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Developing and using taxonomies of errors

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'Please bring me the red dress.'

'Do you mean the one with the white polka dots?'

What is the dress? Is it a red dress, or is it a white polka dot dress? Dr Michael Ghiselin, noted biologist and taxonomist, used this example to set the stage for a discussion of the ambiguities inherent in formal systems of classification, or taxonomies. A taxonomy is a classification system for ordering things into groups based on their similarity. The characteristics of the objects, events or phenomena that one uses to classify them, however, are always somewhat arbitrary.

Classifying objects can be difficult, but classifying events is even more so. Consider the following real patient safety event report:

> The husband of a 74-year-old patient called in with complaints that she had had diarrhea, with occasional incontinence. She has dementia and Parkinson's, and it seemed as if the diarrhea and incontinence could be related to these chronic problems, without much chance of satisfactory resolution. A stool sample was dropped off for analysis at the clinic and was negative for everything but blood. The results sat in a stack of papers for a week, until the husband called in saying she was weak and having black stools. She came in for a hemoglobin, which was found to be critically low. She was admitted to the hospital, transfused, and scoped. She was found to have stomach ulcers from the arthritis medication she had taken for a decade. The patient's husband thinks that she had a small stroke during the episode, the symptoms of which have now resolved. She spent the weekend in the hospital. I have a chaotic work environment and am way behind on paperwork. My piles of thing to do grow larger every day.
>
> (Reporter – physician)

Under what rubric shall we classify this event? Is it a medication event, a communication event, a geriatric event? If patient safety events – or incidents – must be classified

in mutually exclusive categories, what type of event is this? It depends on the structure of the taxonomy.

In this chapter we will first discuss principles of classification and how these principles apply to patient safety taxonomies. Then we will discuss the classification of medical errors, also called patient safety events/incidents. We will summarize existing approaches to the reporting and classification of medical errors, providing examples of how patient safety taxonomies are useful to direct improvement efforts to areas in which they are most needed. We will conclude with comments about the future of patient safety taxonomy and suggestions for users and researchers.

General principles of classification and their application to patient safety

Careful thought about the purpose of a taxonomy (classification system) guided by theory and practical experience is necessary to develop a functional taxonomy. There is a delicate interplay between the theoretical framework of a body of knowledge and the classification system used to codify that knowledge. Knowledge, understanding, and theory change over time; sometimes advanced by intellectual insights (theory development) and sometimes by empirical discoveries. Science is an iterative process that uses inductive and deductive reasoning; specific findings to general rules; general rules applied to specific findings. The role of classification systems is to organize and display specific, empirical findings in ways that enhance understanding. The periodic table, for example, was originally constructed to represent 'families' of elements with similar chemical properties – not as an expression of theory. However, understanding the theoretical framework underlying a classification system is necessary to fully comprehend the data. The periodic table means a great deal more to those who know what protons, neutrons and electrons are. Taxonomies are powerful political and social tools as well, and they reflect prevailing societal beliefs. As evidence, one need only recall that homosexuality was an abnormal psychiatric diagnosis in previous versions of medical classifications.

An ideal classification system should have mutually exclusive categories and be exhaustive. That is, an event or object may not be located in more than one place in the classification system, and all events of the type being classified must fit somewhere. A library book, for example, can have only one identification number in the Dewey decimal system and can occupy only one spot on the shelves, and all books can be assigned an identification number. But many phenomena are multi-dimensional, especially patient safety events such as the event described above. Therefore, patient safety classification systems must be multi-dimensional in order to provide comprehensive summaries of events. The advent of computerized databases has made multi-axial classification systems easier to create and use for analyses. One can attach many names or codes to a given object or event. When one wishes to retrieve all the objects that have similar characteristics, it is as simple as pressing a button. The difficulty with the database approach, if not developed with appropriate conceptual models, is that it may not provide a hierarchy of objects or events that are related in some important ways. Hierarchical organization of categories facilitates understanding of similarities and differences. Modern classification systems can take advantage of both approaches.

