



---

## **Use of Trigger Tool for Detection of Adverse Drug Reactions among Hospitalized Patients in a Nigerian University Teaching Hospital**

**Okoye, Lilian Uchechukwu<sup>1</sup>, Okechukwu, Raymond C.<sup>2\*</sup>,  
Odinduka, Sunday<sup>3</sup>, Ogbuagu N. Chukwuanugo<sup>4</sup>  
and Emelumadu Obiageli F.<sup>5</sup>**

<sup>1</sup>*Department of Pharmacy, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria.*

<sup>2</sup>*Department of Pharmacy, Center for Community Medicine and Primary Healthcare, Nnamdi Azikiwe University Teaching Hospital, Neni, Anambra State, Nigeria.*

<sup>3</sup>*Department of Clinical Pharmacy and Pharmacy management, Faculty of Pharmaceutical Sciences, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.*

<sup>4</sup>*Department of Accident and Emergency, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria.*

<sup>5</sup>*Department of Community Medicine, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria.*

### **Authors' contributions**

*This work was carried out in collaboration between all authors. Author ORC conceptualized and designed the study and also performed the statistical analysis. Author OLU wrote the protocol, collected data. Authors ORC and OS wrote the first draft of the manuscript. Authors OLU, ORC and ONC managed the analyses of the study. Author OLU managed the literature searches. Authors EOF and OS did proof-reading of the manuscript. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/JAMPS/2018/40970

Editor(s):

(1) Dr. Armando Cuellar, Pharmacy Faculty, Havana University, Cuba.

Reviewers:

(1) Sheikh Shahnawaz, India.

(2) Ioan Magyar, University of Oradea, Romania.

Complete Peer review History: <http://www.sciencedomain.org/review-history/26823>

**Original Research Article**

**Received 10 February 2018  
Accepted 26 April 2018  
Published 25 October 2018**

## ABSTRACT

**Objectives:** To determine the incidence and severity of adverse drug reactions among hospitalized patients in a Nigerian teaching hospital using the trigger tool method.

**Study Design:** Descriptive cross-sectional study.

**Setting:** The study was conducted in Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria from July to December, 2012.

Participants: Medication charts of discharged patients were reviewed by a healthcare team consisting of one pharmacist, a nurse and a physician.

**Intervention and Method:** Randomly selected patients medication charts were reviewed using the procedure described in the Institute of Health Improvements (IHI) global trigger tool for measuring adverse events. Twenty minutes were allocated for review of each patient record. Treatment charts with positive trigger(s) were reviewed further by the doctor in the review team to ascertain if adverse reaction(s) did occur. Detected adverse reactions were then categorized and statistically analysed.

**Results and Main Outcome Measure(s):** From the 120 patients charts randomly selected and reviewed, there were 2173 patient-days. About 473 triggers were identified of which 175 were confirmed to be adverse drug reactions by the review panel. The incidence measures calculated were 145.8 adverse drug reactions per 100 admissions and 80.5 ADRs per 1000 patient-days. A total of 97 patients had at least one ADR during their hospitalization and the proportion of patients' admissions with an adverse event was 80.8%.

**Conclusions:** This study identified high incidence of adverse drugs reactions among the hospitalized patients in the teaching hospital. Further research is required to develop strategies towards the incorporation of this technique in the routine healthcare process. This would possibly improve case detection of adverse drug reactions and promote patients safety.

*Keywords: Incidence; adverse drugs reactions; hospitalized patients; trigger tool.*

## 1. INTRODUCTION

Improving patient safety continues to be a priority for both policy makers and health care providers worldwide. Adverse drug reactions (ADRs) present the greatest challenges towards the attainment of set healthcare goals globally [1,2]. ADRs have been implicated in increased hospital admissions, prolonged hospital stay, high morbidity and mortality rates among patients as well as increase in the legal, operational and other patient care costs [3]. ADRs also resulted in a projected annual cost of £466 million to the UK's National Health Services [4]. In the USA it has been shown that over two million ADRs occur annually resulting in more than 100,000 deaths thus making ADRs the fourth leading cause of death ahead of pneumonia, AIDS, automobile accidents and diabetes and fiscal cost to the US health systems was estimated at \$136 billion per year [5,6,7].

