ORIGINAL ARTICLE

DEVELOPMENT OF AN ERROR CLASSIFICATION SYSTEM FOR MALAYSIAN PRIMARY CARE

Nuur Asikin ABD RAMAN [1], Ibrahim Adham TAIB [1*], Samsul DRAMAN [2]

[1] *Biomedical Science Department, Kulliyyah of Allied Health Sciences, International Islamic University Malaysia (IIUM), 25200 Kuantan, Pahang, Malaysia.*
[2] *Family Medicine Department, Kulliyyah of Medicine, International Islamic University Malaysia (IIUM), 25200 Kuantan, Pahang, Malaysia.*
*corresponding author's email: tibrahim@iium.edu.my

ABSTRACT

Worldwide, medical errors occur at an unacceptable rate. Fortunately, various steps can be taken to minimise medical errors, including submitting reports to incident reporting systems, following which incidents can be categorised using error classification systems to inform risk management strategies. To this end, a diverse range of classification systems have been developed for different healthcare settings, but primary care in Malaysia has received limited attention. This study was carried out to develop an error classification system for categorising the type of medical errors in Malaysian primary care by integrating and modifying two primary care error classification systems. The new error classification system comprised of eleven major categories that branched into a total of 60 lower categories. After 107 participants analysed three cases studies, the inter-rater reliability of the 11 major categories were found to be low (Krippendorff's alpha = 0.347). Unsurprisingly, the 60 lower categories had an even lower inter-rater reliability (Krippendorff's alpha = 0.143). The participants then provided feedback about the error classification system by completing a modified questionnaire. Most of the participants viewed the error classification system as easy to use and understand. Furthermore, most of them would be willing to use the error classification system again in the future. In summary, this study successfully developed an error classification system for Malaysian primary care. Nevertheless, its low level of reliability would need to be addressed before the system can be adopted by primary care providers.
Keywords: *Error Classification System, Medical Error, Primary Care, Patient Safety*

INTRODUCTION

Primary care is often the initial point within the healthcare system for patients seeking health advice and treatment before they are referred to secondary or tertiary care if necessary. The many services in primary care include chronic disease management, maternal services, and home visits. In Malaysia, primary care is provided at more than 6000 public and private clinics nationwide and are commonly staffed by doctors, nurses, pharmacists, and medical assistants among others (Hwong et al., 2012).

The literature suggests that all healthcare settings, including primary care, are not as safe as they should be. For example, medical error is believed to be the third leading cause of deaths in America; up to 251,000 Americans died due to medical errors in 2013 alone (Makary & Daniel, 2016). Although medical errors might be less severe in primary care than inpatient settings, the overall impact of medical errors in primary care is significant because most patients are treated in primary care (Michel et al., 2017). For example, the median attendances of patients per public and private clinic in Kuala Lumpur in a year are 65,350 and 9,230 patients respectively. As the rate of medical errors in primary care is estimated to be between five and 80 incidents per 100,000 consultations (Sandars & Esmail, 2003), the number of medical errors in a year could be up to 52 cases for each public clinic and 7 cases for each private clinic in Kuala Lumpur.

Medical errors can be prevented by establishing an incident reporting system similar to those that have been successfully used in aviation, rail, and other high risk industries (Weisman, Annas, Epstein, et al., 2005; Institute of Medicine, 2000; Pham, Girard, & Pronovost, 2013). Such systems are designed to collect reports about a diverse range of incidents, ranging from near misses to severe events, to identify systemic factors within the healthcare system, and therefore provide organisations with learning opportunities. According to Anderson, Kodate, Walters, and Dodds (2013), organisational learning can improve staff attitude and knowledge about patient safety, which Leistikow, Mulder, Vesseur, and Robben (2017) argue is more beneficial than solving specific safety issues. Examples of incident reporting systems include the National Reporting and Learning System in the United Kingdom (UK) and the Incident Reporting and Learning System in Malaysia (Ministry of Health, 2015; National Health Service, 2012).

