Online Supplementary Material. Flow Diagram and Search Strategies

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# Flow diagram

Records identified through electronic database searching:

PubMed: 2261

CINAHL: 491

Scopus: 1470

Cochrane Library: 271

Google Scholar: 1274

ClinicalTrials.gov: 134

Additional records identified through other sources:

Hand Search: 4

Personal Library: 3

Records screened after duplicates removed:
4629

Full-text articles assessed for eligibility:

594

Records excluded by abstract review:

4035

Records excluded by full text review: 562

*Reasons for exclusion:*

* Unrelated to physiologic monitor alarms: 48
* EEG (seizure) alarms: 3
* Environmental impacts of alarms unrelated to staff alarm fatigue: 47
* Evaluation/description of equipment: 56
* Experiment performed in laboratory or with computer simulation only: 30
* Preclinical or not clinically actionable: 35
* Report on device malfunction/device recall: 14
* Setting of operating room, procedural area, or ambulatory setting: 34
* Viewpoint/opinion piece or non-peer-reviewed: 294

Studies included in systematic review:

32

# Search strategies

## PubMed

January 1, 1980 through April 30, 2015

Search (("clinical alarms"[mesh] OR alarm\*[ti] OR alert\*[ti] OR "reminder systems"[mesh]) AND ("fatigue"[mesh] OR "mental fatigue"[mesh] OR "auditory fatigue"[mesh] OR psychology[sh] OR "Stress, Psychological"[mesh] OR stress\*[ti] OR "alarm fatigue"[tiab] OR "alert fatigue"[tiab] OR fatigue\*[ti] OR desensit\*[ti] OR sensitiz\*[ti] OR distract\*[tiab] OR "attention"[mesh] OR "habituation, psychophysiologic"[mesh] OR "noise"[mesh] OR nois\*[ti] OR nuisance\*[tiab]) NOT ("animals"[mesh] NOT "humans")) OR ((alarm[tiab] OR alarms[tiab] OR alerts[tiab] OR alert[tiab]) AND ("false positive"[tiab] OR "false negative"[tiab] OR false[ti] OR failure\*[tiab]) NOT medline[sb]) OR (("clinical alarms"[mesh] OR alarm\*[tiab] OR alert\*[ti] OR "reminder systems"[mesh]) AND ("equipment failure"[mesh] OR "Equipment Failure Analysis"[mesh] OR "false positive reactions"[mesh] OR "false negative reactions"[mesh] OR "false positive"[tiab] OR "false negative"[tiab] OR false[ti]) NOT ("animals"[mesh] NOT "humans")) OR ("clinical alarms"[ti]) OR ((Oximetry[mesh] OR "telemetry"[mesh] OR "Electrodiagnosis"[mesh] OR capnography[mesh] OR "Blood Pressure Determination"[mesh] OR "ventilators, mechanical"[mesh] OR ventilator\*[ti] OR respirator\*[ti] OR oximet\*[ti] OR telemetr\*[ti] OR capnograph\*[ti] OR electroenceph\*[ti] OR electrocard\*[ti] OR ecg[ti] OR ekg[ti] OR ((respir\*[ti] OR cardiac\*[ti] OR heart\*[ti] OR "blood pressure"[ti]) AND monitor\*)) AND ("clinical alarms"[mesh] OR alarm\*[ti] OR alert\*[ti] OR "reminder systems"[mesh])) OR ((("Equipment Failure"[MeSH Terms]) AND "Monitoring, Physiologic"[mesh]) AND ("false negative reactions"[mesh] OR "False Positive Reactions"[MeSH Terms])) NOT ("animals"[mesh] NOT "humans"[mesh]) NOT ("Vaccination"[mesh] OR vaccinat\*[ti] OR immuniz\*[ti] OR "terrorism"[mesh] OR bioterror\*[ti] OR terroris\*[ti] OR "Accidents, Traffic"[mesh] OR "automobile driving"[mesh] OR automobile\*[ti] OR "seat belt"[ti] AND "Fire Extinguishing Systems"[mesh] OR "smoke alarms"[ti] OR "smoke alarm"[ti] OR "smoke detector"[ti] OR "smoke detectors"[ti] OR Enuresis[mesh] OR Enuresis[ti] OR bedwetting[ti] OR "bed-wetting"[ti] OR alertness[ti] OR hypoglycem\*[ti] OR glucose\*[ti]) NOT ((electronic[ti] AND (medical[ti] OR health[ti]) AND record\*[ti]) OR "Medical Order Entry Systems"[mesh] OR "Electronic Health Records"[Mesh]) Filters: Publication date from 1980/01/01; English; French; Spanish