Incidence rates for ADRs had been shown to vary widely among hospitalized patients ranging from 1.5% to 35% in general patients' population and between 4.4% and 16.8% in children [3,8]. This wide variability was shown to be due to methodological differences in the collection of data and in the use of non-standardized criteria to diagnose the presence of adverse effects to

medications [9]. However, using a random-effects model to reduce heterogeneity and incidence rates variability, it has been shown that total incidence of both categories of serious ADRs was 6.7%, of which 4.7% were responsible for admission and 2.1% occurred after admission, with an overall fatality rate of 0.32% [10]. Studies based on retrospective patients' records review in several countries have shown that 2.9% to 16.6% of patients in acute care hospitals experience one or more adverse drug reactions and that approximately 50% of these ADRs were preventable [11]. These figures strongly underscore the need to develop effective strategy for detecting and reporting of ADRs within the framework of a functional pharmacovigilance system.

Several methods have been developed for detecting and documenting ADRs including spontaneous reporting, computerized monitoring system and recently the use of trigger tool. The Global Trigger Tool (GTT) developed by the Institute for Healthcare Improvement (IHI) in 2003 relies on use of identification of 'signals' or 'triggers' for the detection of ADRs using the techniques of focused review of patients' charts. This method has been shown to detect far more ADRs than the traditional methods that use unfocused patients charts review techniques

[12]. The use of this methodology for ADRs detection in Nigerian hospitals has not been adequately researched. In this study we carried out case detection of ADRs among hospitalized patients in the Nnamdi Azikiwe University Teaching Hospital, Nnewi between June and December 2012 using the global trigger tool. The primary objective was to determine the incidence and severity of adverse drug reactions among hospitalized patients using this tool.

### 1.1 Setting

Nnamdi Azikiwe University Teaching Hospital, Nnewi Nigeria where this study was carried out is one of the foremost public-owned tertiary healthcare facilities in Nigeria. It is a centre for excellence for nephrology in the country. The hospital have full complements of all clinical departments and service units namely: surgery, medicine, paediatrics, obstetrics and gynaecology, nursing services, pharmacy, health records and other non-clinical departments. There are also accidents and emergency and special Intensive care units within the hospital. There are healthcare professionals of various cadres and specialties: including doctors, nurses, pharmacists, health records officers and laboratory scientists among others.

### 1.2 Participants

The participants in chart review process were three-member team made up of two primary reviewers: a pharmacist and a nurse, and a physician who served as the secondary reviewer. The medication charts included in this study were those of hospitalized adult and paediatric patients discharged from five major departments of the teaching hospital: Obstetrics-Gynaecology, Surgery, Internal Medicine, Paediatrics and Intensive Care units from July to December, 2012.

Inclusion criteria for patients' chart review were:

- Patients treated for not less than 24 hours and discharged from the selected units

within the hospital between July and December 2012

- Patients with complete records including discharge summary

Exclusion criteria

- Psychiatric and rehabilitation inpatients
- Patients discharged more than 30 days prior to the review date.
- Patients' with incomplete records

## 2. METHODS

About 120 randomly selected patients' medication charts were reviewed using the procedure adapted from the global trigger tool for identifying and measuring adverse events developed by the Institute of Health Improvements. According to the procedure, because readmission within 30 days is a trigger, only records of patients who were discharged more than 30 days prior to the review date were selected so that readmissions can be checked for the sample. For each patient's chart the review team as previously mentioned collected and analyzed data including patients' demographics, clinical diagnosis, discharge summary, medications administration record, laboratory results, prescriber orders, surgical notes, nursing notes, physician progress notes as well as emergency department notes. Twenty minutes were allocated for review of each patient record. When a positive trigger was found, the record was reviewed further by the physician in the review team to ascertain if adverse event(s) did occur. Detected adverse reactions were then recorded in the review worksheet and summary sheet according to the appropriate Trigger Modules described in the 'IHI Global Trigger Tool for Measuring Adverse Events (Second Edition)'. All identified adverse drug reactions associated with any positive trigger were categorized and statistically analyzed. The five category model proposed by the trigger tool (Table 1) was used to characterize the severity of harm.

