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AUSTRALIAN COMMISSION ON SAFETY AND QUALITY IN HEALTH CARE

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SAFE STAFFING AND PATIENT SAFETY LITERATURE REVIEW

Final Report – 31 January 2003

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CONTENTS

1. EXECUTIVE SUMMARY

The Australian Resource Centre for Hospital Innovations (ARCHI) has been contracted by the Commonwealth Department of Health and Ageing on behalf of the Australian Council for Quality and Safety in Health Care to undertake a comprehensive review of published and unpublished literature on safe staffing and patient safety.

The literature review aims to identify staffing factors that are associated with patient safety or the effectiveness of safety cultures within non-health industries. It also aims to identify the quality of evidence and gaps in research.

This comprehensive review includes 230 papers from both health (152 papers) and non-health literature (78 papers) that are case studies, literature reviews, research studies or guideline documents containing data. The papers were grouped by the domain areas of:

- Staff physical and mental health
- Communication and feedback
- Hours of work, shift work, numbers of staff and fatigue
- Competency, supervision and staffing mix.

The results indicate clear gaps in the health literature relating to staffing factors and patient safety, and in particular, a dearth of well-designed intervention studies.

There is a need to increase understanding of effective strategies that reduce fatigue and fatigue related errors, the contributing factors that lead to poor communication in the workplace, physical and mental health of staff and their ability to provide safe patient care and systems that prevent rule-based and skill-based errors in health care delivery. The non-health literature reviewed here offers some insight for the development of these strategies and has been incorporated into the recommendations for further research.

2. OVERVIEW OF THE PROJECT

The Australian Resource Centre for Hospital Innovations (ARCHI) has been contracted by the Commonwealth Department of Health and Ageing on behalf of the Australian Council for Quality and Safety in Health Care to undertake a comprehensive review of published and unpublished literature on safe staffing and patient safety. The literature review aims to identify staffing factors that were associated with patient safety or the effectiveness of safety cultures within non-health industries. The review also aims to identify the quality of evidence and gaps in research.

Staffing factors include staff competency, communication, supervision, fatigue, rostering and working hours. Patient safety includes the variables that limit or affect preventable adverse patient outcomes and errors.

3. METHOD

3.1 Search term used for the health industry literature

The search terms for health related literature were based on the standard medical subject headings (MeSH) and include any or all of the following terms:

- Manpower, doctors, medical staff, nursing staff, health personnel, staffing, personnel staffing, scheduling, personnel administration, workload[#]
- Nursing staff, hospital/supply, distribution
- Quality assurance
- Hospital safety management
- Patient safety, patient incidents, patient adverse health effects, clinical risk, quality management, quality care, risk management, quality of healthcare, quality indicators, outcome assessment/methods, hospital/standards, accident prevention, safety management, adverse events, adverse drug reactions
- Staff* rostering, staff fatigue, staff supervision, work place harassment, staff dissatisfaction, clinical governance, staff competency.

[#] *The term 'out-of-hours' was not searchable in the majority of databases used for this review. As a general rule, the term 'of' is not searchable in a database as it is considered a 'stop' word that occurs too frequently to make search results relevant. 'Out-of-hours' is found in the searching related to workload, scheduling and working hours.*

** The term "staff" will include doctors, nurses, midwives, managers, surgeons, anaesthetists, physicians, allied health professionals.*

3.2 Search terms used for non-health industries

Search terms for other literature not related to the health industry will include any or all of these terms:

- Workers safety, customer/ consumer/ client/ passenger incidents, safety risk, quality management, customer service
- Staff* rostering, staff fatigue, staff supervision, work place harassment, staff dissatisfaction, clinical governance or staff competency.

**The term "staff" will also include the specific title of the industry workers such as pilot, airline steward, bus driver, truck driver, police officer etc.*

3.3 Inclusion criteria

All literature to be included in the review had the following characteristics. The paper was:

- Published not earlier than 1992
- Written in English
- Related to the search terms
- Based on either qualitative or quantitative data
- A review, research paper or report, guideline, or case study that describes the relationship between staffing variables and patient or customer outcomes

3.4 Exclusion criteria

Papers are not included if they do not provide data that links at least one staffing variable with at least one aspect of patient care outcomes or as in the case of non-health industry, at least one aspect of industry safety.

Literature that relates to occupational health and safety of staff working in the health industry is not included unless it contains data on adverse patient events. For example, violence directed at staff from patients is not included. However, papers describing violence from staff towards patients is included because the adverse event was focused on the patient. Papers that examine system type failures and patient safety, equipment and environmental factors and patient safety without a human factor or staffing variable included do not meet the inclusion criteria.

3.5 Process for culling the literature

The following questions were asked for each citation (where there was insufficient information in the citation, the paper was located):

Is the paper related to health or another industry other than health?

For health related papers:

1. Does the paper explore staffing factors (such as competence, skill, stress, fatigue, rostering, workload, supervision) and this association with patient safety (such as patient injury, harm, outcome, preventable adverse events)?

2. Is the paper a review containing data, a case study, a research study or guideline document with supporting data?

For non-health related papers:

1. Does the paper examine the relationship between human factors and work performance that can impact on safety?

2. Is the paper a review containing data, a case study, research study or guideline document with supporting data?

Paper was included when the answer was “yes” for each point.

