems to be on the rise at least in the USA and in the Nordic countries, as part

of large organizational, as well as national patient safety programmes. In this paper, we focus on the current status of GTT implementation for purposes of patient safety monitoring in Nordic hospitals, including experimentations for further development of electronic tools. Moreover, methodological issues and potential limitations and strengths of the tool as identified through a review of the literature are reflected upon and discussed against the backdrop of the authoring team's practical experiences.

## 2 Patient safety in the Nordic countries

Measurements of quality—of which patient safety is an essential dimension (Arah et al. 2006), have long been an issue in health care. However, only during the last decade, patient safety has become an entity and a target area for specific improvement efforts. Nordic countries have been in the forefront of patient safety activities in the European context, although in each country matters have progressed with a different intensity, areas of focus and speed of uptake. In the course of the last five years particularly, the legal and policy frameworks around patient safety have become clearer and more specific (see Table 1).

Denmark was the first Nordic country to perform a national study of the rate of patient safety adverse events (Schiøler et al. 2001). The study detected an adverse event in 9 % of hospital admissions. As of January 1, 2004, the Danish Patient Safety Act came into effect, mandating the first national patient safety incident reporting system in the world (Danish National Board of Health 2007). In 2008, the Swedish National Board of Health and Welfare published a large-scale retrospective medical record review on the level of injuries in Swedish hospital care (Soop et al. 2009). The study evoked interest in both the healthcare sector and in the media and is still a source for estimation of the extent of the problem with injuries. The results indicated that an avoidable injury to the patient occurs in approximately 8.6 % of hospital stays. Out of those injuries approximately 3 % were considered to have contributed to the death of the patient.

In Norway, the National Unit for Patient Safety was established as part of the Norwegian National Knowledge Centre for Healthcare in 2007. In 2009, the health minister mandated a patient safety campaign, which was launched in January 2011 (Norwegian Ministry of Health and Care Services 2011). The 3-year campaign aims to reduce patient harm and involves both specialist and primary healthcare services.

As of 2012, the health and care services have a statutory duty of systematic work with quality improvement and patient safety. The responsibility of the hospitals with

**Table 1** Overview of patient safety activities in the Nordic countries

| | Denmark | Finland | Norway | Sweden |
|---|---|---|---|---|
| Legal framework | Act on patient safety (2004) | Decree of the Ministry of Social Affairs and Health for quality management and the implementation of the patient safety plan (2010) | Statutory duty of systematic work with quality improvement and patient safety (2012) | Lex Maria, National Board of Health and Welfare (Socialstyrelsen) 2005 Health and Medical Service Act 1982:763, Patient Safety Act 2010:659 |
| National epidemiological data | Incidence of adverse events in hospitals. A retrospective study of medical records (2001) | Extrapolations from other national level studies | First estimates based on national GTT use in 2011 (data of March–December 2010) | The incidence of adverse events in Swedish hospitals: a retrospective medical record review study (2009) |
| Dedicated national body | Several organizations and bodies with different roles in the patient safety landscape (e.g., National Health and Medicines Agency, National Agency for Patients' Rights and Complaints, the regions) | No formal body. Several organisations with various roles related to patient safety. Programme's coordinating team resides in National Institute for Health and Welfare | National Unit for patient Safety (part of the Norwegian National Knowledge Centre for Healthcare –2007) | The Swedish Association of local Authorities and Regions (SALAR, SKL) National Board of Health and Welfare (Socialstyrelsen) |
| Large-scale patient safety programmes | Operation Life, Danish Safer Hospital Programme | Patient Safety with Skill Programme 2011–2015 | National Patient safety campaign (In Safe Hands), launched in January 2011 | National initiative for improved patient safety launched by (SALAR, SKL) in 2007. Government national patient safety initiative introducing financial incentives for the caregivers for the years 2011–2014. |

regard to serious events has increased, and a special emergency unit of the Board of Health has been established, in an effort to improve learning from adverse events. In order to convert the focus of the national reporting system from litigation to learning, the national reporting system has been moved from the Norwegian Board of Health Supervision to the Knowledge Centre. This demanded a change in the law which was passed by the parliament. In 2012, a new proposal on patient safety and quality in health care was presented to the parliament. The proposal includes policy elements and informs on new potentials for law adjustments.