## CINAHL

January 1, 1981 through April 30, 2015

(Neither Stanford nor University of Pennsylvania has access to pre-1981 CINAHL)

(((MH “Equipment Alarm Systems+” OR TI alarm\* OR TI alert\*) AND (MH “fatigue+” OR MH “stress+” OR MH “anxiety disorders+” OR TI stress\* OR TX “alarm fatigue” OR TI fatigue\* OR TI desensit\* OR TI sensitiz\* OR TI distract\* OR MH “attention+” OR TX habituat\* OR MH “noise+” OR TI nois\* OR TX nuisance\*)) OR ((MH “Equipment Alarm Systems+” OR TI alarm\* OR TI alert\*) AND (MH "equipment failure" OR MH “false positive results” OR MH “false negative results” OR TI “false positive” OR TI “false negative” OR TI false\*)) OR ((MH “Equipment Alarm Systems+” OR TI alarm\* OR TI alert\*) AND (MH “Oximetry” OR MH “telemetry” OR MH “Electrodiagnosis+” OR MH capnography OR MH “Blood Pressure Determination+” OR MH "ventilators, mechanical" OR TI ventilator\* OR TI respirator\* OR TI oximet\* OR TI telemetr\* OR TI capnograph\* OR TI electroenceph\* OR TI electrocard\* OR TI ecg OR TI ekg OR ((TI respir\* OR TI cardiac\* OR TI heart\* OR TI “blood pressure”) AND TI monitor\*))) OR (TI "clinical alarms" OR TX “alarm fatigue”)) NOT **(**MH “immunization+” OR TI immuniz\* OR TI vaccinat\* OR MH “terrorism+” OR TI bioterror\* OR TI terroris\* OR MH “Accidents, Traffic+” OR TI automobile\* OR TI “seat belt\*” OR MH “Smoke Alarms” OR TI “smoke alarm\*” OR TI “smoke detector\*” OR MH “enuresis+” OR TI enuresis OR TI “bed wetting” OR TI alertness OR TI hypoglycem\* OR TI glucose\* OR MH “Computerized Patient Record+” OR MH “Patient Record Systems+”)