3.6 Search strategy

Published health literature

Extensive searching has been undertaken in the following electronic databases:

- ACP Journal Club (ACP)
- Cochrane Controlled Trials Register (CCTR)
- Cochrane Database of Systematic Reviews (COCH)
- Database of Abstracts of Reviews of Effectiveness (DARE)
- MEDLINE
- Pre-MEDLINE
- PsycINFO,
- CINAHL
- EMBASE
- HealthStar
- OSH-ROM

Unpublished health literature

The following strategies were used to access unpublished health literature:

- Posting a request on several pages of the ARCHI website

- A teleconference with the ARCHI state-based satellite officers to identify “gray literature” (6 officers)
- Teleconferences of the Queensland, Victoria, Tasmania, South Australia and New South Wales ARCHI Clinician’s Advisory Committees
- ARCHI change management e-mail discussion group (92 members)
- ARCHI bed management e-mail discussion group (106 members)
- Postings on ARCHI Net News (approximately 3200 subscribers)
- Emails to National Rural Health Alliance, Health Canada, American Academy of Family Physicians, Agency for Healthcare Research and Quality, Australian Industrial Relations Commission, National Occupational Health and Safety Commission, Civil Aviation Safety Authority, NSW Safe Hours Group
- Individual discussions with leaders in the area of clinical governance and patient safety including the Health Care Complaint's Commission, the Australian Patient Safety Foundation and the Institute for Clinical Effectiveness.

Non-health related literature

A search of electronic databases included the following:

- ABI Inform
- ANRO - Australian Agriculture & Natural Resources Online
- CCOHS - Canadian Centre for Occupational Health & Safety
- AGIS
- WORKLIT
- IREL - Industrial Relations, Australian Transport Index
- ELIXER - Natural Resources
- STREAMLINE - Natural Resources
- ANSTI - Nuclear Science
- BUILD - Building & Construction
- AUSTROM
- Business Australia
- AGSM

3.7 Process for examining and summarising the findings

Endnote libraries and databases were established for tracking the searches and cataloguing of the "gray literature".

The papers in the review were classified using the hierarchy of study designs listed in table 1. This classification is helpful in summarising the study design in relation to quality of evidence and was used only for research papers. A rating of the evidence was made based on the quality of evidence rating seen in table 2 and applied to each paper. This rating is useful in determining the strength of evidence and was applied to all of the types of papers used in the review including case studies.

The literature is categorised into summary tables and is divided into two main groups, health related literature and the non-health related literature. The documents are reported using the following headings:

- Author, year, country
- Type of document (published or unpublished, study, guideline or case study)
- Rating using a level of 1 - 8 using the hierarchy of study designs
  This was applied to research papers only and categorises the study design by ranking the design. Studies that minimise bias such as randomized controlled trials are ranked more highly than designs that are subject to bias and few controls such as descriptive studies and expert opinion.
- Rating the level of evidence 1 - 4.
- Industry type (for non-health related literature)
- Staffing variables examined and related patient outcomes (staffing variables examined and factors contributing to a safety culture are used for the non-health related literature)
- Study design and summary description
- Findings and comments

Four major domain areas relating to staffing variables have been identified across both the health and non-health related documents. These are:

- Staff physical and mental health
  - Health literature included: staff with infectious diseases and cross infection to patients; and, mental health and appropriate clinical decision-making.
  - Non-health literature included: staff anxiety and threats to safety practices; and, impact of airline pilots with heart disease and potential for an airline crash.
- Communication and feedback
  - Health literature included: staff errors in communication leading to adverse events; and, telephone orders leading to inappropriate treatment.
  - Non-health literature included: communication between staff at shift hand-over and mining disasters; and, staff behaviour in relation to safety reporting and feedback.
- Hours of work, shift work, numbers of staff and fatigue
  - Health literature included: medical practice and fatigue and the impact on patient injury; and, nurse to patient ratios and its effects on mortality and morbidity.
  - Non-health literature included: fatigue prevention initiatives for air force pilots; and, the impact of extended working days in an under-ground mine.
- Competency, supervision and staffing mix
  - Health literature included: hospital reviews and the staffing factors that were associated with patient safety; and, child maltreatment by hospital staff.

- Non-health literature included: motor vehicle injury among duty army officers; and, accidents among airport ground personnel.

Many of these staffing variables were inter-related however the variable that was the primary focus of the paper was used to determine the domain area.

TABLE 1 Hierarchy of research designs in decreasing level of importance[1]

Classification of the study design	Type of research design
1	Randomised controlled trials
2	Non-randomised controlled trials
3	Cohort studies
4	Case-control studies
5	Comparisons between time and place
6	Uncontrolled experiments
7	Descriptive studies
8	Expert opinions

TABLE 2 Quality of evidence ratings[2]

Levels	Controlled trials	Prevalence, risk factors and sensitivity studies
I	Evidence obtained from a systematic review of all randomised controlled trials	Evidence from a systematic review of all available population-based studies
2	Evidence obtained from at least one properly-designed randomised controlled trial	Evidence obtained from a well-designed population-based study representative cohort study
3 – 1	Evidence obtained from well-designed controlled trials without randomisation	Evidence obtained from a well-designed case control study, cohort study or less well-designed population-based study
3 – 2	Evidence obtained from well-designed cohort or analytic studies, preferably from more than one centre or research group	
3 – 3	Evidence obtained from multiple time series with or without the intervention	
4	Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees	Evidence obtained from a descriptive case series, clinical experiences, respected authorities, or reports of expert committees

[1] Report of the US Preventive Services Task Force. *Guide to clinical preventive services*. Baltimore, USA, Williams and Wilkins, 1996.
[2] Quality of Care and Health Outcomes Committee, National Health and Medical Research Council. *Guidelines for the development and implementation of clinical practice guidelines. Canberra*. AGPS, 1995.