Incident reporting systems often include a database of incidents that is organised using an error classification system so that incident trends can be identified (Wallace & Ross, 2006). For example, error classification systems have been utilised to determine the patterns of maritime,

aviation, healthcare, and nuclear power generation incidents (Macrae, 2009; Shah et al., 2009; Shah, Kentala, Healy, & Roberson, 2004; Shorrock & Kirwan, 2002; Ujita, 1985) by categorising or classifying one or more features of the incidents according to categories that adhere to classification schemes (Wallace & Ross, 2006). The outcome of the categorisation or classification process is categorical data of the selected feature which, when collated into a database, can be analysed using frequency analysis to rank types or causes of incidents across departments or industries (Berry, Stringfellow, & Shappell, 2010).

Given that various error classification systems have been proposed, and that each error classification system can affect incident analyses differently, an organisation's decision to adopt an error classification system should be based on the system's reliability, which refers to

> "…the degree of consensus that exists between coders in terms of the coding or classifying of individual events" (p34, Wallace and Ross, 2006).

Wallace and Ross (2006) also argued that a reliable error classification system would ensure a meaningful database can be built as different users could still categorise or classify similar incidents in a similar manner. Besides reliability, another important criterion would be the error classification system's usability, as this reflects the extent an error classification system can be used as intended by a user in an effective, efficient, and satisfactory manner (Bevan, 2001). An error classification system with a high level of usability would be more convenient to use; as such, users would have a high willingness to use the system (Wiele & Rantanen, 2015).

There is little evidence in the literature to indicate that an error classification system has been developed specifically for primary care in Malaysia. As an alternative, an error classification system could be sourced overseas in its original form, but that would risk adopting an error classification system designed for a different healthcare system, such as in Australia or UK, as public clinics in Malaysia is part of a universal health coverage (Ng, Mohd Hairi, Ng, & Kamarulzaman, 2016), while private clinics both prescribes and dispenses medicines. Another option would be to use a generic error classification system for all settings within the Malaysian healthcare system, yet this may lead to less meaningful classifications and decreased reliability (Taib, McIntosh, Caponecchia, & Baysari, 2012). Therefore, this study was carried out to develop a error classification system for primary care in Malaysia, and subsequently assess its reliability and usability in classifying primary care incidents.

METHODS

Development of error classification system

To develop an error classification system for primary care in Malaysia, two error classification systems for primary care in UK and America were integrated (Taib and McIntosh, 2010) and modified into a single error classification system (Phillips, Dovey, Graham, Elder, & Hickner, 2006; Rosser et al., 2005; Rubin, George, Chinn, & Richardson, 2003) The integration was carried out by collating their categories before grouping the categories according to similar themes. For example, categories such as 'communication with patients' and 'referral errors' were grouped under 'communication'. This process continued until the themes became the major categories, and the categories grouped under each theme became the minor categories of the error classification system, which was then reviewed by a family medicine specialist to check its suitability for Malaysian primary care.

Participants

Using single proportion formula (α=0.05, proportion=0.6, precision=0.1), at least ninety-two participants were required for this study. A cross-sectional study was carried out at a primary care clinic and university campus by recruiting one hundred and seven participants (n=107) through convenience sampling. Six of the participants were healthcare workers, while the rest were undergraduate students from various health-based programmes such as medicine, pharmacy, and nursing, all of whom have at least a basic background in primary care. Each participant then provided informed consent after a researcher explained the study.

Reliability of error classification system

To test the error classification system's reliability, three case studies of medical errors that occurred in primary care were obtained from a database maintained by the Patient Safety Network in America (Agency of Healthcare Research and Quality, n.d.). These cases were then reviewed by the family medicine specialist to ensure their relevance to Malaysian primary care. The three case studies were then given to each participant along with three copies of the error classification system.

Next, each participant read one case study, followed by selecting one most suitable major category and one most suitable minor category in the error classification system that matches the type of error described in the case study. This categorisation process was then repeated with the other case studies. To minimise order effect due to the sequence of case studies, each participant categorised the case studies in random order. The categories chosen by each participant were then compared with one another to determine the error classification system's reliability.

User perception of error classification system
This study modified the System Usability Scale (Department of Health and Human Services, n.d.) to construct a questionnaire that could gauge the participants' perception of the error classification system's ease of use, comprehensiveness, and mutual exclusivity (Wallace and Ross, 2006). The questionnaire had eighteen items, each with the following five-point Likert rating scales: strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree. Out of the eighteen items, fourteen were for assessing ease of use, for example 'It was easy to learn to use this error classification system'. Three items were for assessing comprehensiveness, such as 'The categories in the taxonomy cover all the possible error present in primary care clinic'. One item, 'I did not find any overlapping category present', was used to assess the mutual exclusiveness of the categories in the error classification system. At the end of the questionnaire, a close-ended question asked about willingness to use the error classification system in an actual primary care setting. The questionnaire was then validated for internal consistency (Cronbach's alpha = 0.831) in a pilot study. Lastly, the questionnaire was completed by each participant after they categorised the three case studies.