In Sweden, a national initiative for improved patient safety with a special focus on the reduction of hospital acquired infections was launched by the Swedish Association of Local Authorities and Regions (SALAR, SKL) in 2007. The government followed with a national patient safety initiative in 2010, introducing financial incentives for the caregivers and action plans for the years 2011–2014. A new patient safety law in 2011 (Swedish Code of Statutes 2010) and a zero vision for preventable injuries, all indicate increased attention from politicians and implicate higher activity in the field from the care providers.

In Finland, since the publication of the first patient safety strategy in 2009, patient safety activities have been steadily gaining momentum. The coming into force of the long awaited Healthcare Service Act (Finnish Ministry of Social Affairs and Health 2010), including a specific clause on patient safety and quality, and the respective Decree (Finnish Ministry of Social Affairs and Health 2011) have provided a clear legal framework for patient safety activities. At the same time, healthcare service provider organizations are being held accountable for meeting specific requirements, including the follow-up and monitoring of patient safety. The national patient safety programme, launched in the fall of 2011 (Väisänen and Milén 2012), has acknowledged the need and importance of patient safety measurement but has not as yet endorsed any particular tool for the purpose. Rather, the primary emphasis has been on gradually educating all healthcare personnel on the basics of patient safety through a large-scale online training programme.

## 3 Context and status of GTT implementation

### 3.1 Denmark

In Denmark, first experiences with the GTT method were gained in a project by the Danish Cancer Society which aimed to assess the risks of hospitalized cancer patients in the country. The researchers used a combination of two methods: A GTT-based review of 527 patient records and analysis of patient safety events sent to the Danish Patient Safety Database (DPSD). They found that each method captured different types of adverse events and concluded that combination of different approaches is needed in order to get as full as possible a picture of causes of harm (Lipczak et al. 2011). A much larger project was undertaken in 2008 (Center for Quality, Region of Southern Denmark 2008) with hospital-level implementation and piloting of the tool. At that point, although 3 years had passed since the start of adverse event reporting to the DPSD, it was still not possible to assess the extent by which patient safety promotion efforts had actually resulted in a reduction of the number of patient injuries. The GTT was viewed as a validated tool that could be utilized to illustrate the extent of iatrogenic injuries. The Danish version of the method was produced through translation and adaptation to Danish conditions of the IHI original paper and its Swedish version (Center for Quality, Region Southern Denmark 2008). A clinical expert customized triggers to reflect more appropriately areas such as Danish laboratory values and clinical practices. A GTT learning kit was sent to all hospitals in January 2009. The project provided very useful insight in the practical aspects of using the tool (among others, composition of reviewing teams, training and statistical support) and also pointed out the need for continued validation and development of the method in the context of Nordic and broader international collaboration. More recently, in the framework of the Safer Hospital initiative, which is a collaboration between the Danish Society for Patient Safety, the Danish Regions, the TrygFonden Foundation and the IHI, targets of 15 % reduction in 30-day mortality and 30 % reduction in unintended harm (as measured by the GTT) were set. Five geographically distributed hospitals are participating to the initiative. As part of the quality strategy for 2011–2014, the Center for Quality in South Denmark made the decision to systematically apply the GTT in all hospital units. Presently, the GTT material is undergoing revision in collaboration between the Danish Society for Patient Safety and the Region of Southern Denmark.

### 3.2 Finland

Between 2008 and 2011, the IHI GTT classic method has been used as part of two hospitals' patient safety projects (Hospital District of Southwest Finland and Vaasa Central Hospital). Severity and preventability of the identified adverse events have also been assessed. The intention is to continue with implementation of IHI's GTT in different hospital departments. It is expected that using the methodology on the department level will produce more accurate and detailed information. However, this also requires

the translation and validation of additional triggers related to, e.g., day surgery, pediatrics and psychiatry.

Pilots adapting the GTT in neurosurgery and NICU environments have been undertaken in the Tampere University Hospital (TAYS), accompanied by experimentation with data mining approaches (Öhman et al. 2011). Finally, there has been a preliminary assessment of the fitness of the national minimum data set for electronic health records to support such applications (Doupi et al. 2013).