4. RESULTS

4.1 Overview of the findings

A total of 20 people have provided information including reports, reference lists, web sites, papers and contact details for other people to contact.

Contact was made with aviation, transport, mining and forestry industries and a total of 77 web sites have been reviewed for relevant documents.

A total of 10 755 citations were generated using the search terms under the MeSH terms and criteria described in the search strategy. Of these, 859 papers were examined for suitability to be included in the literature review. The review includes 230 papers that are a case study, a literature review, a research study or a guideline document containing data. Almost all of the papers are published in a journal, as a report or book chapter, or are available on-line. Health related literature accounts for 152 (66%) documents and non-health literature totals 78 (34%) documents.

Table 3 provides a description of the domain areas by main grouping.

TABLE 3 Papers included in the review by domain area

Domain area	Health related documents n=152 (%)	Non-health related documents n=78 (%)	Total n=230 (%)
Staff physical and mental health	7 (5)	7 (9)	14 (6)
Communication and feedback	18 (12)	13 (17)	31 (13)
Hours of work, shift work, numbers of staff and fatigue	36 (23)	31 (39)	67 (29)
Competency, supervision and staffing mix	91 (60)	27 (35)	118 (52)

Table 4 provides a summary of the type of paper for each domain area. These numbers include health and non-health literature.

TABLE 4 Summary of the types of papers in the review by domain area

		Staff physical and mental health N=14		Communication and feedback N=31		Hours of work, shift work, numbers of staff and fatigue N=67		Competency, supervision and staffing mix N=119		Total N=230
		Health	Non-Health	Health	Non-Health	Health	Non-Health	Health	Non-Health	
Published papers		7	7	18	13	35	30	91	27	227
Unpublished papers		0	0	0	0	1	1	1	0	3
Type of paper	Literature Review	0	0	1	0	1	2	6	0	10
	Guidelines	2	1	0	0	1	1	4	2	11
	Case Studies	3	1	2	4	3	3	30	13	59
	Research Study	2	5	15	9	31	25	51	12	150

Hierarchy of study designs and quality of evidence

The quality of evidence available on any aspect of safe staffing and patient safety is very limited. The broad search strategy was able to capture papers that may not have been readily available through a search confined to the key electronic health literature databases. The absence of quality research papers on this topic demonstrates that well designed studies are needed. There are few research studies and of these a small selection are a randomised controlled trial (approximately two papers) and provide a limited contribution to understanding staffing and patient outcomes as in both cases these were not the primary end-points in the study. There are no meta-analytical studies.

TABLE 5 Summary of the quality of evidence of the papers in the review

		Staff physical and mental health N=14		Communication and feedback N=31		Hours of work, shift work, numbers of staff and fatigue N=67		Competency, supervision and staffing mix N=119		Total N=231
		Health	Non-Health	Health	Non-Health	Health	Non-Health	Health	Non-Health	
Levels of Evidence	1	0	0	0	0	0	0	0	0	0
	2	0	0	1	0	3	0	4	0	8
	3	0	3	3	5	14	13	21	4	63
	4	7	4	14	8	19	18	66	23	159
Hierarchy of Study Design **(Applicable to research studies only)**	1	0	0	1	0	1	0	3	0	5
	2	0	0	0	0	2	0	1	1	4
	3	0	0	0	1	2	0	5	0	8
	4	0	0	0	0	1	2	0	1	4
	5	1	1	2	2	9	10	13	3	41
	6	0	0	1	0	1	1	5	0	8
	7	1	4	11	6	15	12	24	7	80
	8	Not included for studies using original data								

The majority of the research studies are cross-sectional descriptive surveys. Very few use an intervention / experimental design with or without randomisation. There was one evidence based literature review included in the domain *hours of work, shift work and number of staff*. This review *Making health care safer: A critical analysis of patient safety practice*[3] included only level 1 – 3 evidence using the levels outlined in table 2. This review was not focused on safe staffing variables, however, it contains sections on "nurses staffing and staffing models" and "fatigue, sleepiness and medical errors".

The authors identify that the methodological issues in combining the studies are problematic and there still remains conflicting outcomes with no clear understanding if certain nurse staffing models and number of staff improve or reduce patient safety. The same applied to the number of hours worked and fatigue experienced by medical practitioners and the effects on performance.

There were only five randomized controlled trials located in this review, one in the area of communication and feedback, one in the area of hours of work, shift work, numbers of staff and fatigue and three in the area of competency, supervision and staffing mix.

[3] Shojania KG et al (eds) *Making health care safer: a critical analysis of patient safety practices.* Evidence Report / Technology Assessment No. 43 (Prepared by the University of California at San Francisco – Stanford Evidence-based Practice Centre) Agency for Healthcare Research and Quality, July 2001.

4.2 Staff physical and mental health

4.2.1 Staff physical and mental health – summary findings

There were seven health and seven non-health papers included in this review that examined the relationship between staff and safety. The following tables provide a description of the types of papers.