Data Analysis
All data acquired were analysed using IBM Statistical Package for Social Sciences (SPSS) Statistics 20.0 software. The reliability of the error classification system was determined by calculating Krippendorff's alpha, which represents the level of agreement between participants in their selection of categories that best matches the case studies provided (Hallgren, 2012; Hayes & Krippendorff, 2007). Meanwhile, data obtained using the questionnaire was examined using frequency analysis.

RESULTS

Demographic information of participants
Table 1 shows the demographic information of this study's participants. More than two-thirds of them were female, and almost 95% were undergraduate students in their third or fourth year of studies from the medical, pharmacy, allied health sciences, and nursing faculties in International Islamic University Malaysia. Only a small number of primary care staff (n=6), who consisted of nurses and medical assistants, were successfully recruited for this study due to their busy schedule. All the students were between 20 and 25 years old; on the other hand, no information about the healthcare workers' age managed to be collected.

Table 1 Participant information (n=107)

Gender	n (%)
Male	36 (33.6)
Female	71 (66.4)
Occupation	n (%)
Undergraduate student	101 (94.4)
Primary care staff	6 (5.6)

Categories in the primary care error classification system
Table 2 lists all the categories in the primary care error classification system that this study developed. The classification system contains 11 major categories (listed using Arabic numerals), such as office processes and diagnosis, and 60 minor categories (listed using Roman numerals), for example workload poorly managed and computer not working. Overall, the classification system is comprehensive as it covers not just consultation matters but various other facets of primary care, including patient registration, communication between different professions, and billing.

Table 2 The major and minor categories in the error classification system (modified from Rubin *et al.*, 2003; Rosser *et al.*, 2005; Phillips *et al.*, 2006)

Categories
1. OFFICE PROCESSES
i. filing system
ii. chart completeness
iii. scheduling appointments
iv. patient flow through the healthcare system
v. message handling
vi. maintenance of physical building/ surrounding/ practice site
vii. lack of experience or knowledge in an administrative procedure
viii. failure to respect/ understand confidentiality of patient
2. WORKFORCE MANAGEMENT
i. scheduling after-hours coverage
ii. clinicians arriving late
iii. tasks of absent staff not covered
iv. dysfunctional referral procedures
v. physician left early
vi. no interpreter during office visit

vii. workload poorly managed

3. EQUIPMENT
   i. computer not working
   ii. other equipment not working

4. APPOINTMENTS

5. CLINICAL KNOWLEDGE/TASK
   i. patient given incorrect appointment details
   ii. failure to follow standard practice
   iii. lack of experience or knowledge in a clinical procedure
   iv. nonclinical staff making wrong clinical decision

6. COMMUNICATION
   i. communication with patients
   ii. communication with other healthcare providers (non-medical)
   iii. communication with other doctors
   iv. communication amongst the whole healthcare team
   v. cases notes missing
   vi. delivery of post
   vii. information missing or in the wrong place
   viii. wrong case notes (for e.g. patients with similar names)
   ix. failure to pass on/ collect messages
   x. referral errors

7. PRESCRIPTION/MEDICATION
   i. administrative (for e.g. prescription not ready, missing)
   ii. unavailable drug information
   iii. miscommunication of drug orders
   iv. lack of appropriate labeling
   v. clerical (for e.g. prescription not signed or incorrect patient details)
   vi. incomplete patient information
   vii. medication (for e.g. incorrect drug dose)
   viii. inaccurate computer prescribing records
   ix. wrong drug
   x. wrong route of administration

8. DIAGNOSIS
   i. wrong decision by a nurse
   ii. delay in diagnosis
   iii. wrong or delayed diagnosis attributable to misinterpretation of investigations
   iv. wrong decision by a pharmacist
   v. wrong diagnosis by a hospital-based doctor

9. TREATMENT DECISION
   i. wrong treatment decision by a consultant
   ii. wrong treatment decision attributable to doctor's action(s) or omission
   iii. wrong treatment decision influenced by patient preference