### 3.3 Norway

In Norway, first experience with use of the GTT begun from Akershus hospital,[1] where the tool was combined with patient safety culture measurements. During the period of January–May 2007, the Akershus University Hospital's Quality Department checked the records of a random sample of 481 patient records in four of the hospital's departments using the IHI GTT method. (Deilkås and Hofoss 2008). Overall, in the period 2007–2010, 6,368 patient records (2,906 in the surgical and 3,462 records in the internal medicine department) were reviewed using the GTT (Svaar 2012). The results were used to promote improvement in the areas of hospital acquired infections, in conjunction with campaigns on hand hygiene and the introduction of the WHO Surgical Safety Checklist.

#### *3.3.1 The national patient safety campaign*

One of the missions of the campaign is to uncover the extent of patient harm in Norwegian health care. The first step is a national review of patient records in order to achieve an overview of patient harm in the country. Throughout the campaign, all hospital trusts will continue to conduct review of patient records using the GTT, as a means of detecting patient harm. The figures will be used to monitor the improvement of each individual healthcare provider organization, rather than compare hospitals (Norwegian Ministry of Health and Care Services 2011).

Preliminary results were reported in the fall of 2011 (In Safe Hands 2011) based on data submitted from 11 out of 19 health authorities, and the official report was published in December 2011, presenting the final results of the first year of national GTT use (Deilkås 2011). Eighteen out of 19 trusts and five private hospitals eventually submitted results. A total of 39 GTT teams reviewed the medical records from minimum 200 randomly selected hospital admissions of patients that had been discharged between March 1 and December 31, 2010. Records of 7,819 admissions were reviewed.

- A total of 16 % of the hospital admissions included at least one adverse event (95 % CI 14–18 %; min 3.5 %–max 38 %).
- A total of 7 % of the hospital admissions included at least one adverse event that led to prolonged hospitalization (95 % CI 6–9; min 2 %–max 18 %).
- A total of 1 % of the hospital admissions included at least one adverse event that caused the patient permanent harm (95 % CI 0.8–1.4 %; min 0 %–max 3 %).
- A total of 0.66 % of the hospital admissions involved patient harm that contributed to death (95 % CI 0.48–0.83 %; min 0 %–max 2 %).
- A total of 9 % of the admissions involved an adverse event that led to prolonged hospitalization or more serious consequences (F to I categories) (95 % CI 7–10 %; min 2.5 %–max 21 %).

The procedure was repeated in 2011 (Delkås 2013). This time 47 GTT teams reviewed 240 admissions. All 19 health authorities participated, reviewing 9,808 admissions in total.

- A total of 16 % of the hospital admissions included at least one adverse event (95 % CI 15–18 %; min 4 %–max 29 %).
- A total of 9 % of the admissions involved an adverse event that led to prolonged hospitalization or more serious consequences (F to I categories) (95 % CI 8–10 %; min 2.1 %–max 19 %).

### 3.4 Sweden

Trigger-type methodology was the basis of the 2008 retrospective record review of the National Board of Health, following on the steps of the Harvard Medical Practice Study and its subsequent modifications (Brennan et al. 1991). In addition to establishing the national rate of adverse events in hospitalized patients, a figure for the number of extra hospitalization days that had been necessary due to the avoidable injuries and the extra economic cost were also presented. Regarding the method itself, the researchers concluded that the criteria list would need to be revised if it should be suitable for clinical purpose use.

Piloting of medical record review with a translated version of the GTT method had begun already in 2005, in the hospitals of Östergötland, Kalmar and Jönköping counties. The efforts were fruitful. The three counties, in cooperation with the County Councils Mutual Insurance Company and SKL, published a Swedish handbook for GTT in 2008. The method has since then spread

[1] The hospital has 500 somatic (and 200 psychiatric) beds, 4,200 employees, and an annual budget of 2.500.000.000 NOK (approximately 450 million US$). It serves a population of 280.000 people, treats 53.000 in-patients and provides 150.000 out-patient consultations annually. Most in-patients (85 %) are unscheduled emergency admissions.

successively. In 2011, a survey showed that record review according to the GTT was being performed in at least one hospital per county, in 10 out of the 21 counties and regions in Sweden.