Papers for staff physical and mental health by type of paper and classification

		Health	Non-Health	TOTAL
Published papers		7	7	14
Unpublished papers		0	0	0
Type of paper	Literature Review	0	0	0
	Guidelines	2	1	3
	Case Studies	3	1	4
	Research Study	2	5	7
Levels of Evidence	1	0	0	0
	2	0	0	0
	3	0	3	3
	4	7	4	11
Hierarchy of Study Design (**Applicable to research studies only**)	1	0	0	0
	2	0	0	0
	3	0	0	0
	4	0	0	0
	5	1	1	2
	6	0	0	0
	7	1	4	5
	8	0	0	0

Papers relating to health practitioners focused on physical stamina and effective cardiac compressions during a simulated cardio-pulmonary resuscitation exercise [1], health professionals who have HIV infection and the potential to infect patients [2] and the association of staff anxiety and patient incidents [3]. The conclusion of these papers, whilst seen in the context of their design limitations, identify the following themes that merit further examination:

- Self-perceptions of physical stamina may interfere with effectiveness of carrying out physically demanding procedures such as cardiac compressions before being aware of the fact
- Staff that are more anxious may increase the likelihood of adverse events
- Hospitals and health service organisations that employ practitioners who have HIV or other infections and restrict their practice may face additional issues relating to discrimination and human rights violations when the evidence is not clear that there is any increased risk to patient safety.

Papers relating to staff working in other non-health related industries provided a slightly increased number of studies although all but one are descriptive. Consistent with the health related study examining nurse stress and the increase likelihood of incidents, a study examining staff worry and safety concerns on an off-shore mining platform found that increase in job satisfaction, appropriate workload and a range of other measures were associated with a reduction in risk perception and risk behaviour [4]. The non-health literature identified the following themes that may be useful in examining further:

- The relationship between staff anxiety and workplace morale in improving performance and reducing adverse events
- Identification of the early signs of dangerous practice by considering staff mental health, physical health and the assessment of their fitness to practice.

4.2.2 Staff Physical and Mental Health – Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description	Comments / Findings
Poole et al / 2002 / UK [5]	P, G Level 4	SV: Staff fitness to practice PO: Abuse to paediatric patients, infection to patients, incompatibility with safe practice	This is a guideline document that describes standards of health for clinical health care workers, their suitability for certain positions and the effects of their health status on their performance and clinical judgment. Citations: 52.	The paper covers 15 areas relating to fitness to practice including: depression, substance misuse, anorexia and bulimia, personality disorders, anxiety and visual impairment.
Ochoa et al / 1998 / Spain [1]	P, S Level 4 COSD 5	SV: Staff fatigue whilst doing chest compressions during CPR practice PO: Resuscitation	The clinicians were assessed by ineffective chest compressions with on-set of fatigue. SS: 38 RR: n/a DS: Observed cardiac compressions using doctors and nurses on a manikin	Rescuer fatigue occurred before 60 chest compressions. After this point the chest compressions were observed as being ineffective. Rescuers did not recognize their fatigue until almost 2 minutes later. Efficacy of the chest compressions did not differ between clinical groups.
AIDS/TB Committee of the Society for Healthcare Epidemiology of America / 1998 / USA [6]	P, G Level 4	SV: HIV, hepatitis B or C infected health care professions PO: Infection from provider	This guideline statement uses available evidence of provider to patient infection rates as a basis for recommending adoption of these guidelines to limit litigation and clarify patient risk. Citations: 111	The transmission rate of HIV, hepatitis B or C is extremely low. The guidelines recommend that practitioners exercise usual universal precautions that infected practitioners have their privacy respected, no special monitoring is required and infection status does not constitute a basis for barring the provider from any patient care activity including invasive procedures. There were 38 instances of provider to patient Hepatitis B transmission from 1972 – 1994.

*** P = published or U = unpublished. L = literature review, S = study containing data, G = guideline or CS = case study.**
Hierarchy of study design rating = Level 1 -4 (See table 2) COSD = classification of study design 1 - 8 (see table 1)
****SS = sample size; RR = response rate; DS = data source**

4.2.2 Staff Physical and Mental Health – Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description	Comments / Findings
Dugan et al / 1996 / USA [3]	P, S Level 4 COSD 7	SV: The effect of stress on nursing PO: Improved quality of care	The article describes a study that measured through a questionnaire; staffing problems, (turnover rates), nurse incidents, (absenteeism, back injuries, needle sticks) and patient incidents (medication errors, falls) over a 3 month period and levels of self-reported stress by nurses. SS:293 RR:49% DS: Registered and Licensed Practical Nurses self-report in one hospital	Results showed that the higher the reported levels of nurse stress (Stress Continuum Scale) the greater likelihood of patient incidents (0.59 correlation).
Reason / 1995 / UK [7]	P, CS Level 4	SV: Recognition, memory, attention and selection factors PO: Morbidity and death	This is a case that describes 2 adverse events to illustrate a theoretical model of categorizing human error. One case study describes a patient having repeated doses of radiation leading to premature death and the second describes the dislodgment of an iridium source wire causing 90 people to be irradiated.	The conceptual framework categorizes human causes of an adverse event as a violation or an error, active or latent human failure. Errors are defined as mistakes or execution errors. Case studies are used to illustrate Reason's theoretical model.
Shuster / 1993 / USA [2]	P, CS Level 4 COSD 7	SV: The role of infected physicians and health professionals PO: Patient safety from infectious disease	This single case study looks at the issues surrounding a physician with acquired immune deficiency syndrome (AIDS) and the potential for physician to patient infection.	Legal issues raised include informed consent and disclosure of identifiable risk. The paper concludes that more reasonable approaches need to be considered rather than continuing the guidelines established in 1991 by the Centres for Disease Control that called for infected