In developing a classification system, one may start either with a conceptual framework or with data. For example, one might ask a pharmacist to list everything that might go wrong in medication prescribing or one could ask the pharmacist to report all the errors she observes during the next month. Either approach relies on close familiarity with the area of interest. The advantage of a theory-driven approach is that the categories are likely to be related in important and logical ways from the beginning. The advantage of the empirical, data-driven approach is that one is not constrained by the initial categories or the taxonomists' biases. In reality, classification systems evolve as one moves from data to theory and back to data again, as with any scientific process.

Taxonomists must ask themselves four questions before they begin their work. What do we want to classify? What kind of thing is it? Why do we want to classify it? What sort of classification is appropriate? Although the answer to 'What do we want to classify?' might appear straightforward, let us again consider the red dress. What is a dress? Is it a one-piece garment worn by women that covers the body? Is a tunic, then, a dress? Is a sari a dress? What about a kimono? Different classifiers might have different answers to these questions, and even expert dressmakers might not agree. Usually it is possible to agree on including or excluding objects that fit centrally or not at all into a classification scheme. Around the boundaries classification becomes much more difficult. We see this problem appearing in patient safety taxonomies. Do we include all adverse events regardless of cause or only those due to error? Does one include only errors that resulted in harm to a patient? What constitutes harm? The Institute of Medicine definition of medical errors includes errors of commission and errors of omission. Does this mean that failure to perform a recommended screening test for cancer is a medical error? If so, are all quality-related events and non-events medical errors? Furthermore, are we speaking about medical errors or healthcare errors? Whose actions, then, shall we include? If a patient does not adhere to a dietary regimen, is that an error? Or, is the patient simply exercising her autonomy? A broad definition of medical errors has the advantage of including important 'latent errors' of healthcare policy and organization but has the disadvantage of distracting the patient safety conversation from the most urgent goal – avoiding actively harming people from medical interventions. The importance of boundaries cannot be overstated. Objects or events that do not fit into the taxonomy become invisible.

What kind of thing is it? Most generally, a dress is a garment. But a dress may also be a fashion statement, a way to attract attention, or a ceremonial symbol. When considering medical errors, do we mean discrete mistakes by individuals, or shall we include systems problems and organizational problems? Errors that harm patients are frequently the result of a series of errors that can be due to human error, systems design flaws, and organizational problems; hence the terminology 'patient safety event'. Shall we seek, then, to classify individual errors or events? The correct answer is 'it depends'. Because most of the taxonomies of patient safety have been developed in association with event reporting, patient safety taxonomies, in reality, classify events that pose a threat to patients' safety rather than the individual errors that combine to form the event. It is important to note that not all safety events result in harm. There is value in studying 'near misses' as well because they can reveal what went right as well as what went wrong.

Why do we want to classify it? The purpose of a taxonomy is to organize knowledge

to facilitate understanding. Taxonomies are fundamental to knowledge organization and communication. They provide a framework for understanding new discoveries. They facilitate critical thinking. They allow comparison and conversation between those interested in a particular field of human endeavour. Taxonomies include definitions of words and rules of classification that facilitate meaningful discussion and communication. Classification relates the general to the specific, 'kinds' to 'instances'. The most useful classification systems also address the issues of aetiology, cause and effect. Therefore, the fundamental characteristics or 'dimensions' of the things being classified that one selects for a taxonomy are crucial.

The purpose of patient safety taxonomies should be to facilitate understanding of threats to safety in a way that informs efforts to reduce harm. Patient safety taxonomies must be useful to a variety of users, including policy-makers, healthcare administrators, quality managers, healthcare personnel including practitioners and staff, and safety researchers. A patient safety taxonomy's value should be judged on how well it organizes data to create knowledge and understanding to inform improvement. A good patient safety taxonomy helps to identify and clarify the safety issues in medicine and it provides a foundation for resolving those problems. A good taxonomy serves as the basis for action.