**Table 1. Showing categories of harm and their description**

| Category | Description                                                                                                   |
|----------|---------------------------------------------------------------------------------------------------------------|
| E        | Contributed to or resulted in temporary harm to the patient and require intervention                          |
| F        | Contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalization |
| G        | Contributed to or resulted in permanent patient harm                                                          |
| H        | Contributed to or resulted in patient harm: Required intervention to sustain life                             |
| I        | Contributed to or resulted in the patient's death                                                             |

Data collected were then presented in adverse events per 1,000 patient days, adverse events per 100 admissions and then, percent of admissions with an adverse event and presented in a run chart. Finally, the categories of harm were presented in a bar chart to show the volume of harm in each category.

### 3. RESULTS

Of the 120 charts reviewed, 64 (53.3%) were males and 56 (46.7%) were females; 83 (69.2%) were for adults while 37 (30.8%) were for paediatrics patients. Among the reviewed charts were transfers to ICU, 10 (8.3%) or Surgery Unit, 40 (33.3%). A total of 473 triggers were identified from 2173 patient-day visits obtained from the 120 patients' charts reviewed. Of the triggers identified, 118 (25.0%) were seen in paediatrics patients while 355 (75.0%) were in adult clinic. Of these, 175 (37.0%) were confirmed to be adverse drug events. It was also found that 97 (80.8%) of the patients had at least one adverse drug reaction.

A total of 97 patients had at least one ADR during their hospitalization. The different adverse drugs reactions incidence measures suggested by the IHI chart review calculated are as presented below:

**Measure number 1:** Adverse events per 1,000 patient-days was 80.5

**Measure number 2:** Adverse events per 100 admissions was 145.8

**Measure number 3: Percent of admissions with an adverse event was 80.8%**

The run chart for the detected ADRs and the corresponding adverse events per 1,000 patient days for each review period is presented in Fig. 1.

The result of the characterization of the harm severity in this study using the five category model as proposed by the IHI is shown in Fig. 2. From the Figure, 32 (28.3%) were classified into category E, 43 (38.1%) were classified into category F, 8 (7.1%) in category G, 13 (11.5%) in category H and only 17 (15%) of ADRs were classified into category I.

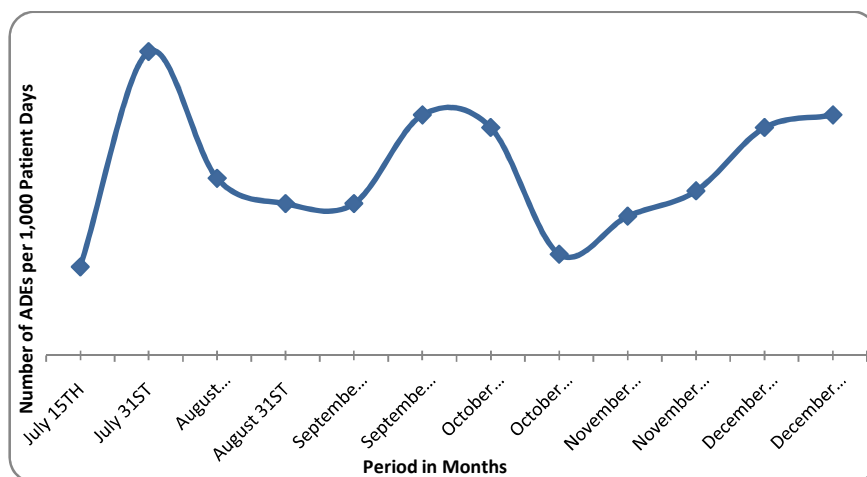
### 4. DISCUSSION

This study found high incidence of adverse drugs reactions (ADRs) as 80.8% of admissions with an adverse event was detected. This was the first study that used the trigger tool method to detect incidence rates for adverse drugs

