Supplementary Materials

1. Methods: Search strategy

PubMed:
(("diagnostic error" OR "diagnostic errors" OR "diagnosis error" OR "diagnosis errors" OR "adverse event" OR "adverse events") AND ("Medical Errors/prevention and control"[Mesh] OR "Medical Errors/statistics and numerical data"[Mesh] OR "Malpractice/statistics and numerical data"[Mesh] OR "Medical Audit"[Mesh] OR "Medical Audit/methods"[Mesh] OR "Risk Management/methods"[Mesh]) AND English[lang])

PubMed search for articles not yet indexed with MeSH terms:
((((((("diagnostic error" OR "diagnostic errors" OR "diagnosis error" OR "diagnosis errors" OR "adverse event" OR "adverse events") AND ("detect" OR "detecting" OR "detection" OR "identify" OR "identification" OR "identifying" OR "trigger") AND ("2012/01/01"[PDAT] : "2013/12/31"[PDAT]) AND English[lang])))) NOT ("Humans"[Mesh]))) NOT ("Animals"[Mesh])

Note: NOT ("Humans"[Mesh]) NOT ("Animals"[Mesh]) was our method for eliminating overlap with those articles already indexed with MeSH terms, essentially searching for"NOT (any) MeSH"

Web of Science:
(((“diagnostic error” Or “diagnosis error” OR “adverse event”) AND (detect* OR identify* OR “identification” OR “trigger”))) IN “Topic”

Eliminate Social Science & Arts/Humanities databases (only Science)

CINAHL (EBSCO):
(((diagnos* AND error*) OR (Adverse event*)) AND ((MH "Diagnostic Errors") OR (MH "Health Care Errors") OR (MH "Failure to Diagnose") OR (MH "Malpractice") OR (MH "Risk Management") OR (MH "Record Review")))

Limits: English language, Peer reviewed, Exclude Pre-Cinahl, Exclude Medline

CINAHL search for most recent, not yet indexed (“Pre-CINAHL”):
(((diagnos* AND error*) OR (Adverse event*)) AND ((detect*) OR (identif*) OR (trigger*) OR (record)))

Limits: English language; Peer Reviewed; Search Only Pre-CINAHL

Table 1: Signals of Potential Inpatient Diagnostic Error, Detailed Table

CRITERIA AMENABLE TO AUTOMATED DETECTION			
Category	**Unique Concepts**	**Specific Wording**	**Study(ies) Used**
Patient deterioration and resultant management	**Death**	Death	O'Leary 2013, Pavao 2012, Mitchell 2008, Williams 2008, Resar 2006, Chapman 2003, Murff 2003, Wolff 2001, Thomas 2000, Bates 1995, Wolff 1995, Bates 1994, Brennan 1990, Hiatt 1989, Craddick 1983, Mills 1977
		Unexpected death	Wilson 2012, Calder 2010, Letaief 2010, Soop 2009, Kobayashi 2008, Sari 2007, Zegers 2007, Baker 2004, Forster 2004, Michel 2004, Kable 2002, Wilson 1995
		Death unrelated to natural course of illness and differing from immediate expected outcome of patient management	Mitchell 2008
		Death or disability associated with misuse or malfunction of a device	Mitchell 2008
		Death meeting criteria but not referred to the Coroner's office	Mitchell 2008
		In-hospital death with autopsy	Herrera-Kiengelher 2005
		In-hospital death without autopsy	Herrera-Kiengelher 2005
	Death joined with other criteria	Death AFTER cardiac arrest team call OR unplanned ICU admission	De Meester 2013
		Cardiac/respiratory arrest, Death	Cappuccio 2009
	Cardiac/ respiratory arrest	Cardiac arrest	O'Leary 2013, Wolff 2001, Wolff 1995
		Cardiorespiratory (cardiac or respiratory) arrest	Soop 2009, Zegers 2007, Baker 2004, Forster 2004, Murff 2003, Kable 2002, Thomas 2000, Bates 1995, Bates 1994, Hiatt 1989
		Cardiac/respiratory arrest, low Apgar score (5-minute Apgar score of less than 6)	Wilson 2012, Letaief 2010, Kobayashi 2008, Sari 2007, Michel 2004, Kable 2002, Wilson 1995, Brennan 1990, Craddick 1983
		Cardiac or respiratory arrest, including newborns with Apgar equal to or less than four at birth requiring resuscitation in delivery room [except: patient admitted for planned terminal care]	Mills 1977