What sort of classification system is appropriate? Biologists and zoologists decided some time ago that plants and animals ought to be classified according to their phylogeny, their evolutionary origin. Physicists have developed an elegant taxonomy for the elements of matter, the periodic table. A variety of taxonomies and nomenclatures exist for defining classifying medical terms and procedures. These include the International Classification of Disease (ICD), Read Codes, and International Classification of Primary Care (ICPC) for diagnoses; Current Procedural Terminology (CPT) for procedures, and nomenclatures such as the Systemized Nomenclature of Human and Veterinary Medicine, Clinical Terms (SNOMED-CT) for categorizing medical phenomena, and Logical Observation Identifiers Names and Codes (LOINC) for describing and coding laboratory and related data. These are useful for classifying patient safety events, but none were designed as comprehensive classification systems for medical errors or adverse events. All of these taxonomies are dynamic, changing to accommodate new discoveries. With the sequencing of the human genome, these medical classification systems and nomenclatures are likely to change radically.

Patient safety taxonomies

With the increased focus on patient safety in the twenty-first century that was accelerated by the 1999 Institute of Medicine publication, *To Err is Human* (Institute of Medicine 1999), hundreds of adverse event reporting systems and patient safety taxonomies have sprung up. An indication of the intensity of interest in patient safety taxonomy is the 60,300 hits we received on *Google* under 'patient safety taxonomy' in January 2005. Most existing patient safety taxonomies are home-grown classification systems used by hospitals and healthcare organizations to organize their adverse event reports. At least half of the states in the USA have mandatory reporting requirements for serious adverse events that occur in hospital, and each of these states uses a

different classification system. While local, and regional taxonomies are useful for regulation and local improvement, it is not possible to compare data from different sites because of the lack of standard terminology and categories. Some patient safety taxonomies are specific to certain specialties, such as anaesthesia, neonatology, pediatrics, or general practice. The ICD-9/10 CM External Cause and Injury Codes (E-Codes) is the classification system used most frequently in US hospitals for classifying adverse events. Only a handful of taxonomies have tackled the larger issues of national and international standardization, allowing comparisons of patient safety events more universally across the continuum of care.

Like the periodic table, most existing patient safety taxonomies started with *observations* of events that visibly (usually physically) harmed patients but unlike most other scientific taxonomies, 'families' of events in patient safety taxonomies tend to be defined not by their aetiology, but by their ultimate outcome. Theory has come later and is currently in rapid development, paralleling the rapid recent accumulation of safety event descriptions. Patient safety taxonomies must start with a clear understanding of their purpose. Most often this purpose has been to provide information to help staff in hospitals and primary care clinics provide care that helps, rather than harms, patients. To provide rich enough descriptions to develop interventions, patient safety taxonomies need to be multi-dimensional. Different developers have arrived at a variety of conclusions regarding the number and types of major domains (axes) to include in a patient safety taxonomy. At a minimum, however, the taxonomy must include domains to describe the context of the event (who, what, when, where) and presumed underlying causes of the event (why). Here, we describe four general patient safety taxonomies and two primary care taxonomies, outlining unique features of each.

The Australian Incident Monitoring System (AIMS) and the General Occurrence Classification (GOC)

The first attempt to develop a comprehensive patient safety taxonomy started in Australia. In 1987 William Runciman and his colleagues launched the Australian Incident Monitoring System (AIMS) to monitor anaesthesia mishaps (Runciman 2002). In the mid-1990s as AIMS expanded to encompass 'things that go wrong' throughout the healthcare system, AIMS researchers developed the Generic Occurrence Classification (GOC) for patient safety events (Runciman et al. 1998). They discovered that existing classifications such as the Read Codes or ICD-9 E Codes were insufficient to describe what goes wrong in health care. To guide development of the GOC, Runciman and colleagues outlined a comprehensive model for understanding patient safety events called the Generic Reference Model (Figure 7.1) that has three major categories: contributing factors and hazards, descriptors of the incident, and outcomes and consequences. This is based on the widely used 'Reason' model of complex systems failure. Using 1,000 reports of patient safety incidents in teaching hospitals, he classified the main features of these reports into 'natural categories' using a process called 'natural mapping' (Norman 1998). A natural category is a descriptor that is brief, easily and commonly understood which captures the essence of an event and is not constrained by being restricted to any class. Natural mapping refers to connecting groups of natural categories in an intuitively reasonable way.