The Swedish version of the tool includes the evaluation of preventability of injuries (Swedish National Board of Health 2007). Even if a statement concerning preventability in the individual case is a matter of judgment by the review team and thus not completely reproducible, it has been seen to be of value for stimulation of critical self-appraisal in departments and hospitals. Assessment of preventability has the potential to both give a platform for preventive action and to improve the safety culture.

In 2010, the Swedish Government established a national patient safety initiative and made an agreement with the counties and regions to intensify efforts to increase patient safety. The agreement covers the years 2010–2014 and frames numerous goals where introduction of record review by GTT in all 65 hospitals has to be accomplished in 2012. For 2013, there will be a requirement of ongoing record reviewing on hospital level, but also introduction of record review on department level in those hospitals where that has not been done as yet. Formal training with the GTT method was given in the beginning of 2012 and all hospitals now have one or more teams for record review according to the GTT method. Follow-up meetings for further discussion of the method and for introduction of a new handbook took place during the autumn of 2012.

According to the national patient safety initiative, results from record review for the first 3 months in 2012 have been collected in a national data base and a figure on the level of injuries in non-psychiatric in-hospital care of adult patients has been calculated. Records of 3,900 admissions were reviewed. A total of 14 % of the hospital admissions included at least one adverse event. The most frequent adverse event was hospital acquired infections (39.5 %), of which the most common type was urinary tract infections. The complete study, published in November 2012, is available online (SKL 2012a, b). Data in the national database will be made available in detail to each participating hospital. At present, only figures concerning a mean value of level of injuries will be calculated on the national level. Data on preventability will neither be summarized, nor presented on national level for the time being.

A new Swedish handbook for trigger-based record review has been published during the autumn of 2012 (SKL 2012a, b). During 2011–2012, a project group evaluated the experiences from the first years of record reviewing to further develop the review process. Triggers have been evaluated, partly reformulated and guidance has been added to facilitate consideration on injuries and preventability with the aim of reducing variation in inter-rater reliability. Another aim has been to improve the efficiency in coverage of injuries in non-surgical health care. The potential of the method for use on hospital level in parallel to use on department level is described and the benefit of team work in the review process is stressed. Triggers covering neonatal, surgical and non-surgical care for children are under development and a handbook will be published in the beginning of 2013. Development of triggers covering primary care, outpatient care and psychiatry is under consideration.

## 4 Automating the GTT: back to the future

The current generation of paper-based trigger tools has its roots in work on automated triggers in the early 90s (Classen et al. 1991). The systems developed at that time remained the prerogative of a few pioneering organizations. Nowadays, as the adoption of electronic health records continues to grow across all healthcare settings, the prospect of utilizing a computerized version of the GTT becomes again increasingly realistic.

### 4.1 Relevant examples in the Nordic countries

Being at the forefront of eHealth developments in general and having well-established health-IT infrastructures (Stroetmann et al. 2011), it is not surprising that the Nordic countries are also exploring the automation of the GTT.

In the domain of GTT automation, Sweden has led the way. During 2009–2010, a computerized tool was developed at the Karolinska University Hospital for facilitation of the GTT review process. The tool, named “MAG” (Modified Automated GTT), was introduced in all departments with surgical activities during 2010–2011 and during 2011 in the remaining departments. All surgical departments used the automated model for the review of 20 patient records per month. In 2011, the tool was also introduced at S:t Göran’s Hospital. The plan is to successively broaden the use of the tool to all hospitals in Stockholm County.

The “MAG” performs the search for triggers and presents detailed information on where the triggers are found in the individual medical records and thus facilitates the subsequent in-depth review. The trigger search is performed on structured data such as medication, laboratory results and ICD codes, but also on unstructured text by text mining. The results from the in-depth reviews are collected by the tool, where the results can then be overviewed and summarized. Evaluation of the technical possibilities, exploration of national interest in such a development and estimates of the economical assumptions for constructing an IT-tool for universal use in Swedish hospitals are at present performed.