		Reversed cardio-respiratory arrest	Pavao 2012
		Cardiac arrest team call (THEN death)	De Meester 2013
		Condition complicated during hospital stay by intervening event (eg heart failure, DVT, PE, MI, pressure sore, neurological episode, cardiorespiratory arrest, etc)	Williams 2008, Chapman 2003
	Activation of teams responding to acute patient decompensation	Code, cardiac or pulmonary arrest or rapid response team activation	Hwang 2013
		Medical emergency team referral/response	Mitchell 2008, Braithwaite 2004
		Codes or arrest	Naessens 2010, Classen 2008
		Code	Resar 2006
	Increased acuity of care	(Unplanned) transfer from general care to intensive (or special or acute) care unit	Wilson 2012, Letaief 2010, Soop 2009, Kobayashi 2008, Sari 2007, Zegers 2007, Baker 2004, Murff 2003, Kable 2002, Wolff 2001, Thomas 2000, Brennan 1990, Wilson 1995, Wolff 1995, Hiatt 1989, Mills 1977
		Transfer from general care to special care unit (except: scheduled prior to procedures)	Craddick 1983
		Unplanned transfer from general care to intensive care or higher dependency	Michel 2004
		(Unplanned) transfer to intensive (or semi-intensive or special) care unit	O'Leary 2013, Pavao 2012, Mitchell 2008, Herrera-Kiengelher 2005, Bates 1995, Bates 1994
		Unplanned ICU admission (THEN death)	De Meester 2013
		Transfer to a higher level of care	Hwang 2013, Cappuccio 2009, Classen 2008, Resar 2006
		Transfer of patient from general care to coronary care, neonatal intensive care, intensive care	Mitchell 2008
		Transfer to intermediate care	Herrera-Kiengelher 2005
		Readmission to ICU	Hwang 2013, Classen 2008, Resar 2006
	Change of code status	Code status change in the unit	Resar 2006
	Intubation	Intubation/re-intubation	Hwang 2013, Naessens 2010, Classen 2008, Resar 2006

	New dialysis	New dialysis	O'Leary 2013, Resar 2006
	Unexpected surgery or other procedure	Unplanned visit to operating theatre or elsewhere for procedure	Williams 2008, Chapman 2003
		Unplanned transfer or return to the operating room	Forster 2004, Michel 2004
Prolonged hospitalization	**LOS longer than threshold number of days**	Length of stay greater than 35 days	Wolff 1995
		Hospital stay >30 days	Herrera-Kiengelher 2005
		Length of stay exceeding 21 days	Wolff 2001
		Length of admission >10 days	Williams 2008, Chapman 2003
	LOS longer than expected	Length of admission longer than expected	Williams 2008, Chapman 2003
		Unexpectedly long LOS (LOS >50% expected)	Cihangir 2013
	LOS longer than percentile for DRG	Length of hospital stay above 90th percentile for diagnosis-related group in patients under 70, and 95th percentile in those 70 or older	Hiatt 1989
		Length of stay exceeds the number of days listed at the 90th percentile [except: excessive LOS due solely to non-medical problems (administrative or social delay)]	Mills 1977
		Length of stay greater than ___ percentile or allotted days (individual hospital criteria)	Craddick 1983
		Greater than 7 days in ICU	Resar 2006
Subsequent healthcare encounter	**Subsequent readmission**	Unplanned readmission to any hospital during the 12 months following discharge from the index admission	Pavao 2012, Kobayashi 2008
		Readmission within 30 days/Unplanned readmission after discharge from index admission within 30 days	Hwang 2013, Naessens 2010, Cappuccio 2009, Classen 2008
		Unplanned readmission within 28 days after discharge	Wolff 1995
		Unplanned readmission within 21 days of discharge	Wolff 2001