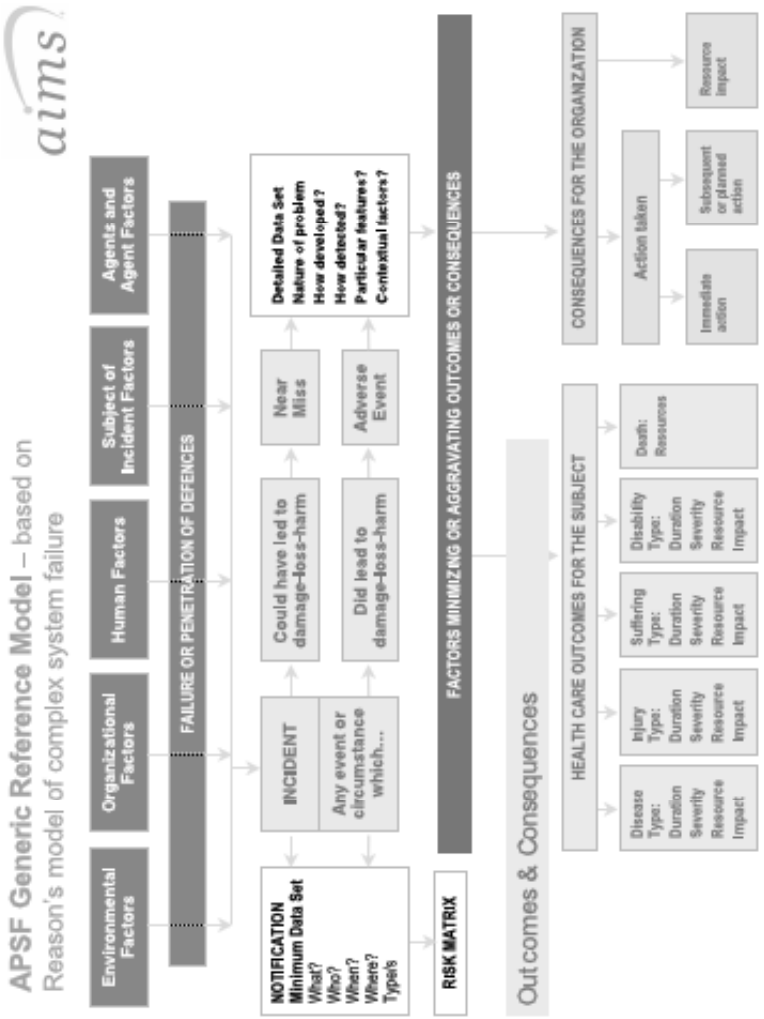

Figure 7.1 The Generic Reference Model of the Australian Incident Monitoring System
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The GOC is not, strictly speaking, a taxonomy but rather a huge computerized branching database that elegantly organizes salient and important elements of an incident report in a way that preserves the narrative description yet allows complex analyses of relationships among many variables. One begins coding an event into the system by starting with the Health Incident Type. The data entry operator follows the computer tree branches to the last branch or as far as data allow. It is not possible to display this complex database on paper; only segments of the trees, as it has over 1.5 million permutations. For less serious events, an abridged form can be used. Domain-specific computer programs that use the same structure as the GOC are being developed that will simplify data entry for specific healthcare venues such as nursing homes and general practice. This system is a powerful engine for analysis of patient safety issues but requires considerable training to enter data properly. AIMS is perhaps unique in that it is designed to receive reports from a wide variety of sources including incident monitoring, medical record review, death certificates, hospital discharges, surveys of general practice, patient complaints, medico-legal investigations, coroner investigations, results of other enquires and investigators and even literature searches.

The Medical Event Reporting System (MERS)

In the mid-1990s Hal Kaplan and colleagues at the University of Texas Southwestern in Dallas developed an incident monitoring system for transfusion medicine, MERS-TM. At Columbia University in New York, he and his team have since expanded this system to capture events from all healthcare domains and settings. MERS-TH (Medical Event Reporting System – Total HealthSystem) is a web-based approach designed to collect, classify, analyse and monitor events that could potentially compromise patient safety. It provides the opportunity to study events and their associated causes to facilitate the development of corrective actions and process improvement efforts that will reduce future risk of harm.