In Finland, the Neurosurgery Department of Tampere University Hospital (TAYS) has assessed the ability of text mining to detect accurately the same triggers as manual review does in electronic patient records. The study was performed as a structured retrospective medical record review based on the use of 13 modified IHI GTT screening criteria. Compared to manual review the sensitivity of detecting triggers with text mining varied from 60 to 100 % between the triggers. Specificity between triggers varied from 80 to 98 %. The study team concluded that triggers can be found with the text mining tool, and that this method is as reliable and less time- and manpower-consuming than the conventional manual method (Öhman et al. 2011).

In Norway, a project for automatic trigger identification has been launched in collaboration between the SAS institute and Nordlandsykehuset, while a similar project is under preparation in the Region of Southern Denmark.

## 5 Methodological issues

### 5.1 Reviewing methodology

GTT is founded on the basic pattern of the two-stage review, according to the tradition of the Harvard Medical Practice Study (Brennan et al. 1991), but with the time limitation of 20 min allocated per record. Typically, the primary (first stage) reviewers—those who scan the selected sample of patient records for the presence of triggers—are not physicians, but mostly nurses and pharmacists. Physicians act then as the secondary (second stage) reviewers, who make the final decision as to the presence or absence of an adverse event, its severity and potentially preventability (since preventability assessment is not part of the original method). The size of the reviewing team may vary, as well as the way of recording and presenting the results. Teams may consist of internal reviewers, i.e., staff members of the organization being studied, or external reviewers—clinicians not related to the organization whose data is being analyzed.

### 5.2 Limitations of the method

#### *5.2.1 Documentation quality*

Reliability of the method as an indicator of patient safety levels within an organization relies directly on the quality of documentation practices. If the necessary data are not included or adequately described in the patient's record, then they will not be found during the trigger scanning process. Similarly, the success of an automated trigger tool will also rely on the completeness and accuracy of documentation in the electronic patient record, an area, however, where electronic patient record systems may introduce new problems and challenges. In addition to quality of documentation, the performance of an automated trigger tool relies also on the selection of triggers, as well as on simple and reliable access to the relevant clinical data.

Patient safety interventions have also been observed to induce changes in documentation practices where the elements of intervention focus begin to appear more consistently in patient documentation, as, e.g., has been the case with peripheral venous lines in Denmark. At most hospitals, these lines were never documented in the record until a few years ago—now they are.

Yet another issue is the changing or improving detection skills of reviewers. Even if documentation quality would remain the same, the ability of the reviewers to identify certain adverse events may increase as they become more experienced. However, if that would be the case, trends of patient harm levels as measured by the method may not reflect anything else but that process of reviewer 'maturity'.

#### *5.2.2 Inter-rater reliability*

The GTT and related methodology were developed specifically with the aim of addressing inter-rater reliability problems that had been encountered with earlier tools of the IHI (Resar et al. 2003). The assumption was that training on the use of a precisely defined methodology would address the problem of reviewer disagreement in assessment of potential patient safety incidents. An important aim of the training is to reduce variation by providing a commonly shared understanding of the definition of an AE, and corresponding ability to identify it (Resar et al. 2003), as well as a shared view of AE's severity and preventability. The advice and practice of using consistently the same review team (at least for a 1-year period at a time) is also a common one (Rozich et al. 2003).

Indeed, Classen et al. (2008) demonstrated in their study that training improves inter-rater level of agreement. In other studies reviewed (Naessens et al. 2010; Schildmeijer et al. 2012) inter-rater reliability was variable, depending on the object of review (the presence of an AE, severity, preventability) and the type of reviewers compared (nurses vs. physicians, internal vs. external reviewer teams, etc.). Generally, in most studies, there seems to be at least a moderate level of agreement achieved (higher when internal reviewers are used, as in the study of Sharek et al. (2011). On the other hand, every implementation of the GTT seems to be an own, local variant, with the two-staged review approach and the NCC MERP method of severity assessment (although there is not necessarily agreement on its implementation) being the only truly stable elements across studies. Has the goal of reducing variation in inter-rater reliability and achieving generalizability been attained then? The answer is of particular relevance in cases where cross-organization comparison is attempted, as in benchmarking.