		Short-term hospital readmission (in 15 days)	Herrera-Kiengelher 2005
		Hospital readmission within 72 hours	Mitchell 2008
		(Unplanned) readmission after discharge	O'Leary 2013, Wilson 2012, Letaief 2010, Soop 2009, Zegers 2007, Baker 2004, Kable 2002, Thomas 2000, Bates 1995, Wilson 1995, Brennan 1990, Hiatt 1989, Mills 1977
		Unplanned readmission related to the care provided in the index admission	Sari 2007
	Subsequent outpatient or ED visit, causally associated	Subsequent visit to ER or outpatient doctor for complication or adverse results related to this hospitalization	Craddick 1983
Change of general management (team or facility)	**Change of facility**	Unplanned transfer to another hospital/acute care hospital or facility	O'Leary 2013, Wilson 2012, Letaief 2010, Soop 2009, Kobayashi 2008, Williams 2008, Sari 2007, Herrera-Kiengelher 2005, Baker 2004, Michel 2004, Chapman 2003, Kable 2002, Wolff 2001, Thomas 2000, Wolff 1995, Bates 1995, Wilson 1995, Wolff 1995, Brennan 1990, Hiatt 1989, Craddick 1983
		(Unplanned) transfer from or to another acute care hospital (excluding transfers for specialized exams or procedures, or mandatory transfers for administrative reasons)	Pavao 2012, Mills 1977
	Change of physician or team	Abrupt change of physician in charge	Resar 2006
	Multiple consultations	3 or more consultants	Resar 2006
Change of specific treatment plan	**Change of medications**	Abrupt medication stop/Abrupt cessation of medications	Hwang 2013, O'Leary 2013, Naessens 2010, Cappuccio 2009, Classen 2008
	Change of procedure	Change in procedure	Hwang 2013, Naessens 2010, Classen 2008
	Cancellation of procedure	Patient booked for theatre and cancelled	Wolff 1995
Discordance between diagnoses and test results	**Difference between diagnosis and pathology results**	Pathology report normal or unrelated to diagnosis	Naessens 2010, Classen 2008

CRITERIA NOT LIKELY AVAILABLE IN ELECTRONIC FORMAT			
Dissatisfaction with care	**Patient dissatisfaction**	Patient or relative made complaint regarding care	Williams 2008, Chapman 2003
		Dissatisfaction with care documented in the medical record	Letaief 2010, Soop 2009, Kobayashi 2008, Kable 2002, Sari 2007, Zegers 2007, Baker 2004, Kable 2002, Wilson 1995
		Dissatisfaction with care received as documented on patient record, or evidence of complaint lodged	Pavao 2012
		Patient/family dissatisfaction with care received documented in the medical record and/or evidence of complaint lodged	Wilson 2012, Forster 2004, Craddick 1983
		Complaint about quality of service	Herrera-Kiengelher 2005
		Family complaints	Resar 2006
	Patient pursuing litigation	Documentation or correspondence suggesting/indicating litigation (either contemplated or actual)	Pavao 2012, Wilson 2012, Letaief 2010, Soop 2009, Kobayashi 2008, Sari 2007, Zegers 2007, Baker 2004, Forster 2004, Kable 2002, Thomas 2000, Bates 1995, Wilson 1995, Hiatt 1989
		Legal suit	Herrera-Kiengelher 2005
	Both complaint and litigation	Patient or family dissatisfaction with care received documented in the medical record, or documentation of claim or litigation	Michel 2004
	Provider dissatisfaction	Doctor or Nurse unhappy about any aspect of care	Williams 2008
Reporting external to EHR	**Referral to hospital ethics board**	Specific case referral	Mitchell 2008
	Incident report to external board	High-level incident report	Mitchell 2008
Clinical judgment needed for interpretation	**Delays in diagnosis/detection**	Diagnosis significantly delayed at any stage of admission	Williams 2008
		Significant delay in diagnosis/initiating effective treatment at any stage of admission	Chapman 2003