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4.2.2 Staff Physical and Mental Health – Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description	Comments / Findings
				physicians to cease performing invasive procedures or inform their patients. It was decided that each state of the USA is to set its own rules in compliance to the Center for Disease Controls guidelines.
Hudson / 1992 / USA [8]	P, CS Level 4 COSD	SV: HIV Positive Health care workers PO: Decreasing patient exposure to infectious disease	This single case study looks at the issues surrounding a pharmacist with acquired immune deficiency syndrome (AIDS). The pharmacist was barred from preparing IV solutions because of his HIV status.	Issues raised in this hospital based case study include legal issues, reaching compliance with the Center for Disease Control (CDC), cost issues, fitness for duty, training logistics and exposure management. The implementation of the CDC guidelines provided a legal conflict between the employer and employee on the basis of discrimination.

*** P = published or U = unpublished. L = literature review, S = study containing data, G = guideline or CS = case study. Hierarchy of study design rating = Level 1 -4 (See table 2) COSD = classification of study design 1 - 8 (see table 1)**
****SS = sample size; RR = response rate; DS = data source**

4.2.3 Staff Physical and Mental Health - Non- Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
Joy / 1999 / UK [9]	P, G Level 3 - 3	Aviation SV: Cardio-vascular disease in professional flight crew SC: minimizing plane disasters	This paper synthesizes the conclusions of an international conference on aviation cardiology with recommendations for cardiology assessment and appropriate standards for pilot licensing.	Human factors are responsible for approximately 80% of aircraft accidents. The paper cites that of the 1000 fatal accidents in a 40-year period, half occurred in private or commercial aircraft, 4.7% were due to medical causes of which about 2.35% were due to a cardiovascular incident. The implications of an aging pilot are discussed.
Rundmo et al / 1998 / Norway [10]	P, S Level 3-2 COSD 5	Offshore mining SV: Job stress and physical working conditions and commitment and involvement in safety work SC: Improvement of safety attitudes and accident prevention	Comparative analysis two cross-sectional surveys undertaken in 1990 and in 1994. SS: 9 companies, 12 offshore platforms, 912 employees RR: 92% DS: Off-shore personnel	Improvements were found in job satisfaction, physical workload, safety and contingency measures. These factors affected risk perception and risk behaviour.
Edkins et al / 1997 / Australia [11]	P, S Level 3-2 COSD 7	Railway transport SV: Morale SC: Reduction of rail accidents	A retrospective analysis of railway accidents over a 3-year period and cross-sectional survey of train drivers examining the extent to which Railway Problem Factors interfere with doing their job SS: 112 accidents and 190 train drivers RR: n/a for accidents and 42% for train drivers DS: Incident reports of train accidents and survey of train drivers.	Sustained attention to railway signals was the major contributing human factor across all types of railway accidents, particularly inattentiveness to signals. Train drivers identified low morale was the most serious problem in safe conduct of their job.

*** P = published or U = unpublished. L = literature review, S = study containing data, G = guideline or CS = case study. Hierarchy of study design rating = Level 1 -4 (See table 2) COSD = classification of study design 1 - 8 (see table 1)**
****SS = sample size; RR = response rate; DS = data source**

4.2.3 Staff Physical and Mental Health - Non- Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
Raymond et al / 1995 / USA [12]	P, CS Level 4	Aviation SV: Emotional stress SC: Impact on pilot performance	Three case studies all resulting in fatal aircraft accidents. Explanations suggest that the impact of emotional stress resulting from family problems and other social stress, career instability, worry, aircraft accidents and difficult flight schedules as a contributing factor to pilot performance.	The paper suggests that the aviator "at risk" may exhibit warning signs such as defensiveness, arrogance, hostility, financial irresponsibility, excess in routine habits, fatigue, deteriorating performance, or increased risk taking.
Haugli et al / 1994 / Norway [13]	P, S Level 4 COSD 7	Aviation SV: Heath, sleep and mood perceptions SC: Health promotion	This prospective questionnaire forms part of a major survey, which looks at the health of cockpit and cabin crews. SS: 1240 RR: 83% DS: Cock-pit and cabin crew.	Common problems reported by more than 30% included dry skin, lower back pain, colds, fatigue, and sleep disturbances. Pilots report least, while female cabin attendants register most problems. Long distance crews reported more problems than short distance crews. Health concerns in cabin crews need to be considered along with factors such as aircraft facilities and equipment, job demands, duty schedules, work conditions, robustness of personnel, and effects associated with length of service.
Sutherland / 1993 / Belgium [14]	P, S Level 4 COSD 7	Offshore installations SV: Stress SC: Vulnerability to accidents	A stress audit examines the factors relating to stress, accidents and personal life. SS: Random sample of 310 males working on offshore drilling and production rigs RR: 32%	Significant differences relating to stress. Workers with job insecurity were more stressed than those with job security. Workers had higher levels of stress during the Winter months. Workers were more