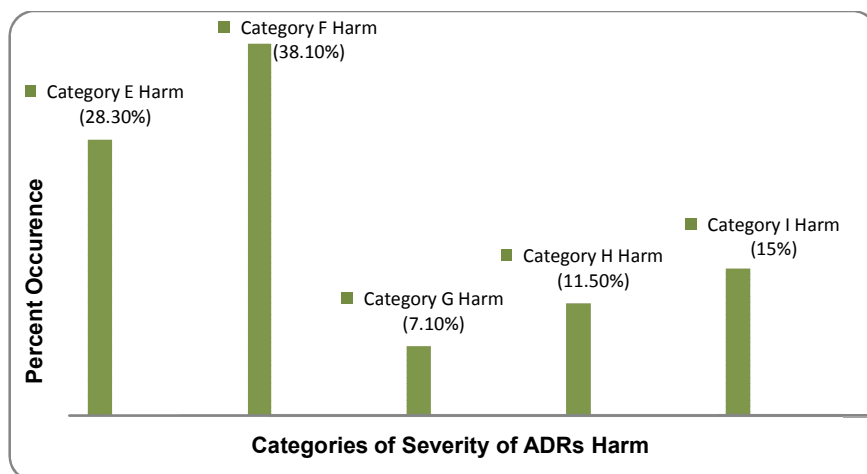
reactions in Nigeria. Earlier documented work in Nigeria used direct observation and merely focused on incidence and cost of treatment of ADRs among paediatrics patients [13]. The most common category of harm caused by ADRs among the patients included in this study was Category F where ADRs either contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalization. ADRs occurred most between July and August and least between October and November. This may be due to seasonal variations in disease patterns and the health-seeking behaviours of people in this part of the world.

The rate of ADRs among adult patients in this study (107 per 100 admissions) is higher than the 33.2 per 100 hospital admissions reported in a recent comparable study in three leading hospitals in the United States of America [14, 15]. These high ADRs incidences are also consistent with findings from a recent study in North Carolina hospitals and from the recent Health and Human Services study on Medicare patients [16]. These high rates may be because the use of trigger tool have been shown to detect more ADRs than the traditional pharmacovigilance system used in the hospitals which rely on spontaneous voluntary reporting. However, the true rates of ADRs are likely to be higher still, given the fact that consistent findings have shown that direct observational studies would detect higher rates of adverse events than retrospective studies using the trigger tool methodology because not all adverse events are documented in the patient record.

A recent study using neonatal population-focused trigger tool techniques reported ADR rate of 74 events per 100 admissions among the paediatrics patients in an intensive care unit, (ICU) in the USA [17], which is higher than the ADRs rate of 39.2 per 100 admissions found among paediatrics patients in our study. It is becoming increasingly clear that the more traditional methods of identifying ADRs using unfocused chart review or chart review with voluntary reports are less sensitive than the strategies that incorporate the trigger methodology. The mean rate of 3.94 triggers per paediatrics patient reported here is comparable to the 2.49 documented among paediatrics patients by other researchers. However the ADE rate of (107 per 100 patients) we report here among hospital inpatients is higher than (15 per 100 patients) reported by other researchers in six community hospitals in Massachusetts [18].