10. CLINICAL CARE
   i. note keeping/ recording
   ii. diagnostic imaging
   iii. laboratory tests
   iv. processes of other investigations
   v. therapeutic

11. FINANCIAL ACCOUNTING/PAYMENT
   i. insurance-related
   ii. electronic payment
   iii. billing slip problems
   iv. wrongly charged
   v. forms not complete/accurate
   vi. payment dispute

Reliability of primary care error classification system

Table 3 shows the value of Krippendorff's alpha for the 11 major categories and the 60 minor categories in the error classification system. The value of Krippendorff's alpha for both the major and minor categories were far below the minimally acceptable level, i.e. at 0.67 (Hallgren, 2012). A possible reason for the low reliability could be the limited training that each participant received

prior to using the error classification system (Baysari, Caponecchia, & McIntosh, 2011). This, along with the absence of a written definition for each major and minor category, could have led each participant to interpret the categories differently. As a result, different participants may have chosen different categories to classify similar cases, and thus lowered the error classification system's reliability.

Table 3 Reliability of the major and minor categories in the error classification system

Categories	Krippendorff's Alpha
Major	0 .347
Minor	0 .143

User perception of the error classification system

The participants' user perception of the error classification system is displayed in Table 4. Overall, close to half of the participants agreed with 12 out of 14 items on the error classification system's ease of use, 2 out of 3 items on its comprehensiveness, and neither agree nor disagree with the item on its mutual exclusivity. These findings provide evidence that the error classification system developed in this study was easy to use, and this is corroborated by the results shown in Table 5, which indicates that more than three quarters of participants were willing to use the error classification system in an actual primary care setting in the future. In terms of comprehensiveness, the results show that the error classification system has adequate quantity and type of categories for classifying errors in the primary care setting. Nevertheless, given that most of the participants could not agree on the absence of overlapping categories in the error classification system, it is possible that participants may have had trouble in differentiating the redundant categories, which therefore led to the error classification system's low reliability.

Limitations

Due to their busy schedule, only a small number of healthcare workers in a primary care centre participated in this study. As a result, the vast majority of participants in this study were undergraduate medical or health science students. Thus, the conclusions made in this study, for example the user perception on the error classification system, may not truly reflect the views of healthcare workers in primary care centres in Malaysia. Furthermore, the error classification system's reliability was only tested using three case studies downloaded from a database overseas. Hence, the reliability of the error classification system could be different if it is tested with a larger number of case studies sourced locally. Therefore, a study could be conducted in the future to obtain more feedback from healthcare workers in Malaysian primary care centres using local case studies before the error classification system is adopted in primary care in Malaysia.

Table 4 Participant's user perception of the primary care error classification system

Question	n (%)				
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1. It was easy for me to familiarize myself with error classification system's functions.	2(1.9)	19 (17.8)	31 (29.0)	49 (45.8)	6 (5.6)
2. It was easy to learn to use this error classification system.	1 (0.9)	21 (19.6)	30 (28.0)	49 (45.8)	6 (5.6)
3. It took me a long time to categorize the given cases according to the error classification system.	7 (6.5)	32 (29.9)	31 (29.0)	25 (23.4)	12 (11.2)
4. I found the error classification system developed user friendly and easy to use.	2 (1.9)	15 (14.0)	37 (34.6)	47 (43.9)	6 (5.6)
5. I do not have any problems while using this error classification system.	2 (1.9)	20 (18.7)	36 (33.6)	40 (37.4)	9 (8.4)
6. I found the categories present in the error classification system were comprehensive.	0 (0.0)	7 (6.5)	39 (36.4)	53 (49.5)	8 (7.5)
7. The categories in the error classification system were clear and easy to understand.	0 (0.0)	16 (15.0)	28 (26.2)	57 (53.3)	6 (5.6)
8. I imagine that most primary care clinics' staff would learn to use this error classification system very quickly.	0 (0.0)	14 (13.1)	34 (31.8)	49 (45.8)	10 (9.3)
9. I imagine that most primary care clinics' staff would want to use this error classification system.	3 (2.8)	13 (12.1)	40 (37.4)	46 (43.0)	5 (4.7)
10. I did not have any problem to find the suitable category for the cases given.	3 (2.8)	19 (17.8)	33 (30.8)	46 (43.0)	6 (5.6)
11. I found the error classification system very cumbersome to use.	4 (3.7)	30 (28.0)	39 (36.4)	28 (26.2)	6 (5.6)
12. The error classification system has all the categories I	1 (0.9)	9 (8.4)	44 (41.1)	47 (43.9)	6 (5.6)