The MERS-TH 'process' includes the following steps: Detection, Selection, Investigation, Description and Classification, Computation, and Interpretation. Each step involves a standardized process and associated tools. Coding, using the system's unique event and root cause taxonomies, takes place during Description and Classification and is heavily relied upon for Computation and Interpretation strategies. The taxonomy was specifically developed to capture reports of actual events (with and without associated harm), near-miss events, 'dangerous' situations, and clinical adverse events. In contrast to Runciman's very empirical method of getting started, Kaplan chose to ground his root cause taxonomy in general safety theory, with the goal of assigning causal codes to each 'branch' of an event. He reasoned that a safety taxonomy should, above all, produce understanding of causation as a first step in understanding and avoiding similar mishaps in the future. Kaplan and van der Schaaf adapted an existing causal classification model originally developed for safety event reporting in the chemical industry (Van der Schaaf 1992). The Eindhoven Classification Model for Medical Domain has three main causal categories: latent errors (technical and organizational), active errors (human), and other (patient-related and unclassifiable). These categories are consistent with the theoretical frameworks of Reason and Rasmussen (Rasmussen 1987; Reason 1990).

In addition to the causal codes that are assigned to root causes that led up to the mishap, MERS includes many contextual variables for comparative analyses that were developed after reviewing other patient safety systems, which for the most part were domain-specific. Information is shared by the reporter using a computerized, standardized approach (searchable fields, drop-down lists), and both the 'discovery' situation and the 'occurrence' situation of each event are coded using a four-tiered taxonomy model: Service, Event Type (broad category), Event Description (specific event), and Contributing Factor(s). If a root cause analysis is performed (risk analysis and search tools are provided to assist in decision-making), multiple chronological 'layers' of the chain of occurrences that led up to the event are coded. Initially, this taxonomy was tested using a retrospective sampling of event reports. It was then piloted in limited hospital units, followed by a full rollout throughout both hospital and ambulatory care settings. Like AIMS, MERS is not, strictly speaking, a taxonomy, but rather a powerful structured relational computer database and tool for causal analyses. It requires a skilled systems operator to perform the coding and root cause analysis.

The National Reporting and Learning System (NRLS)

Development of the National Patient Safety Agency (NPSA) taxonomy started in 2002 with an examination of other patient safety-related classifications used in the UK. From this analysis the most suitable classification was chosen and piloted, but due to its acute sector focus the Agency decided to develop its own taxonomy to cover the needs of all service sectors. Reference groups for nine service areas (acute, ambulance, dentistry, general practice, optometry, mental health, learning disabilities, pharmacy and primary care) were established. These groups were made up of internal NPSA staff, service representatives, the Royal Colleges and healthcare associated charities. The taxonomy then developed iteratively and once the groups were comfortable with its structure and nomenclature it was re-piloted.

A web-enabled electronic eForm was developed to allow reporters to submit live patient safety-related data to the NPSA. During this phase some 12,000 reports were submitted and analysed by NPSA statisticians. In addition to this empirical analysis, anecdotal evidence on the quality and usability of the taxonomy was gathered from user feedback and usability studies. To work through all of these inputs, a series of intensive workshops were held, bringing together NPSA staff and external experts representing all the service areas, with the aim to rationalize and harmonize the taxonomy. The patient safety incident type taxonomy was a key focus area during these workshops. Prior to the workshop, each service area had a distinct patient safety incident categorization that meant there were around 300 incident types in total. With such a categorization, statistical cross-service comparative analysis was almost impossible. It was therefore clear that for meaningful information to be obtained from the system, the NPSA needed to rationalize and standardize the taxonomy.

To achieve this harmonization, participants from different service areas were mixed together to encourage sharing of knowledge and experience. A series of card-sorting workshops took place to agree on the classification, which led to a standardized terminology to describe incident types and a cross-service incident classification

(Table 7.1). This has established an excellent basis from which to compile cross-service statistical reports that will highlight issues, themes and national trends worthy of further investigation.