**Fig. 1. Run chart showing the adverse events (AEs) per 1,000 patient days for each review period**



**Fig. 2. Proportion of categories and severity of harm of identified adverse drugs reactions**

Most studies on the use of the trigger tool methodology to document ADRs had focused mainly on paediatric patients. The rate of 107 ADRs per 100 patient detected among paediatric patients in our study is higher than the rate of 11.1 per 100 patients detected among paediatrics patients by other researchers [19]. Similarly the overall total of 80.5 ADRs per 1000 patient-days found for both adult and paediatrics patients in this study is higher than the 38 ADRs per 1000 patient-days reported among hospital patients in New Zealand [20]. The rate of ADRs of 8.4 per 100 admissions found among hospitalized paediatric patients in this study is comparable to the rate of 6 per 100 admissions reported by the team of researchers among pediatric in-patients in intensive care units, (ICU)

and general care unit at a university hospital in the USA [21]. The ADRs rate of 39.2 per 100 admissions found among paediatrics patients in our study was very much higher than the rate of 0.7% reported among hospitalized children in a recent study in Nigeria [13]. This study, however, did not use the global trigger tool methodology and the study period was very much longer. The use of trigger tools has emerged as the next generation of ADR detection methods. The trigger tool methodology that relies on identification of "occurrences, prompts, or flags found on review of the medical record that 'trigger' further investigation to determine the presence or absence of an adverse event", are shown to identify higher rates of ADRs than other methods [14].

The higher ADRs rates reported in this study is consistent with recent studies which showed that more ADRs are detected using trigger tool methods than other detection methods such as: The traditional methods of occurrence reporting [22], the non-triggered chart review [23], and the administrative data analysis methods [24]. These findings are consistent with other trigger tool occurrence report comparisons which showed that the trigger tool methodology identified over twenty times more ADRs than the other frequently used but flawed occurrence report methods. The higher rate of ADRs identified by the use of the trigger methodology tool is likely attributable to the ability of the tool to direct focus on specific circumstances associated with ADRs, on specific chart elements, and on specific ADR types identified a priori to be of interest.

## 5. CONCLUSION

The high incidence rate of adverse drugs reactions found in this study showed that trigger tool methodology has potential to detect more adverse drug reactions among the hospitalized patients. Further research is required to develop strategies towards the incorporation of this technique in the routine healthcare process. This would possibly improve case detection of adverse drug reactions and promote patients safety. Data on the incidence of ADRs is required to better understand them and to identify the most common stages of the medication management process in which they occur. Such data are also required for developing strategies for effective detection and control of adverse drugs reactions and for preventing them from reaching the patients.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

It is not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Sharma H, Aqil M, Imam F, Alam MS, Kapur P, Pillai KK. A pharmacovigilance study in the department of medicine of a university teaching hospital. *Pharmacy Practice*. 2007;5(1):46-49.
2. Hasford J, Goettler M, Munter KH, et al. Physicians' knowledge and attitudes regarding the spontaneous reporting system for adverse drug reactions. *Journal of Clinical Epidemiology*. 2002;55:945-50.
3. Weeks WB, Waldron J, Foster T, et al. The organizational costs of preventable medical errors. *Jt Comm J QualImprov*. 2001;27:533-9.
4. Davies EC, Green CF, Taylor S, Williamson PR, Mottram DR, et al. Adverse drug reactions in hospital in-patients: A prospective analysis of 695 patient-episodes. *PLoS One*. 2009;4(2):e4439. DOI: 10.1371/journal.pone.0004439
5. Johnson JA, Bootman JL. Drug-related morbidity and mortality. A cost-of-illness model. *Achieves of Internal Medicine*. 1995;155(18):1949-1956.
6. Leape LL, Brennan TA, Laird N, Lawthers AG, Localio AR, Barnes BA, et al. The nature of adverse events in hospitalized patients. Results of the Harvard Medical Practice Study II. *New England Journal of Medicine*. 1991;324(6):377-384.
7. Classen DC, Pestotnik SL, Evans RS, Lloyd JF, Burke JP. Adverse drug events in hospitalized patients. Excess length of stay, extra costs, and attributable mortality. *Journal of American Medical Association*. 1997;277(4):301-306.
8. Wilson RM, Miche P, Olse S, Gibberd RW, Vincent C, El-Assady R, et al. Patient safety in developing countries: retrospective estimation of scale and nature of harm to patients in hospital. *British Medical Journal*. 2012;344:e832. DOI: 10.1136/bmj.e832
9. Marieke Zegers, Martine C. de Bruijne, Bertus de Keizer, Hanneke Merten, Peter P. Groenewegen, Gerrit van der Wal, Cordula Wagner. The incidence, root-causes, and outcomes of adverse events in surgical units: Implication for potential prevention strategies. *Patient Saf Surg*. 2011;5:13.
10. Lazarou J, Pomeranz B, Corey PN. Incidence of adverse drug reactions in hospitalized patients: A meta-analysis of prospective studies. *JAMA*. 1998;279:1200-1205.
11. Zegers M, de Bruijne MC, de Keizer B, Merten H, Groenewegen PP, van der Wal G, Wagner C. The incidence, root-causes,