*** P = published or U = unpublished. L = literature review, S = study containing data, G = guideline or CS = case study. Hierarchy of study design rating = Level 1 -4 (See table 2) COSD = classification of study design 1 - 8 (see table 1)**
****SS = sample size; RR = response rate; DS = data source**

4.2.3 Staff Physical and Mental Health - Non- Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			DS: Personnel working on off-shore mining platforms	stressed if they had experienced an accident and the level of stress increased if the accident was severe. Workers with type A personality classifications were more vulnerable to stress than other workers.
Ore / 1993 / Australia [15]	P, S Level 4 COSD 7	Stevedoring / Transport SV: Morale SC: Occupational accidents	A retrospective analysis of accidents by stevedoring employees. SS: 124,279 accidents and lost time incidents. RR: n/a DS: Database of accidents and incidents from the Association of Employers of Waterside Labour over a 20-year period.	A significant decrease in the frequency of accidents was evident with a significant increase in the severity of the accident. Most of the accidents occurred between 8am and 12 noon on Mondays resulting from slipping and falling. The paper hypothesizes that there could be a culture among workers that an accident or sporting injury may have occurred on the weekend so the worker comes to work “to have their accident” on the Monday. Morale improves generally as the weekend approaches.

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4.2.4 Recommendations

The impact of long hours, shift work and stress are known to affect mood, mental health and emotional wellbeing. This also has an impact on clinical decision-making, alertness, vigilance and effective communication.

There are clear gaps in the literature given that few papers in this review focus on staff health and patient safety. There needs to be further research that provides a better understanding of the link between staff physical and mental health and patient safety particularly in the following areas:

1. Evidence-based guidelines for employing staff that provides a basis for assessing their fitness for practice
2. Understanding of the factors that affect staff mental health and effective clinical decision-making
3. Interventions that improve staff health which result in an increased capacity for improved performance particularly vigilance, resilience, alertness and effective communication.

4.3 Communication and feedback

4.3.1 Communication and feedback – summary findings

There were 18 health papers and 13 non-health papers included in this review that examined the relationship between staff and safety. The following table provides a description of the types of literature within this domain area.

		Health	Non-Health	TOTAL
Published papers		18	13	31
Unpublished papers		0	0	0
Type of paper	Literature Review	1	0	1
	Guidelines	0	0	0
	Case Studies	2	4	6
	Research Study	15	9	24
Levels of Evidence	1	0	0	0
	2	1	0	1
	3	3	5	8
	4	14	8	22
Hierarchy of Study Design (**Applicable to research studies only**)	1	1	0	1
	2	0	0	0
	3	0	1	1
	4	0	0	0
	5	2	5	7
	6	1	0	1
	7	11	6	17
	8	0	0	0

Papers that examined the relationship of communication and feedback between health practitioners and patient safety contained the following themes:

- Equipment and systems that alert, communicate or provide feedback about patients' conditions have the potential for early intervention, avoidance of error and promote quality feedback processes.
- The impact of litigation has a major impact on doctors' self-esteem, anxiety and mental state. Those who have experienced litigation often believe that inadequate communication between staff and the patient is the major cause of accidents.
- Practitioners' fear and low self-esteem inhibit open disclosure.
- Patients have the least confidence in junior medical officers
- Inexperienced staff combined with difficult communication increase the potential for adverse events
- Systems that have a high level of feedback and high level of programming such as the use of policies and procedures, clinical guidelines and critical pathways are perceived to be providing the best care.
- High level of staff coordination has an impact on reducing patient morbidity in surgical units
- Complaints are seldom about clinical treatment alone but include dissatisfaction with personal treatment.

- The impact on patients when they are confused or have little knowledge of the adverse event may lead to increased anxiety if they are faced with a similar situation.

The papers that examined communication and feedback and its relationship between staff factors and the influence of a safety culture highlight the following points:

- Improvements in communication within an organisation improve the safety within the organisation
- Sub-cultures within an organisation such as professional groups or particular workgroups have an impact on the organisation's teamwork and communication effectiveness.
- Social relationships on the shop floor are the strongest predictor of safety compliance.
- In one study the predictors for work disability for men are monotonous work, neuroticism and job dissatisfaction and for women these were interpersonal conflict at work and a combination of marital and work conflict.
- Role overload and negative perceptions of safety decreased safety behaviour
- In an aviation study the frequency of crew changes was stressful. Regular meetings, supervision and support had a positive influence on information exchange
- Implementing goals and feedback processes to encourage safety compliance is not enough where there is high absenteeism, difficult communication between management and staff.
- Improvements were identified in the reduction of incidents in one organisation when an occupational health and safety (OH&S) committee was established, an organisational OH&S policy was developed and staff roles and responsibilities were clearly states and documented.