The JCAHO Patient Safety Event Taxonomy (PSET)

The Joint Commission on Accreditation of Hospitals and Healthcare Organizations (JCAHO) is the largest independent accrediting agency for medical organizations in the United States. In 2003–4 a team of researchers from JCAHO took a different approach to developing a taxonomy. The investigators not only incorporated the best features of several existing taxonomies, but also utilized an extensive review of the literature and the Joint Commission's Sentinel Event Database to populate taxonomy elements (Chang et al. 2005). They sought to 'identify similarities and gaps in the terminology and classifications to create a multidimensional taxonomy that encompasses diverse health care settings and incident reporting systems' (Chang et al. 2005). The JCAHO Patient Safety Event Taxonomy has five primary classification domains: impact, type, domain, cause, and prevention and mitigation (Table 7.2). Impact is the outcome or effects of medical error and systems failure, commonly

Table 7.1 Domains and primary categories of the NPSA patient safety taxonomy

Incident types	*Contributory factors*	*Harm*
Access, admission, transfer, discharge	Organization and strategic working conditions	No harm
Clinical assessment (incl. diagnosis, tests, assessments)	Team and social task factors	Impact prevented
Consent, communication, confidentiality	Patient factors	Impact not prevented
Disruptive, aggressive behaviour	Communication	Low
Documentation (including records, identification)	Education and training	Moderate
Infection control	Medication	Severe
Implementation and ongoing monitoring/review	Equipment and resources	Death
Infrastructure (including staffing, facilities, environment)		
Medical device, equipment		
Medication		
Patient abuse		
Patient accident		
Self-harming behaviour		
Treatment, procedure		
Other		

In addition to incident type, contributory factors and harm, data is gathered regarding the service area, location, staff type, specialty, medications and devices involved in the incident.

Table 7.2 Domains and primary categories of the JCAHO taxonomy

Impact	*Type*	*Domain*	*Cause*	*Prevention and mitigation*
medical psychological physical non-medical legal social economic	communication patient management clinical performance	setting staff patient target	systems (structure and process) technical organizational human	universal selective indicated

referred to as harm to the patient. Type is the implied or visible processes that were faulty or failed. Domain is the characteristics of the setting in which an incident occurred and the type of individuals involved. Cause is the factors and agents that led to an incident. Prevention and mitigation are the measures taken or proposed to reduce incidence and effects of adverse occurrences.

A preliminary test of the alpha version taxonomy conducted at one hospital with an active incident reporting system (Stanford's ICUsrs) demonstrated acceptable correlation between its coded categories (n = 111) and the categorized data requirements of the system. Thirteen (12 per cent) categories were identical, 42 (38 per cent) were synonymous, 45 (41 per cent) were related, and 6 (5 per cent) had to be extrapolated. Five (4 per cent) categories were unmatched – date and time of incident, patient or family dissatisfaction, and two patient identifiers – and were therefore omitted from the taxonomy.

Dimensions of Medical Outcomes (DMO)

The Dimensions of Medical Outcomes (DMO) taxonomy is designed to provide a detailed description of the processes and individuals involved in unsatisfactory patient outcomes, including events with and without identified errors, across all locations of medical care. The DMO taxonomy was developed using a theoretical model based on error processes as opposed to clinical domains. In the DMO framework, causation codes are considered within the general domain of a system, individual or institutional process. The original taxonomy was then iteratively enhanced and refined through coding of several thousand patient care events reported to a malpractice insurance carrier. These events included poor outcomes without evident error, clear-cut errors, and patient complaints without evident error or injury. The fifth revision of the original taxonomy (version 01–0927) was further refined through the coding of approximately 350 ambulatory primary care medical errors (Fernald et al. 2004; Pace et al. 2005). Both the original taxonomy (Victoroff 2001) and the ASIPS modified version (http://fammed.uchsc.edu/carenet/asips/taxonomy) are available for review (www.errorsinmedicine.net). Recent improvements include the addition of a new axis to code error mitigation and recovery.