- and outcomes of adverse events in surgical units: Implication for potential prevention strategies. *Patient Safety in Surgery*. 2011;5:13.
12. Ganachari MS, Wadhwa T, Walli S, Khoda DA, Aggarwal A. Trigger tools for monitoring and reporting of adverse drug reactions: A scientific tool for efficient reporting. 2013;2:724.  
DOI: 10.4172/scientificreports.724
  13. Oshikoya KA, Njokanma OF, Chukwura HA, et al. Adverse drug reactions in Nigerian children. *Paediatr Perinat Drug Ther*. 2007;8:81–8.
  14. Resar RK, Rozich JD, Classen DC. Methodology and rationale for the measurement of harm with trigger tools. *Qual Saf Health Care*. 2003;12:39–45.
  15. Classen DC, Resar R, Griffin F, Federico F, Frankel T, Kimmel N, Wttington JC, Frankel A, Seger A, James BC. Global trigger tool shows that adverse events in hospitals may be ten times greater than previously measured. *Health Affairs*. 2011; 30:4.
  16. Medicare Patient Safety Monitoring System (MPSMS). Annual Report of 2011 Data Overview 2012 MPSMS Annual Report of 2011 Data: Overview. (Accessed on 3rd May 2013)  
Available:<http://www.qualidigm.org/wp-content/uploads/2012/02/MPSMS-Overview-Final-Report.pdf>
  17. Sharek PJ, Classen D. The incidence of adverse events and medical error in pediatrics. *Pediatr Clin N Am*. 2005;53: 1067–1077.
  18. Hug BL, Witkowski DJ, Sox CM, Keohane CA, Seger DL, Yoon C, Matheny ME, Bates DW. Adverse drug event rates in community hospital. *J. Gen Intern Med*. 2009;25(1):31–8.
  19. Takata GS, Mason W, Taketomo C, Logsdon T, Sharek PJ. Development, testing, and findings of a pediatric-focused trigger tool to identify medication-related harm in US children's hospitals. *Pediatrics*. 2008;121:e927.
  20. Seddon ME. The adverse drug event collaborative: A joint venture to measure medication-related patient harm. *Journal of the New Zealand Medical Association (NZMJ)*. 2013;126(1368):9.  
(Assessed on May 23 3014)  
Available:<http://journal.nzma.org.nz/journal/126-1368/xxxx/>
  21. Holdsworth MT, Fichtl RE, Behta M, et al. Incidence and impact of adverse drug events in pediatric inpatients. *Arch Pediatr Adolesc Med*. 2003;157:60–5.
  22. Resar RK, Rozich JD, Simmonds T, Haraden CR. A trigger tool to identify adverse events in the intensive care setting. *Jt Comm J Qual Saf*. 2006;32(10): 585–590.
  23. Brennan TA, Leape LL, Laird NM, et al. Incidence of adverse events and negligence in hospitalized patients: Results of the Harvard Medical Practice Study I. *N Engl J Med*. 1991;324(6):370–376.
  24. Miller MR, Zhan C. Pediatric patient safety in hospitals: A national picture in 2000. *Pediatrics*. 2013;113(6):1741–1746.

© 2018 Uchechukwu et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Peer-review history:*  
*The peer review history for this paper can be accessed here:*  
<http://www.sciencedomain.org/review-history/26823>