4.3.2 Communication and Feedback – Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
O'Cathain et al / 2002 / UK [16]	P, S Level 3-3 COSD 5	SV: Acceptability of an emergency medical dispatch (EMD) system to people who call ambulance services PO: Improve patient care and satisfaction with ambulance services	Prospective cross sectional survey in which postal questionnaires were sent to two systematic random samples of approximately 500 named callers to one ambulance service before and 1 year after the introduction of EMD. The EMD consisted of telephone information for first aid and urgency of the incidence. SS: 493 (before) 466 (after) RR: 72% (before) 63% (after) DS: Callers to an ambulance service	Callers reported increases in first aid information (7% to 43%), general information (13% to 58%) with satisfaction on advice given rising from 71% to 73%. Two main issues were found with EMD, some callers were advised to take actions that were not needed and secondly, some callers felt that ambulance crew did not treat the situation as seriously as they would have liked.
Taylor et al / 2002 / Australia [17]	P, S Level 4 COSD 7	SV: Emergency department (ED) complaints PO: Decreasing patient complaints in the ED	This study is a retrospective analysis of patient complaints from 36 Victorian ED's during a 61 month time frame. Data was obtained from the Health Complaint Information Program with the aim of analyzing complaints in order to identify procedures/practices that require change. SS: 3418 complaints RR: N/A DS: Patients in emergency departments	2419 ED patients complained about 3418 issues (15.4% of all hospital complaints). 47.8% were made by telephone, 34.4% were received by letter, 63.1% were made by a person other than the patient. Highest complaint rates were received from patients who were female, born in non-English speaking countries and were very young or old. Remedial action was taken in 3.2% (109) of cases and compensation paid to 8 patients.
The Bristol Inquiry / 2001 / UK [18]	P, CS Level 4	SV: Communication amongst health professionals and management / peer review PO: Deaths of infants undergoing cardiac surgery	This hospital review examines the factors that led to a pattern of high mortality in infants aged less than 1 year undergoing cardiac surgery. Evidence was obtained from 577 witnesses	There were 30 – 35 excess deaths during 1991 – 1995 for children under the age of 1 year. Mortality rates were at least twice as high as those for the UK. Major findings

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4.3.2 Communication and Feedback – Health Literature Summary Tables

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			and reviews of over 1,800 medical records. Activities for the hospital were examined for the period of 1984 – 1995.	included poor teamwork, no system to monitor outcomes and performance, a 'club' culture of either being included or being treated as an outsider in the hospital management, confusion around responsibilities for monitoring quality of care and no requirement for clinicians to ensure their skills and knowledge are up-to-date.
Walton / 2001 / Australia [19]	P, L Level 4	SV: Communication with patients about adverse events PO: Reduction in litigation, improved understanding of medical conditions	This systematic literature review examines documents on open disclosure, informed consent, ethics and communication. Papers Reviewed: 91	The review concludes that early disclosure by clinicians of the adverse event to the patient minimizes litigation and improves the patient's understanding of the event. The review also identifies open disclosure is inhibited by clinicians fear of litigation, loss of self-esteem and being seen as a failure by colleagues.
Greco et al / 2001 / UK [20]	P, S Level 4 COSD 7	SV: Patient assessment of interpersonal skills PO: Improved quality of health care	The prospective pilot study used a questionnaire to provide doctors and nurses, with the perceptions held by patient perceptions of their interpersonal skills, and to evaluate the process in terms of its impact on professional development and ongoing training. SS: 21 consultants, 10 registrars, 10 senior nurses and 1416 patients	Consultants had a mean score of 82%, juniors 79% and nurses 92% (the higher % score the better the perceived communication skills). Consultants scored highest in `respect shown to patient' and 'patients confidence in ability'. Junior doctors scored highest in 'respect shown to patient' and 'warmth of greeting' and lowest in 'patients confidence in ability'.

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4.3.2 Communication and Feedback – Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			RR: Unspecified DS: Questionnaire given to patients	
Pichert et al / 1999 / USA [21]	P, S Level 4 COSD 7	SV: Communication with patients PO: Complaints about dissatisfaction with care	Review of hospital complaints over a 7-year period. SS: 6,419 reports containing 15,631 individual complaints RR: N/A DS: Complaints recorded by hospital staff	The complaints were: negative perceptions of care and treatment (29%) related to diagnosis, problem with treatment or discharge; communication (22%) classified as general failure or inability to listen; billing and payment (20%); humaneness of staff (13%) related to rudeness, blaming the patient and name calling; access to staff (9%); cleanliness or safety of the environment (7%).
Randolph et al / 1999 / USA [22]	P, S Level 4 COSD 6	SV: Accuracy of telephone orders in nursing homes PO: Reduction in medical errors	A cohort of 4 physicians and 1 nurse participated. The study involved recording telephone instructions of the physicians and then comparing the orders not less than 12 hours later. The clinicians then judged the medical accuracy of the order to see if any medical errors had been made. SS: 820 verbal orders in 10 months RR: Unspecified DS: 100 patients from 7 facilities	Types of orders made included: medication (34%), lab tests (21%), diet (9%), nursing procedures (9%), equipment (4%), wound care (4%), monitoring (3%), physician procedures (3%), transfer (2%) and mobility (2%). The significant error rate was found to be 6.1 per 1000. This rate is consistent with other studies.
Young et al / 1998 / USA [23]	P, S Level 3-2 COSD 7	SV: Coordination and feedback within surgical teams PO: Reduction in morbidity and mortality	This cross-sectional study describes the views of surgical nurses, attending surgeons and	Surgical units that had high feedback (ie. case conferences, hand-over