The DMO taxonomy includes 5 domains and 38 axes. Individual codes are arranged hierarchically within the 38 axes, ranging from 3-digit upper-level codes through 7-digit detailed, subordinate end codes. A fully coded event includes codes for all process steps (including causation), associated diagnoses, associated tests, associated medications, all participants, the outcome(s), the person(s) who discovered the event, and the setting(s). Mitigation and recovery codes are used only if these activities took place. Each event may be assigned several codes within each axis. Therefore, events can have a variable number of codes assigned. Users typically determine a minimum number of domains and axes to be used for a given project. For instance, the ambulatory project described above required a minimum of 10 codes to describe an event but averaged over 14 codes per event with a range of 10 to 44 codes for a single event.

The process orientation of the taxonomy is most evident in the domain 'Course of Event'. This domain is arranged according to the process problems, e.g., delay in performing a procedure, a procedure not performed, a procedure performed incorrectly. Detail of the clinical activity, e.g., lab process, imaging process, history taking, physical examination, is then coded at a deeper level of the taxonomy.

Through parallel construction the DMO taxonomy allows errors to be coded by process and clinical activity at the finest gradation while permitting facile grouping by process across various types of clinical activities or by clinical activity across various types of processes.

The International Taxonomy of Medical Errors in Primary Care (ITME-PC)

The AAFP/Linnaeus International Taxonomy of Medical Errors in Primary Care (ITME-PC) started as a data-driven taxonomy that has continued to evolve with further testing and influence by taxonomy theory. In 1999 the American Academy of Family Physicians investigated whether medical errors observed by family physicians in the United States could be adequately described by existing error taxonomies. The goal was to understand errors or mistakes ('anything that you see in your daily practice of medicine that should not happen') – not harms or adverse events. From a data set of 344 error reports submitted by family physicians in a 6-month period, it became apparent that a new structure for describing these errors was necessary. The AAFP taxonomy of medical errors grew from these data reports, using standard qualitative research techniques to develop descriptions of the types of errors reported and establish hierarchies of these descriptions (Dovey et al. 2002).

In 2001 this work was extended internationally through the Linnaeus Collaboration, a group of primary care researchers. General practitioners and family physicians in Australia, Canada, England, Germany, the Netherlands, New Zealand, and the United States reported 605 errors that were coded using the AAFP's taxonomy, which was freely modified and extended to accommodate the variety of reports coming from the seven different countries. Researchers in all seven countries were involved in the taxonomy development process that produced the AAFP/Linnaeus Taxonomy. This is a fairly complex taxonomy with a 6-level hierarchy in four domains encompassing error descriptions, contributory factors, consequences (including physical and emotional harm and harm severity, financial, time, and

resource consequences) and prevention strategies. It is displayed in full in a paper file about 25 pages long.

Studies using the AAFP-Linnaeus taxonomy also collected data about errors that did not affect patients but instead involved healthcare providers (for example, needle stick injuries) or the care environment (for example, clinic cleanliness or lighting, refrigeration of vaccines). If a patient were involved in the event, the reporting system collected information about the doctor's familiarity with the patient, their age, sex, and whether they had a chronic or complex health condition. The taxonomy itself does not include these factors. Throughout its development, the ITME-PC has been tested using reports from primary care settings of error events observed there. Doctors, nurses, administrators, and students have all contributed reports.

Essential features of patient safety taxonomies

Despite their differences, each of these six taxonomies attempts to summarize the limited number of important features of patient safety events. Table 7.3 lists the primary domains or 'axes' of several patient safety taxonomies. Although different words are used to describe the domains, the concepts are very similar. Concepts not included in the first level of a taxonomy usually appear in the second level of the other taxonomies. We are in the early stages of patient safety taxonomy development, so there are likely to be many changes in all of these taxonomies, and efforts to collaborate and standardize are underway. Taxonomies will be evolutionary, not static, because of the constantly changing nature of medicine and technology, but the basic framework for the important issues affecting patient safety will stay reasonably stable regardless of location, healthcare setting, or specialty. Runciman's General Occurrence Model (Figure 7.1) for patient safety events provides an excellent model for developing any patient safety taxonomy, whether it be one designed to capture 'anything that goes wrong' in health care or for local or discipline-specific purposes (Aspden et al. 2004).