expected it to have.					
13. I felt very confident using the error classification system.	1 (0.9)	17 (15.9)	47 (43.9)	37 (34.6)	5 (4.7)
14. I able to find the category I want easily.	2 (1.9)	16 (15.0)	37 (34.6)	49 (45.8)	3 (2.8)
15. I did not find any overlapping category present.	2 (1.9)	13 (12.1)	45 (42.1)	41 (38.3)	6 (5.6)
16. The categories in the taxonomy cover all the possible error present in primary care clinic.	1 (0.9)	7 (6.5)	57 (53.3)	36 (33.6)	6 (5.6)
17. It is easy to classify cases according to the error classification system developed.	2 (1.9)	6 (5.6)	40 (37.4)	52 (48.6)	7 (6.5)
18. Overall, I am satisfied with how easy it is to use this error classification system.	1 (0.9)	12 (11.2)	33 (30.8)	52 (48.6)	9 (8.4)

Table 5 Participants' willingness to use the error classification system

Response	n (%)
Yes	77 (72.0)
No	30 (28.0)
Total	107 (100.0)

CONCLUSION

This study developed an error classification system consisting of 11 major categories and 60 minor categories for primary care in Malaysia. Overall, the error classification system's reliability was low, possibly due to the limited training and instructions received by this study's participants. Furthermore, close to half of the participants agreed that the error classification system was easy to use and comprehensive but may have overlapping categories. In terms of future adoption, more than three quarters of participants were willing to use the error classification system in an actual primary care setting. However, due to certain limitations in this study, additional studies would need to be carried out before the error classification system can be adopted for primary care in Malaysia.

ACKNOWLEDGEMENTS

The authors would like to thank all the participants for volunteering in this study.

COMPETING INTERESTS

There is no conflict of interest.

REFERENCES

Agency of Healthcare Quality and Research. (n.d.). WebM&M Cases & Commentaries. Retrieved October 24, 2018, from https://psnet.ahrq.gov/webmm

Anderson, J. E., Kodate, N., Walters, R., & Dodds, A. (2013). Can incident reporting improve safety? Healthcare practitioners' views of the effectiveness of incident reporting. *International Journal for Quality in Health Care*, *25*(2), 141–150.

Baysari, M. T., Caponecchia, C., & McIntosh, A. S. (2011). A reliability and usability study of TRACEr-RAV: The technique for the retrospective analysis of cognitive errors - For rail, Australian version. *Applied Ergonomics*, *42*(6), 852–859.

Berry, K. A., Stringfellow, P. F., & Shappell, S. A. (2010). Examining Error Pathways: An Analysis of Contributing Factors using HFACS in Non-Aviation Industries. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *54*(21), 1900–1904.

Bevan, N. (2001). International standards for HCI and usability. *International Journal of Human-Computer Studies*, *55*(4), 533–552.

Department of Health and Human Services. (n.d.). System usability scale. Retrieved October 24, 2018, from https://www.usability.gov/how-to-and-tools/resources/templates/system-usability-scale-sus.html

Hallgren, K. A. (2012). Computing inter-rater reliability for observational data: an overview and tutorial. *Tutorials in Quantitative Methods for Psychology*, *8*(1), 23.

Hayes, A. F., & Krippendorff, K. (2007). Answering the call for a standard reliability measure for coding data. *Communication Methods and Measures*, *1*(1), 77–89.

Hwong W. Y., Sivasampu S., Aisyah A., Shantha Kumar C., Goh P. P., & Hisham A. N. (2012). National Healthcare Establishment & Workforce Statistics (Primary Care) 2012. National Clinical Research Centre.

Institute of Medicine. (2000). *To Err Is Human: Building a Safer Health System*. Kohn, L. T., Corrigan, J. M., & Donaldson, M. S. (Eds.), Washington, DC: The National Academies Press.

