Identifying adverse events after outpatient surgery: improving measurement of patient safety

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Identification of adverse events (AEs) is critical for improving patient safety. However, accurate measurement continues to be challenging, and efforts to detect and track surgical AEs in the outpatient setting lag behind those of the inpatient setting. Although numerous methods have been utilised over the years to detect AEs (eg, voluntary reporting systems, chart review and patient interviews), these detection systems suffer from a variety of limitations including resource constraints.[1 2] More recent development of automated surveillance systems to detect AEs using electronic medical record (EMR) data has greatly facilitated the identification of AEs, particularly among ambulatory patients.[3–6] Menendez *et al* illustrate how EMR data and electronic triggers can contribute to better measurement of patient safety in outpatient surgery.[7]

Trigger methodology has substantially improved since the seminal work of the Institute for Healthcare Improvement (IHI) in the early 2000s that helped promulgate the use of chart-based trigger tools for retrospective detection of AEs.[8–10] Although triggers are still evolving as informatics tools, and are likely in their 'early stages' of development, the trigger methodology represents a good compromise between two modalities: automated surveillance systems and manual chart review (ie, the 'gold standard'). Triggers rely on both electronic and manual review processes to search for patterns in the data consistent with a possible AE. Triggers use surveillance rules or algorithms derived from clinical logic to flag patient medical records for the presence of an AE. Once a trigger is flagged in the data, then the patient's medical record is reviewed to confirm the occurrence (yes/no) of the AE.[11] Triggers facilitate more selective EMR review and also capitalise on the richness of EMR data, resulting in efficient and cost-effective tools that capture events missed by other methods (eg, voluntary reporting).[12–15]

The US Agency for Healthcare Research and Quality (AHRQ) sponsored a conference in 2008 that helped highlight the importance of triggers in identifying patient safety risks and hazards, while also endorsing future development of prospective triggers to enable timely interventions to prevent or reduce specific AEs.[11 16] Triggers are now widely used to detect many types of AEs, including diagnostic errors, adverse drug events, hospital-acquired infections, delays in diagnoses and outpatient surgical AEs.[17–26] Trigger algorithms are frequently applied to EMRs for automated surveillance, and increasingly to prospectively identify patients at risk of AEs.[27 28]

Menendez *et al*[7] build off the EMR-based trigger methods in the field to develop and test 13 retrospective triggers used to identify 90-day postoperative events following orthopaedic outpatient surgery. The research has a number of limitations, some of which are noted by the authors; we point out a few that are not. While it is noteworthy that the authors produced a formula to predict the likelihood of identifying an AE in the medical record, limiting review of records to under 10%, the generalisability and applicability of this formula to other healthcare systems and AEs remains to be determined. Further, their methods for trigger development and AE definition were not well described, and it would be difficult for another group of researchers to replicate them. Their methods, as currently described, were generally not consistent with the considerations recommended in the AHRQ trigger conference calling for more rigorous development of such metrics through

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the use of explicit criteria and techniques.[29] While a few triggers had positive predictive values (PPVs) that were greater than 50%, most did not meet the criteria for 'good' performance,[24] suggesting that as currently developed, they are probably not suitable for external monitoring or benchmarking purposes. However, they may very well be useful for quality improvement initiatives since they appear to be a more efficient way to screen for AEs than other methods. The AHRQ conference also recommended that researchers should estimate sensitivity as another method for evaluating trigger performance, since PPV is largely a function of event prevalence (which, in the case of AEs, is generally low).[30] Regardless of which performance characteristic is selected, an important goal of trigger development should be to increase the accuracy of AE rate estimation in the population. We commend Menendez *et al* for developing a predictive formula that allows for more efficient identification of AEs; further refinement of this could potentially improve the accuracy of AE rate estimation.

As the authors also point out, "there is a need for better outpatient quality measures", as well as further research "to understand the optimal use of electronic triggers as surgical quality indicators and as screening tools". We agree that the field of outpatient surgery has largely been neglected until recently, with few studies focused on this area[20 23 31] and where gaps in knowledge currently exist. There are, however, key considerations in developing such metrics. A well-designed quality measure should be reliable, valid and easy to use across care settings. Similarly, a trigger that performs well should have good face validity, and target those AEs that are likely to be preventable and that represent a relatively high proportion of patients within the population; it should also be able to assess harm. Trigger development should involve an iterative process of development and testing that includes guidance from clinical experts, review of the existing literature, discussion and testing of explicit criteria for each trigger, and incorporation of final selected criteria into trigger algorithms for empirical testing.