		Abnormal laboratory, medical imaging, physical findings or other tests not followed up or addressed	Mitchell 2008, Craddick 1983
	Other diagnostic error	Diagnostic error -- missed, delayed, misdiagnosis	Mitchell 2008
	Inadequate observation	Patient deterioration OR death OR medical emergency team referral AFTER inadequate observation process	Mitchell 2008
	Undefined deterioration	Worsening condition	Herrera-Kiengelher 2005
		Documented pain or psychological or social injury	Michel 2004
CRITERIA SUGGESTIVE OF ERROR IN PREVIOUS MANAGEMENT			
Previous management	**Previous healthcare (any), causally associated with current admission**	Unplanned admission as a result of health care provided during the 12 months prior to the index admission	Pavao 2012, Wilson 2012, Michel 2004, Kable 2002
		Unplanned admission related to previous healthcare management	Soop 2009, Sari 2007, Forster 2004
		Admission for complications or incomplete management of problems on previous hospitalization (except: occurred at another hospital and did not involve any member of this medical staff, or readmission for chronic disease excluded by medical staff-determined criteria)	Craddick 1983
	Previous hospitalization	Previous admission to any hospital in the past 12 months	Letaief 2010, Williams 2008, Chapman 2003
		Prior hospitalization within 1 year (patients <65 years of age), or prior hospitalization within 6 months (patients >=65 years old)	Thomas 2000, Bates 1995, Brennan 1990, Hiatt 1989, Mills 1977
		Admission to hospital as a result of clinical management at another hospital	Mitchell 2008
		Unplanned admission before index admission	Kobayashi 2008, Zegers 2007, Baker 2004, Wilson 1995
		Transfer from another acute care hospital	Forster 2004, Murff 2003

	Previous outpatient management	Admission to acute hospital as a result of outpatient management or procedure	Mitchell 2008
		Admission for complications or adverse results of outpatient management [except: previous medical care was unrelated to this hospital's OPD/ER or did not involve any member of this hospital staff]	Craddick 1983

Table 2: Criteria Unlikely to be Useful Triggers forInpatient Diagnostic Error

CATEGORY	SUBCATEGORY	SPECIFIC WORDING	EXAMPLE STUDY(IES)
Adverse drug events	Drug toxicity, lab value detection	Elevated digoxin level	O'Leary 2013
	Usage of a rescue medication as antidote for overdose	Vitamin K administration	Hwang 2013
		Romazicon (Flumazenil) administration	Hwang 2013
		Naloxone (Narcan) administration	Hwang 2013
		Digoxin immune Fab administration	O'Leary 2013
	Overdose, other finding	Over-sedation/hypotension	Hwang 2013
	Use of high-risk medications	Diphenhydramine (Benadryl) use	Hwang 2013
		Anti-emetic use	Hwang 2013
		Vancomycin administration	O'Leary 2013
		Haloperidol administration	O'Leary 2013
		Ondansetron administration	O'Leary 2013
		Polyethylene glycol administration	O'Leary 2013
		Linezolid administration	O'Leary 2013
		Loperamide administration	O'Leary 2013
		Risperidone administration	O'Leary 2013
		Parenteral analgesics last full day prior to and/or day of discharge [except: terminal cancer, preop med, postop med for 48 hrs subsequent to operative procedure]	Mills 1977
		Antibiotic/drug utilization (as developed by the medical staff)	Craddick 1983
	General	New allergy	O'Leary 2013
		Adverse drug reaction (no other specification)	Wilson 2012
Abnormal labs	(Considered part of "medication module" in GTT)	Partial thromboplastin time (PTT) greater than 100 seconds	Hwang 2013
		International normalized ratio (INR) greater than 6	Hwang 2013
		Glucose less than 50 mg/dl	Hwang 2013
		Rising BUN or serum creatinine greater than two times over baseline	Hwang 2013