Table 7.3 The major domains (axes) of several patient safety taxonomies

NPSA	*JCAHO PSET*	*ITME-PC*	*DMO*
incident type	impact	error type	the patient
contributing factors	type	contributing factors	the outcome
severity of harm	domain	severity of harm	the course of the event
service area	cause	actions taken	the participants
location	prevention and mitigation	consequences	the observation
staff type		mitigating and recovery factors	local codes (to be specified by the group using the taxonomy)
specialty		prevention	
medications		context variables (not coded), including location, patient demographics	
devices			

These are the essential issues one must consider in developing a patient safety taxonomy:

- Use a general theory-driven safety framework to organize the data. This differs from the approach of other scientific disciplines and many existing taxonomies that start with observations rather than theory.
- Use a relational database to allow for analyses of associations. This recommendation reflects the technology available to analyse data already organized according to a taxonomy.
- When feasible, use confidential reporting to allow detailed follow-up. This recommendation reflects the difficulty in obtaining full descriptions of 'events'.
- Examine mitigating and recovery factors.
- Incorporate a risk severity index to help direct improvement efforts.
- Consider the granularity issue: how many categories are enough to understand events?; too many categories impedes analyses. This is an issue for taxonomies across disciplines – as meaningful for the period table as for the most complex patient safety taxonomy.
- Develop a taxonomy that will allow the data to be rolled up into a general scheme for comparison with others. This refers to the value of using a single taxonomy to make comparisons across service areas, healthcare sites, organizations, and even countries. It is an issue specifically tackled in the work of the NPSA, JCAHO, and the Linnaeus Collaboration (above).
- Include events where no adverse outcomes occurred, as these help identify mitigating issues or agents in pathways that in other instances cause harm. This recommendation reflects the learning of the Runciman group but may not meet the goals of some other groups.

By following these principles, one is likely to devise a patient safety taxonomy that will provide maximum benefit in improving the safety of health care in any setting.

Future challenges

The patient safety taxonomies that we have presented here and others will compete in the political and economic marketplace. In some countries with national healthcare systems, it is likely that leaders will make decisions regarding the patient safety taxonomy to be used by their country. In countries like the United States that lack centralized healthcare systems and authority, many different patient safety taxonomies will continue to be used for local, regional and state regulatory and quality improvement goals. However, in the United States there is an active movement commissioned by the US Federal Government to the National Quality Forum (NQF) to identify and recommend a US national standard, and the JCAHO PSET taxonomy is the leading candidate.

Concurrent with these efforts is collaboration between JCAHO and the World Health Organization (WHO) to foster the International Safety Event Taxonomy

(IPSET) based on the PSET. In October 2004 the World Health Organization announced its plan to develop an international patient safety taxonomy that will

> serve to provide a uniform approach for linking the panoply of patient safety reporting activities undertaken in WHO Member States and to build a common information infrastructure for WHO to support initiatives to reduce medical errors and improve delivery of high-quality, safety care. The standards are being developed in order to ensure that those data most important to detecting, analyzing, understanding and learning from patient safety related events are comparable across existing reporting systems.
>
> (World Health Organization 2004)

Simultaneously, an international group of primary care researchers are independently working to develop a primary care taxonomy for patient safety that can be mapped to a general patient safety taxonomy such as the IPSET. This group has organized as a subcommittee of the World Organization of National Colleges and Academies of General Practice (WONCA) classification committee and will maintain a dialogue with the World Health Organization.

Box 7.1 Key points

- Classification systems exist to organize and display empirical findings in ways that aid or enhance our understanding. They are theoretical frameworks, not just ways to categorize or group data.
- Careful thought about the purpose of a patient safety taxonomy or classification system, guided both by theory and by practical experience, is needed. There is an interplay between the data and the concepts in design.
- Many adverse event reporting systems and patient safety taxonomies have sprung up, and most are homegrown classifications used in a limited number of organizations or systems. They tend to be empirically driven, by the data, and to have limited theoretical or conceptual grounding.
- Taxonomies will continue to evolve and develop, and it seems likely that a small number of widely accepted leading patient safety taxonomies will emerge, which will help to make data more comparable and lessons more transferable.
- The circumstances in which a taxonomy is used – for example, methods of reporting, the confidentiality of the process, and the response to reports – are just as important as the design of the taxonomy in determining its effectiveness.

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