Filters: English; French; Spanish

## SCOPUS

January 1, 1980 through April 30, 2015

(((KEY(alarm monitor OR alarm monitoring OR alarm systems OR alarm management) OR TITLE(alarm\* OR alert\*) AND KEY(fatigue OR attention OR stress\* OR noise OR Human aspects OR hearing) OR TITLE(fatigue\* OR desensit\* OR sensitize\* OR distract\*) OR TITLE-ABS-KEY(habituat\* OR nois\* OR nuisance\*)) OR ((KEY(alarm monitor OR alarm monitoring OR alarm systems OR alarm management) OR TITLE(alarm\* OR alert\*)) AND (TITLE-ABS-KEY("false positive\*" OR "false negative\*" OR "equipment failure"))) OR ((KEY(alarm monitor OR alarm monitoring OR alarm systems OR alarm management) OR TITLE(alarm\* OR alert\*)) AND (KEY(capnometry OR pulse oximetry OR ventilator OR artificial ventilation OR electrocardiography OR Electrodiagnosis OR "blood pressure monitor") OR TITLE(ventilator\* OR respirator\* OR oximet\* OR telemetr\* OR capnograph\* OR electroenceph\* OR electrocard\* OR ecg OR ekg) OR (TITLE(respir\* OR cardiac\* OR heart\* OR "blood pressure") AND TITLE(monitor\*)))) OR (TITLE("clinical alarm\*") OR TITLE-ABS-KEY("alarm fatigue")))) AND NOT (KEY(immuniz\* OR vaccinat\* OR biological warfare OR terrorism OR automobile\* OR fire protection OR fires OR enuresis OR "seat belt\*" OR seatbelt\* OR clinical decision support systems OR computer assisted drug therapy OR electronic medical record) OR TITLE(immuniz\* OR vaccinat\* OR bioterror\* OR terroris\* OR automobile OR "seat belt\*" OR "smoke alarm\*" OR "smoke detector\*" OR eneuresis OR "bed wet\*" OR alertness OR hypoglycem\* OR glucose\* OR "electronic medical record\*" OR "electronic health record\*")) AND ( LIMIT-TO(PUBYEAR,2014) OR LIMIT-TO(PUBYEAR,2013) OR LIMIT-TO(PUBYEAR,2012) OR LIMIT-TO(PUBYEAR,2011) OR LIMIT-TO(PUBYEAR,2010) OR LIMIT-TO(PUBYEAR,2009) OR LIMIT-TO(PUBYEAR,2008) OR LIMIT-TO(PUBYEAR,2007) OR LIMIT-TO(PUBYEAR,2006) OR LIMIT-TO(PUBYEAR,2005) OR LIMIT-TO(PUBYEAR,2014) OR LIMIT-TO(PUBYEAR,2013) OR LIMIT-TO(PUBYEAR,2012) OR LIMIT-TO(PUBYEAR,2011) OR LIMIT-TO(PUBYEAR,2010) OR LIMIT-TO(PUBYEAR,2009) OR LIMIT-TO(PUBYEAR,2008) OR LIMIT-TO(PUBYEAR,2007) OR LIMIT-TO(PUBYEAR,2006) OR LIMIT-TO(PUBYEAR,2005) OR LIMIT-TO(PUBYEAR,2004) OR LIMIT-TO(PUBYEAR,2003) OR LIMIT-TO(PUBYEAR,2002) OR LIMIT-TO(PUBYEAR,2001) OR LIMIT-TO(PUBYEAR,2000) OR LIMIT-TO(PUBYEAR,1999) OR LIMIT-TO(PUBYEAR,1998) OR LIMIT-TO(PUBYEAR,1997) OR LIMIT-TO(PUBYEAR,1996) OR LIMIT-TO(PUBYEAR,1995) OR LIMIT-TO(PUBYEAR,1994) OR LIMIT-TO(PUBYEAR,1993) OR LIMIT-TO(PUBYEAR,1992) OR LIMIT-TO(PUBYEAR,1991) OR LIMIT-TO(PUBYEAR,1990) OR LIMIT-TO(PUBYEAR,1989) OR LIMIT-TO(PUBYEAR,1988) OR LIMIT-TO(PUBYEAR,1987) OR LIMIT-TO(PUBYEAR,1986) OR LIMIT-TO(PUBYEAR,1985) OR LIMIT-TO(PUBYEAR,1984) OR LIMIT-TO(PUBYEAR,1983) OR LIMIT-TO(PUBYEAR,1982) OR LIMIT-TO(PUBYEAR,1981) OR LIMIT-TO(PUBYEAR,1980) OR LIMIT-TO(PUBYEAR,2014) OR LIMIT-TO(PUBYEAR,2013) OR LIMIT-TO(PUBYEAR,2012) OR LIMIT-TO(PUBYEAR,2011) OR LIMIT-TO(PUBYEAR,2010) OR LIMIT-TO(PUBYEAR,2009) OR LIMIT-TO(PUBYEAR,2008) OR LIMIT-TO(PUBYEAR,2007) OR LIMIT-TO(PUBYEAR,2006) OR LIMIT-TO(PUBYEAR,2005) OR LIMIT-TO(PUBYEAR,2004) OR LIMIT-TO(PUBYEAR,2003) OR LIMIT-TO(PUBYEAR,2002) OR LIMIT-TO(PUBYEAR,2001) OR LIMIT-TO(PUBYEAR,2000) OR LIMIT-TO(PUBYEAR,1999) OR LIMIT-TO(PUBYEAR,1998) OR LIMIT-TO(PUBYEAR,1997) OR LIMIT-TO(PUBYEAR,1996) OR LIMIT-TO(PUBYEAR,1995) OR LIMIT-TO(PUBYEAR,1994) OR LIMIT-TO(PUBYEAR,1993) OR LIMIT-TO(PUBYEAR,1992) OR LIMIT-TO(PUBYEAR,1991) OR LIMIT-TO(PUBYEAR,1990) OR LIMIT-TO(PUBYEAR,1989) OR LIMIT-TO(PUBYEAR,1988) OR LIMIT-TO(PUBYEAR,1987) OR LIMIT-TO(PUBYEAR,1986) OR LIMIT-TO(PUBYEAR,1985) OR LIMIT-TO(PUBYEAR,1984) OR LIMIT-TO(PUBYEAR,1983) OR LIMIT-TO(PUBYEAR,1982) OR LIMIT-TO(PUBYEAR,1981) OR LIMIT-TO(PUBYEAR,1980) ) AND ( LIMIT-TO(LANGUAGE,"English" ) OR LIMIT-TO(LANGUAGE,"French" ) OR LIMIT-TO(LANGUAGE,"Spanish" ) ) AND ( EXCLUDE(SUBJAREA,"AGRI" ) OR EXCLUDE(SUBJAREA,"BUSI" ) OR EXCLUDE(SUBJAREA,"CENG" ) OR EXCLUDE(SUBJAREA,"CHEM" ) OR EXCLUDE(SUBJAREA,"EART" ) OR EXCLUDE(SUBJAREA,"PHYS" ) OR EXCLUDE(SUBJAREA,"MATH" ) OR EXCLUDE(SUBJAREA,"AGRI" ) OR EXCLUDE(SUBJAREA,"CENG" ) OR EXCLUDE(SUBJAREA,"ENVI" ) OR EXCLUDE(SUBJAREA,"ENER" ) OR EXCLUDE(SUBJAREA,"MATE" ) OR EXCLUDE(SUBJAREA,"EART" ) OR EXCLUDE(SUBJAREA,"CHEM" ) OR EXCLUDE(SUBJAREA,"BUSI" ) OR EXCLUDE(SUBJAREA,"ECON" ) OR EXCLUDE(SUBJAREA,"VETE" ) OR EXCLUDE(SUBJAREA,"PHYS" ) OR EXCLUDE(SUBJAREA,"MATH" ) OR EXCLUDE(SUBJAREA,"AGRI" ) OR EXCLUDE(SUBJAREA,"CENG" ) OR EXCLUDE(SUBJAREA,"ENVI" ) OR EXCLUDE(SUBJAREA,"ENER" ) OR EXCLUDE(SUBJAREA,"MATE" ) OR EXCLUDE(SUBJAREA,"EART" ) OR EXCLUDE(SUBJAREA,"CHEM" ) OR EXCLUDE(SUBJAREA,"BUSI" ) OR EXCLUDE(SUBJAREA,"ECON" ) OR EXCLUDE(SUBJAREA,"VETE" ) )