### 5.3 Purpose of GTT use: benchmarking or learning?

In the early days of trigger tools development, the IHI team had stated clearly that the tools should not be used as a benchmarking instrument across institutions, since they had not been validated. In addition, they felt that comparison of adverse event rates across organizations would be counterproductive and instead would cause either unnecessary anxiety or, conversely, a false sense of security (Resar et al. 2003). Later on, more emphasis was placed on the use of the tool for large-scale assessments, but still not in the context of benchmarking.

The study published in April 2011 in Health Affairs (Classen et al. 2011) took the first big step toward comparative use of the tool, by applying it to comparison of specific adverse event rates of different hospitals. The article has drawn a lot of publicity, but it has also received its share of criticism, including the observation that the definition of adverse events used by different methods can be a significant part of the explanation of the results (Campione 2011).

Further yet, by focusing on patient harm (albeit *physical harm,* since psychological and social consequences of events are not included), IHI methodology approaches the subject of patient safety from a viewpoint closer to the patient/subject of care. However, this happens on the expense of preventability—the method does not in itself differentiate between injuries caused by error or substandard care and those that were unavoidable. IHI's view on preventability with regard to the GTT is clear: Preventability should not be an inclusion/exclusion criterion for a patient record, precisely because of preventability's constant change over time (Griffin and Resar 2009). That view, however, is not equivalent to the position that assessment of preventability of confirmed events should not be undertaken. Hence, varying approaches to the topic can also be observed, with some excluding preventability assessment from GTT review (as in Denmark and Norway) and others including it (as in Sweden and Finland). Proponents of preventability assessment view the process as an opportunity to learn, and thus augment the benefits of measuring adverse events.[2]

With regard to learning, attention should also be paid to an inherent limitation of the GTT: namely that the method explicitly excludes near-misses, as well as errors of omission—both of which are very important sources of learning and advancing toward prevention of adverse events. Nevertheless, use of the tool and the adjacent review process present many learning opportunities, on multiple organizational levels:

- Clarification/final assessment of reviewed cases. Reviewers state and exchange their views on presence and type of triggers, severity of case, preventability or not of an adverse event. There is a need to utilize and capitalize better on the rich material generated through assessment sessions, by documenting the reasoning supporting the final decisions made, so that it is available as future reference.
- Identifying target areas for development and monitoring harm levels over time is the place of learning for the leadership and management of the organization, as well as the original aim of the tool.
- Dissemination of findings to the whole organization.
- Dissemination of findings to collaborating partner organizations—connected to identification of cases where the adverse event happened before admission. The means and the most appropriate channel for sharing this knowledge are a subject of further innovation.

## 6 Discussion

Compared to full patient record review, GTT places a smaller demand on resources as a result of reviewing a smaller number of records, with a higher probability of containing actual adverse events. The tendency of the GTT to identify a larger number of adverse events as opposed to other detection methods has been attributed to the broad definition of adverse events used by the method, which includes also events present on admission, as well as less serious than sentinel events. It should be noted, however, that these comparisons have originated in the USA and have focused on event detection methods such as voluntary reporting systems of sentinel events and the AHRQ Patient Safety Indicators. There is very scarce evidence comparing the GTT with other patient safety assessment methods in a European context, where, for example, the rate of voluntary organizational incident reports seems to be much higher than that reported by US healthcare providers. Therefore, at this point, it is not possible to say whether the method's benefits will be equally prominent in the European context as well.

In addition to its ability to detect larger number of events than other assessment methods, comparative studies also indicate that the GTT may identify different types of adverse events. In the light of these observations, it appears that use of the trigger tool approach can supplement incident reporting and other assessment methods when the aim is a comprehensive picture of the level of patient safety

[2] The matter of preventability is receiving now more attention by the IHI, as demonstrated in the interview of David Classen (24), where he is also proposing to enlarge the concept by including mitigability and ameliorability—aspects which become relevant as automation of the GTT progresses.

incidents *within* an organization. This echoes the position of the IHI (White Paper) that: "…hospitals should use the IHI Global Trigger Tool as one part of a learning system that includes other component measures, such as voluntarily reported errors, surgical site infections, and other outcome measures" (Griffin and Resar 2009). The necessity for utilizing a palette of methods to monitor and improve patient safety has been echoed in the publication of both scientists and organizations in the field (Rosen 2005; Battles 2005; Ferranti et al. 2008; Öhrn et al. 2011).