Leistikow, I., Mulder, S., Vesseur, J., & Robben, P. (2017). Learning from incidents in healthcare: the journey, not the arrival, matters. *BMJ Quality &Amp; Safety*, *26*(3), 252 LP-256.

Macrae, C. (2009). Human factors at sea: common patterns of error in groundings and collisions. *Maritime Policy & Management*, *36*(1), 21–38.

Makary, M. A., & Daniel, M. (2016). Medical error—the third leading cause of death in the US. *BMJ*, *353*.

Ministry of Health (2015). Incident Reporting and Learning System. Retrieved October 19, 2018, from http://patientsafety.moh.gov.my/v2/?page_id=56

Michel, P., Brami, J., Chanelière, M., Kret, M., Mosnier, A., Dupie, I., … Quenon, J.-L. (2017).

Patient safety incidents are common in primary care: A national prospective active incident reporting survey. *PLoS ONE*, *12*(2)

National Health Service. (2012). The National Reporting and Learning System. Retrieved October 19, 2018, from https://report.nrls.nhs.uk/nrlsreporting/

Ng, C. W., Mohd Hairi, N. N., Ng, C. J., & Kamarulzaman, A. (2016). Universal health coveragein Malaysia: Issues and challenges. In Tey, N. P., Cheong, K. C., & Rasiah, R. (Eds.), *Revisiting Malaysia's Population-Development Nexus*. Kuala Lumpur: University of Malaya.

Pham, J. C., Girard, T., & Pronovost, P. J. (2013). What to do With Healthcare Incident Reporting Systems. *Journal of Public Health Research*, *2*(3).

Phillips, R. L., Dovey, S. M., Graham, D., Elder, N. C., & Hickner, J. M. (2006). Learning From Different Lenses: Reports of Medical Errors in Primary Care by Clinicians, Staff, and Patients: A Project of the American Academy of Family Physicians National Research Network. *Journal of Patient Safety*, *2*(3), 140.

Rosser, W., Dovey, S., Bordman, R., White, D., Crighton, E., & Drummond, N. (2005). Medical errors in primary care: results of an international study of family practice. *Can Fam Physician*, *51*(3), 386–387.

Rubin, G., George, A., Chinn, D. J., & Richardson, C. (2003). Errors in general practice: development of an error classification and pilot study of a method for detecting errors. *Qual Saf Health Care*, *12*(6), 443–447.

Sandars, J., & Esmail, A. (2003). The frequency and nature of medical error in primary care: understanding the diversity across studies. *Fam Pract*, *20*(3), 231–236.

Shah, R. K., Kentala, E., Healy, G. B., & Roberson, D. W. (2004). Classification and consequences of errors in otolaryngology. *Laryngoscope*, *114*(8), 1322–1335.

Shah, R. K., Lander, L., Forbes, P., Jenkins, K., Healy, G. B., & Roberson, D. W. (2009). Safety on an Inpatient Pediatric Otolaryngology Service: Many Small Errors, Few Adverse Events. *Laryngoscope*, *119*(9), 871–879.

Shorrock, S. T., & Kirwan, B. (2002). Development and application of a human error identification tool for air traffic control. *Applied Ergonomics*, *33*(4), 319–336.

Taib, I. A., & McIntosh, A. S. (2010). On the integration and standardization of medication error data: Taxonomies, terminologies, causes and contributing factors. *Therapeutic Advances in Drug Safety*, *1*(2).

Taib, I. A., McIntosh, A. S., Caponecchia, C., & Baysari, M. T. (2012). Comparing the usability and reliability of a generic and a domain-specific medical error taxonomy. *Safety Science*, *50*(9), 1801–1805.

Ujita, H. (1985). Human error classification and analysis in nuclear-power plants. *Journal of Nuclear Science and Technology*, *22*(6), 496–498.

Wallace, B., & Ross, A. (2006). *Beyond human error: taxonomies and safety science*. CRC/Taylor & Francis.

Weisman, J. S., Annas C. L., Epstein, A. M., Schneider, E. C., Clarridge, B., Kirle, L., Gatsonis, C., Feibelmann, S. & Ridley, N. (2005). Error reporting and disclosure systems: Views from hospital leaders. *JAMA*, *293*(11), 1359–1366.

Wiele, P., & Rantanen, E. (2015). Usability of Incident Reporting Systems: Preliminary Results of A Case Study. *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care*, *4*(1), 168–173.