Thoughtful deliberations are also needed in order for researchers to identify what a 'true' AE is in the outpatient surgical setting. Identification can be difficult, in part because postoperative AEs are relatively infrequent, and those reported tend to include minor complaints and/or morbidities (eg, pain, nausea, dizziness). Thus, distinguishing whether an event is "an injury caused by medical management rather than the underlying condition of the patient" (ie, as defined by the Institute of Medicine),[32] as well as assigning a level of harm to it, can be more subjective and ambiguous in the outpatient setting than in the inpatient setting. To improve identification of outpatient AEs, certain techniques have been used. For example, some authors have used standardised lists of AEs defined in the inpatient setting, expanding these to postoperative outcomes that are likely to occur in outpatient surgery.[20 23 31] Additionally, AEs may be counted only if nurse reviewers agree on whether an AE was present or not and inter-rater reliability, as measured by a Cohen's kappa >0.6, is achieved. An established severity classification scale and a harm scale may be employed to rate the severity of AEs and their associated harm, respectively.[33 34] Finally, defining the time period from the index event (ie, outpatient surgery) to the postoperative AE is also an important component of establishing an accurate count of AEs in outpatient surgery. For example, a postoperative outcome of 90 days, as the authors use, may be too distant an event from the outpatient surgery to be meaningful for evaluating outpatient surgical quality. Thirty-day outcomes may be better for this purpose as they are likely to be more related to the index event.[35–39]

In summary, Menendez *et al* make an important contribution to the patient safety measurement field in that it tackles a relatively understudied area, outpatient surgery (and specifically, orthopaedic surgery). The triggers showed some efficacy but could be enhanced with input from a wider group of clinical experts beyond one institution, additional performance criteria, and a more rigorous validation process for both the trigger algorithms and the AEs identified. Improvement of patient safety in outpatient surgery constitutes an important goal. We look forward to further work of the type carried out by Menendez *et al* providing efficient tools to identify targets for improvement, and, eventually metrics for assessing performance.

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REFERENCES

1 Classen DC, Resar R, Griffin F, *et al*. 'Global trigger tool' shows that adverse events in hospitals may be ten times greater than previously measured. *Health Aff (Millwood)* 2011;30:581–9.
2 Murff HJ, Patel VL, Hripcsak G, *et al*. Detecting adverse events for patient safety research: a review of current methodologies. *J Biomed Inform* 2003;36:131–43.
3 Murff HJ, Forster AJ, Peterson JF, *et al*. Electronically screening discharge summaries for adverse medical events. *J Am Med Inform Assoc* 2003;10:339–50.
4 Bates DW, Evans RS, Murff H, *et al*. Detecting adverse events using information technology. *J Am Med Inform Assoc* 2003;10:115–28.
5 Budnitz DS, Pollock DA, Weidenbach KN, *et al*. National surveillance of emergency department visits for outpatient adverse drug events. *JAMA* 2006;296:1858–66.
6 FitzHenry F, Murff HJ, Matheny ME, *et al*. Exploring the frontier of electronic health record surveillance: the case of postoperative complications. *Med Care* 2013;51:509–16.