## Cochrane Library

January 1, 1980 through April 30, 2015

Note: With each search, user must click through each library and download results for Cochrane Reviews, Other Reviews, Trials, Methods Studies, Technology Assessments, Economic Evaluations, Cochrane Groups.

Search 1: Alarm AND Fatigue NOT Exclusion terms LIMIT to Keyword/Abstract/Title

(alarm\* OR alert\*) AND (fatigue OR attention OR stress\* OR noise OR Human aspects OR hearing) NOT (alertness OR immuniz\* OR vaccinat\* OR "biological warfare" OR terrorism OR automobile\* OR fire\* OR smok\* OR enuresis OR "seat belt" OR seatbelt\* OR "clinical decision support" OR "computer assisted drug" OR "electronic medical record" OR glucose)

Search 2: Alarm + Equipment Failure NOT Exclusion terms LIMIT to Keyword/ Abstract/ Title

(alarm\* OR alert\*) AND ("false positive" OR "false negative" OR "equipment failure") NOT (alertness OR immuniz\* OR vaccinat\* OR "biological warfare" OR glucose OR terrorism OR automobile\* OR fire\* OR smok\* OR enuresis OR "seat belt" OR seatbelt\* OR "clinical decision support" OR "computer assisted drug" OR "electronic medical record")

Search 3: Monitoring + Alarms NOT Exclusion terms LIMIT to TITLE

(alarm\* OR alert\*) AND (ventilator\* OR respirator\* OR oximet\* OR telemetr\* OR capnograph\* OR electroenceph\* OR electrocard\* OR ecg OR ekg) NOT (glucose OR alertness OR immuniz\* OR vaccinat\* OR "biological warfare" OR terrorism OR automobile\* OR fire\* OR smok\* OR enuresis OR "seat belt" OR seatbelt\* OR "clinical decision support" OR "computer assisted drug" OR "electronic medical record")

(alarm\* OR alert\*) AND ((respir\* OR cardiac\* OR heart\* OR "blood pressure") AND monitor\*) NOT (glucose OR alertness OR immuniz\* OR vaccinat\* OR "biological warfare" OR terrorism OR automobile\* OR fire\* OR smok\* OR enuresis OR "seat belt" OR seatbelt\* OR "clinical decision support" OR "computer assisted drug" OR "electronic medical record")

Search 4: Clinical Alarms LIMIT to SEARCH ALL TEXT

("clinical alarm" OR "clinical alarms") NOT (glucose OR alertness OR immuniz\* OR vaccinat\* OR "biological warfare" OR terrorism OR automobile\* OR fire\* OR smok\* OR enuresis OR "seat belt" OR seatbelt\* OR "clinical decision support" OR "computer assisted drug" OR "electronic medical record")

## Google Scholar

January 1, 1980 through April 30, 2015

Search 1: “alarm fatigue”

Search 2: “physiologic monitoring”+”false alarm”

Search 3: “physiologic monitoring”+”false alarms”

Search 4: “clinical alarms”+false

Search 5: “alarm parameters”+fatigue

## ClinicalTrials.gov

January 1, 1980 through April 30, 2015

(alarm AND NOT ( smoke OR Enuresis OR Monoxide OR Vaccination OR Traffic OR automobile OR seat belt OR Fire OR alertness OR glucose OR Schizophrenia OR insulin ) ) [ALL-FIELDS]