		Hyperkalemia	O'Leary 2013
	General lab trigger	Panic or abnormal laboratory result	Bates 1994
Nosocomial infections	Lab finding indicating diagnosis	Positive blood culture	Hwang 2013
		Urine culture positive	O'Leary 2013
	Finding suggestive of infection	Fever (temperature >101F/38.3C) on day of discharge	O'Leary 2013, Mills 1977
		Discharge with indwelling urinary catheter [except: transferred to extended care facility, >70 years, admitted with urinary catheter]	Mills 1977
	Both infection & drug-related	Clostridium difficile positive culture	Hwang 2013
	Diagnosis of infection	Pneumonia onset (ICU module of GTT)	Hwang 2013, Classen 2008
		Healthcare-associated infections (or sepsis)	Hwang 2013
Procedure- related Adverse Events	Reoperation	Return to operating room this admission [except: planned second procedure]	Hwang 2013, Mills 1977
		Back in the operating room within 7 days	Matranga 2013
	Intraoperative complications	Injury, repair or removal of organ during operative procedure	Hwang 2013, Mills 1977
		Patient operated for repair of a laceration, perforation, tear or puncture or an organ subsequent to the performance of an invasive procedure	Mills 1977
		X-ray intraoperatively or in post anaesthesia care unit	Hwang 2013
		Intraoperative administration of epinephrine, norepinephrine, naloxone, or romazicon	Hwang 2013
		Intra- or post-operative death	Classen 2008
		Death of patient who had been generally healthy during or immediately after surgery for localised problem	Mitchell 2008
		S13 Insertion of arterial or central venous line during surgery	Classen 2008
		Unplanned event occurred during surgery/procedure/anesthesia	Williams 2008
		Unplanned open surgery after closed or laparoscopic surgery	Michel 2004
	Postoperative complications	Post-procedure MI, CVA, PE	Hwang 2013, Hiatt 1989
		Admission to intensive care post-operatively	Hwang 2013

		Intubation or reintubation or use of BiPap in post anaesthesia care unit (PACU)	Hwang 2013
		Mechanical ventilation greater than 24 hours post-operatively	Hwang 2013
		Post-operative increase in troponin levels greater than 1.5 nanogram mL	Hwang 2013
		Occurrence of any operative complication	Hwang 2013
		Procedure associated event	Resar 2006
		Treatment or surgery for damaged organ subsequent to an invasive procedure	Brennan 1990
		Acute myocardial infarction and a surgical procedure on same admission	Mills 1977
		Wound infection present on last full day prior to or day of discharge	Mills 1977
Falls or in-hospital trauma		Fall	Hwang 2013
		Fall incident report	O'Leary 2013
		Fall note type	O'Leary 2013
		Hospital incurred patient injury	Wilson 2012
		Injury to patient incurred in hospital (for example, fall, burn, pressure ulcer)	Sari 2006
Venous thromboembolic events		X-ray or Doppler studies for emboli	Hwang 2013
		Venous thromboembolism diagnosis code	O'Leary 2013
Stroke/neurologic complications		In-hospital stroke	Hwang 2013
		CT brain	O'Leary 2013
		Stroke note type	O'Leary 2013
		Development of a neurologic defect not present on admission	Pavao 2012, Mills 1977
Pressure ulcers		Pressure ulcers	Hwang 2013
Myocardial infarction	By diagnosis	Myocardial infarction	
	By lab value	Elevated troponin	O'Leary 2013
Other possibly iatrogenic complications	Xray	X-rays indicating pneumothorax	Bates 1994