7 Menendez ME, Janssen SJ, Ring D. Electronic health record-based triggers to detect adverse events after outpatient orthopaedic surgery. *BMJ Qual Saf* 2016;25:25–30.
8 Idealized Design of the Medication System (IDMS) Group/ Institute for Healthcare Improvement (IHI). Trigger Tool for Measuring Adverse Drug Events. 2004. http://www.ihi.org
9 Institute for Healthcare Improvement (IHI). ICU Adverse Event Trigger Tool Version 1. 2002. http://www.ihi.org
10 Griffin FA, Resar R. *IHI Global Trigger Tool for Measuring Adverse Events*. 2nd edn. IHI Innovation Series white paper. Cambridge, MA: Institute for Healthcare Improvement, 2009. http://www.ihi.org
11 Shimada SL, Rivard PE, Mull HJ, *et al*. Triggers and targeted injury detection systems: aiming for the right target with the appropriate tool. *Paper presented at: Triggers and Targeted Injury Detection Systems (TIDS) Expert Panel Meeting*; AHRQ Pub. No. 09-0003; Rockville, MD, 2008.
12 Classen DC, Lloyd RC, Provost L, *et al*. Development and evaluation of the Institute for Healthcare Improvement Global Trigger Tool. *J Patient Saf* 2008;4:169–77.
13 Mull HJ, Brennan CW, Folkes T, *et al*. Identifying previously undetected harm: piloting the Institute for Healthcare Improvement's global trigger tool in the Veterans Health Administration. *Qual Manag Health Care* 2015;24:140–6.
14 Naessens JM, Campbell CR, Huddleston JM, *et al*. A comparison of hospital adverse events identified by three widely used detection methods. *Int J Qual Health Care* 2009;21:301–7.
15 von Plessen C, Kodal AM, Anhoj J. Experiences with global trigger tool reviews in five Danish hospitals: an implementation study. *BMJ Open* 2012;2:pii: e001324.
16 Shimada SL, Rosen AK, Helwig AL, *et al*. Definitions for trigger terminology. *Paper presented at: Triggers and Targeted Injury Detection Systems (TIDS) Expert Panel Meeting*; AHRQ Pub. No. 09–0003; Rockville, MD, 2008.
17 Kilbridge PM, Classen DC. Automated surveillance for adverse events in hospitalized patients: back to the future. *Qual Saf Health Care* 2006;15:148–9.
18 Samore MH, Evans RS, Lassen A, *et al*. Surveillance of medical device-related hazards and adverse events in hospitalized patients. *JAMA* 2004;291:325–34.
19 Szekendi MK, Sullivan C, Bobb A, *et al*. Active surveillance using electronic triggers to detect adverse events in hospitalized patients. *Qual Saf Health Care* 2006;15: 184–90.
20 Mull HJ, Borzecki AM, Hickson K, *et al*. Development and testing of tools to detect ambulatory surgical adverse events. *J Patient Saf* 2013;9:96–102.
21 Mull HJ, Nebeker JR, Shimada SL, *et al*. Consensus building for development of outpatient adverse drug event triggers. *J Patient Saf* 2011;7:66–71.
22 Mull HJ, Rosen AK, Shimada SL, *et al*. Assessing the potential adoption and usefulness of concurrent, action-oriented, electronic adverse drug event triggers designed for the outpatient setting. *EGEMS (Wash DC)* 2015;3:1116.
23 Rosen AK, Mull HJ, Kaafarani H, *et al*. Applying trigger tools to detect adverse events associated with outpatient surgery. *J Patient Saf* 2011;7:45–59.
24 Murphy DR, Laxmisan A, Reis BA, *et al*. Electronic health record-based triggers to detect potential delays in cancer diagnosis. *BMJ Qual Saf* 2014;23:8–16.
25 Singh H, Giardina TD, Forjuoh SN, *et al*. Electronic health record-based surveillance of diagnostic errors in primary care. *BMJ Qual Saf* 2012;21:93–100.
26 Singh R, McLean-Plunckett EA, Kee R, *et al*. Experience with a trigger tool for identifying adverse drug events among older adults in ambulatory primary care. *Qual Saf Health Care* 2009;18:199–204.
27 Murphy DR, Wu L, Thomas EJ, *et al*. Electronic trigger-based intervention to reduce delays in diagnostic evaluation for cancer: a cluster randomized controlled trial. *J Clin Oncol* 2015 http://jco.ascopubs.org/content/early/2015/08/21/JCO.2015.61.1301.abstract
28 Danforth KN, Smith AE, Loo RK, *et al*. Electronic clinical surveillance to improve outpatient care: diverse applications within an integrated delivery system. *EGEMS (Wash DC)* 2014;2:1056.
29 Agency for Healthcare Research and Quality (AHRQ). Conference Summary Publication No. 09–003. *Paper presented at: Triggers and Targeted Injury Detection System (TIDS) Expert Panel Meeting*; Rockville, MD, 2008.
30 Nebeker JR, Yarnold PR, Soltysik RC, *et al*. Developing indicators of inpatient adverse drug events through nonlinear analysis using administrative data. *Med Care* 2007;45(10 Suppl 2):S81–88.
31 Kaafarani HM, Rosen AK, Nebeker JR, *et al*. Development of trigger tools for surveillance of adverse events in ambulatory surgery. *Qual Saf Health Care* 2010;19:425–9.
32 Institute of Medicine (IOM). *To err is human: building a safer health system*. Washington, DC: National Academy Press, 1999.
33 Griffin FA, Classen DC. Detection of adverse events in surgical patients using the Trigger Tool approach. *Qual Saf Health Care* 2008;17:253–8.
34 Williams T, Szekendi M, Pavkovic S, *et al*. The reliability of AHRQ Common Format Harm Scales in rating patient safety events. *J Patient Saf* 2015;11:52–9.
35 Fink AS, Campbell DA Jr, Mentzer RM Jr, *et al*. The National Surgical Quality Improvement Program in non-Veterans Administration hospitals: initial demonstration of feasibility. *Ann Surg* 2002;236:344–53.
36 Khuri SF, Daley J, Henderson W, *et al*. The Department of Veterans Affairs' NSQIP: the first national, validated, outcome-based, risk-adjusted, and peer-controlled program for the measurement and enhancement of the quality of surgical care. National VA Surgical Quality Improvement Program. *Ann Surg* 1998;228:491–507.
37 De Oliveira GS Jr, Holl JL, Lindquist LA, *et al*. Older adults and unanticipated hospital admission within 30 days of ambulatory surgery: an analysis of 53,667 ambulatory surgical procedures. *J Am Geriatr Soc* 2015;63:1679–85.
38 Morris MS, Deierhoi RJ, Richman JS, *et al*. The relationship between timing of surgical complications and hospital readmission. *JAMA Surg* 2014;149:348–54.
39 Mull HJ, Borzecki AM, Chen Q, *et al*. Using AHRQ patient safety indicators to detect postdischarge adverse events in the Veterans Health Administration. *Am J Med Qual* 2014;29:213–9.