It should be kept in mind that the GTT, just as the rest of the IHI trigger tools family is a relatively new technology. A recent review of the literature (Doupi 2012) located only nine papers specific to the IHI GTT, mostly published during the last 2–3 years. The articles concerned the tool's development and evaluation, performance features, comparisons with other methods and examples of utilization either within or across large health systems or in national level programs. None of the studies had the purpose of formal validation of the tool. There is therefore a need for caution when using the method, as well as further research on its reliability and fitness for specific purposes.

Acknowledging the controversies and still ongoing discussion around the tool's methodological soundness, the coordinating bodies in both Norway and Sweden—where the GTT has been employed on a national scale, have refrained from using the results as a benchmarking instrument. Rather, it has been made explicit that the focus is on each individual hospital's development over time. Whether the focal point of use should be the whole organization or individual hospital departments is also a question of great interest. The potential for increased learning and more effective interventions when the method is brought closer to frontline staff has been recognized, but several methodological issues still remain to be resolved.

Yet another area of unclarity is the suitability of the GTT in the analysis of mortality statistics. Following the publication of the national level analysis results in Norway, intensive discussions have ensued as to whether the GTT is a valid method for identifying and estimating harmful incidents that contribute to a patient's death. Generally, the literature shows very low inter-rater agreement on such decisions, while the subject has not been specifically studied for the GTT. As a result, it has been decided that the respective rates for 2011 in Norway will not be published before consistency of the methodology has been confirmed.

The original inspiration for the current generation of trigger tools was work on automated trigger systems. Now, after almost a decade of development, IHI and the developers of GTT are placing again their hopes for future success and more widespread adoption of the tool on the computerization of medical records (Classen et al. 2011). Many of the groups reporting their experience with the paper-based GTT also refer to the need of a tool integrated with electronic patient record systems (Good et al. 2011). Indicatively, in a recent interview, Dr. Classen communicated that IHI has already proof-tested the automation of the GTT in all 'leading EMR vendors at various health systems" (AHRQ 2012).

At a minimal level of computerization, which is also the view presented in the IHI White Paper (Griffin and Resar 2009), triggers—particularly medications and laboratory values—can be directly captured from a patient information system (once the random selection of records has happened), thus speeding up the review process. Such a trigger system can be viewed as a 'first generation' example, since the objective is still the post hoc identification of harm. As the sophistication and capacity of electronic systems improves, the closer the implementation of trigger systems moves to the possibility of intervening to an adverse patient safety event before it causes harm to the patient (concurrent and real-time systems) or even before it even happens (interventionist trigger system) (AHRQ 2008). Such applications though require on the one hand the establishment of a notification and reaction system well fitted to the organizational workflow, and on the other hand, verification of their accuracy in order to avoid false alarms and ensure relevance for clinical decisions.

We have presented an overview of the current uses of and experiences with the GTT methodology in the Nordic countries, where significant emphasis is being placed on patient safety through ongoing national level programmes and initiatives. We have drawn on the experience of the authoring team, all of whom have functioned in key expert positions in their respective countries and thus closely followed pertinent activities, combined with the evidence provided by a systematic review of the literature on the GTT and automated trigger tools. However, we have not attempted to perform a systematic comparison of the way each Nordic country has proceeded in implementing the GTT, neither have we performed any form of quantitative analysis across national data. Rather, our exploration of the current status of affairs has laid the ground for such approaches in the future.

It should also be noted that this paper focuses exclusively on trigger tools in the hospital environment. Therefore, it is not possible to say how well the GTT or other trigger tool methodology is suited for use in other levels of healthcare services—such as primary care centers, nursing homes, etc. Evidence on this subject exists, and its analysis can be the focus of future research. Work on implementation and research on the GTT is ongoing in the Nordic countries and will certainly continue generating valuable contributions to patient safety measurement methodology.

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