Other high risk procedure		Dialysis (any)	Hwang 2013
		Restraint use	Hwang 2013
Bleeding	Requiring transfusion	Transfusion of blood or use of blood products	GTT
		Transfusion of platelets	O'Leary 2013
		Transfusion: bleeding/anemia, iatrogenic; not clinically indicated; transfusion reaction	Craddick 1983
	As inferred from changes in labs	Abrupt drop of greater than 25% in haemoglobin or haematocrit within 72 hours	Hwang 2013
		Drop in haematocrit	O'Leary 2013
		Abrupt drop in Hg>4	Resar 2006
Psychiatric crises	Suicide attempt causing harm	Patient attempting suicide, resulting in serious disability or admission to intensive care unit	Mitchell 2008
Indicator only of severe disease	Intensive care	Required period of intensive or high dependency care	Williams 2008, Chapman 2003
Specific to intensive care only		In-unit procedure	Classen 2008
		Chest tube insertion	Resar 2006
		Tracheostomy done	Resar 2006
		Albumin <2	Resar 2006
Specific to obstetrics/perinatology		Apgar less than 7 at 5 minutes	Classen 2008
		Maternal/neonatal transport/transfer	Classen 2008
		Magnesium sulfate or terbutaline use	Classen 2008
		Infant serum glucose less than 50 mg/dl	Classen 2008
		Third- or fourth-degree lacerations	Classen 2008
		Induction of delivery	Classen 2008
		Platelet count less than 50,000	Hwang 2013
		Estimated blood loss greater than 500 ml for vaginal delivery, or greater than 1,000 ml for caesarean delivery	Hwang 2013
		Specialty consult	Hwang 2013
		Administration of oxytocic agents	Hwang 2013
		Instrumented delivery	Hwang 2013
		Administration of general anaesthesia	Hwang 2013

		Obstetric mishap or complication of abortion or labor-delivery	Brennan 1990
Specific to emergency department only		Readmission to ED within 48 hours	Classen 2008
		Time in ED greater than 6 hours	Classen 2008
Only administrative error		Clerical administration error related to patient information (eg, incorrect name, unique patient identifier)	Mitchell 2008
		Non-adherence to clinical policy, procedure or guideline impacting on patient outcome	Mitchell 2008
		Adverse outcome associated with patient transfer or retrieval	Mitchell 2008
		Operative consent problems (incomplete, missing, for a different procedure or surgeon, other)	Craddick 1983
		Departmental or other problem (e.g., admitting, ER, laboratory, x-ray)	Craddick 1983
Vague: "catch-all" screening category	"Catch-all" category for manual review	Care: other	Hwang 2013
		Medication: other	Hwang 2013
		Any other undesirable outcome not covered above	Hiatt 1989
		Other patient complication	Mills 1977
		Other unexpected complications during index admission which are NOT a normal development of the patient's disease or an expected result of the treatment	Pavao 2012
		Any unwanted events not mentioned above	Pavao 2012
		Other finding on chart review suggestive of an adverse event	Bates 1995
	Multiple events considered a single criterion	Other patient complications to include: AMI, CVA, PE, etc	Wilson 2012
		Other complications (for example, DVT, MI, CVA, PE, ARF)	Sari 2006
		Hospital-incurred patient incident: fall, IV problem, medication error, skin problem, other	Craddick 1983
	Patient decision-making contradicting physician's	Hospital discharge decided by patient against medical advice	Herrera-Kiengelher 2005

Requires significant clinical judgment or interpretation		Inappropriate hospital discharge/inadequate discharge plan from index admission	Pavao 2012
		Poorly planned discharge from hospital	Mitchell 2008
		Previous failure of or untoward result from medical management	Murff 2003, Brennan 1990
		Admitted (from any source, including transfer from another health care facility) for conditions suggesting potential prior failure or adverse results of management	Mills 1977
Requires individual hospital to define criteria		Medical records review--physician	Craddick 1983
		Medical records review--nursing	Craddick 1983