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4.3.2 Communication and Feedback – Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			attending anaesthetists on perceptions of quality of care and coordination approach as well as patient morbidity and mortality data from 44 university affiliated surgical units. SS (staff survey): 7,364 RR: 73% SS (patient data): 60,000 operations. DS: Survey of surgical staff, clinical data from patient charts and mortality and morbidity from Department of Veteran Affairs.	reports) and high programming (ie use of policies and procedures, clinical guidelines and collaborative decision-making processes) had the best perceived quality of care however there were no significant differences in patient morbidity and mortality. Staff coordination is more important for improving morbidity than mortality in surgical services.
Fiesta /1998 / USA [24]	P, CS Level 4	SV: Liability for falls PO: prevention of patient falls	This case report uses 4 case studies to examine the problems of patient falls and the surrounding litigation.	For example, a 92 year old patient tripped over a sale representative's suit case on the way to the examination room and broke her hip. The court ruled 40/60 pharmaceutical company and the hospital. The court ruled that it was the employee's duty to perceive open and obvious hazards and to see that the patient did not sustain injury.
Chen et al / 1998 / Hong Kong [25]	P, S Level 4 COSD 7	SV: Incident reporting in acute pain management PO: Preventing adverse patient events in postoperative pain management	Prospective study looking at voluntary incident reporting in pain management. Over a 12-month period incidents were reported in 1275 patients who received pain relief treatments. SS: 53 incidents RR: N/A	The most common incidents involved delivery circuits, delivery pump and drug administration. 81.4% of the incidents were thought to be preventable. Human factors were involved in 41.9% most commonly associated with

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4.3.2 Communication and Feedback – Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			DS: Hospital incident reporting system	inattention, inadequate communication and inexperience.
Bark et al / 1997 / UK [26]	P, S, Level 4 COSD 7	SV: Views of consultants and registrars providing feedback PO: Reducing adverse patient events and litigation	A cross-sectional self-report postal survey to seek the views of consultants and senior registrars on ways of reducing patient adverse events and litigation. SS: 769 RR: 76% DS: Survey of consultants and senior registrars in acute hospitals	Of those respondents, 37% had experienced some form of litigation. Anger, distress and feeling personally attacked were common responses. Suggestions for reducing litigation included a need for change at the clinical level including supervision of junior doctors, workload and training in communication skills.
Beckman et al / 1996 / Australia [27]	P, S Level 4 COSD 7	SV: Development and evaluation of an incident reporting system in intensive care (IC) PO: Improving patient safety	The incident reporting (IR) form included both a narrative section and a multiple choice section to gain more detail. The evaluation questionnaire was designed to assess staff attitudes to the study, understanding and identify any problems. SS: 129 incidents RR: 88% DS: 3 Intensive Care Units in NSW	More than 90% of respondents showed a good understand of the incident monitoring study. The IR form allocated five main incidents types, airway (20.5%), drugs (25%), procedures (21.2%), environment (22.7%) and management (10.6%). The IR report form was redesigned (simplified) for use in an ongoing national study.
Kuperman et al / 1996 / USA [28]	P, S Level 3-3 COSD 5	SV: Alerting system for physicians PO: Improved quality of inpatient care	This study developed and evaluated an early alerting system that notifies the physician via a pager that an alert is present and offers potential therapies for the inpatient's condition at the time he views the alert information, over a six month period.	Physicians responded to 70% of alerts for which they were paged. 82.5% were responded to in less than 15 minutes. They said they would take action in 71.5% of cases and 39.4% placed an order directly from the alert screen. Further evaluation is needed to

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4.3.2 Communication and Feedback – Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			SS: 10,064 admissions which generated 1945 alerts RR: Unspecified DS: Mumps database	determine if the system improves processes or outcomes of care.
Crowther / 1995 / Germany [29]	P, S Level 4 COSD 7	SV: Women's perceptions of the adequacy of communication by staff about the stillbirth or neonatal death during a pervious pregnancy PO: Anxiety with current pregnancy	Pregnant women were interviewed who had previously experienced a stillbirth or neonatal death. SS: 48 RR: unspecified DS: Pregnant women	Women who had either poor or confused information surrounding the death accounted for 25 of the 48 interviewed. 29% were satisfied with the information, one third were admitted to hospital because of anxiety about the current pregnancy.
Anderson et al / 1994 / USA [30]	P, S Level 2 COSD 1	SV: Comparisons of adverse event reports by patient and physician PO: Reported adverse events	Two parallel randomised, double-blind multicentre clinical comparisons of quality of life in men under treatment with anti-hypertensive agents were collected using physician reports, patient reports to a symptom distress checklist, physician interviews and laboratory reports for adverse event information. SS: 2,318 RR: Unspecified DS: Physician interviews, lab reports, responses from the patient checklist, and responses from the concurrent physician checklist	Symptoms in the checklist were generally more widely reported by patients than by physicians. Large disparities in the frequency of symptoms reported by the physician group (whose information came from consulting with the patient) was on occasion four times higher rates of reporting by patients using the 51-item checklist. The paper explores issues around the reliability of the checklist, physicians reporting patterns based on their knowledge of the importance of reporting on some and not other symptoms and the patients' ability to recall symptoms over time. This study indicates that under-reporting of adverse drug events is high.

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4.3.2 Communication and Feedback – Health Literature Summary Tables

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Bark et al / 1994 / UK [31]	P, S Level 4 COSD 7	SV: Clinical complaints PO: Improving quality of care	Cross sectional survey to establish the reasons for clinical complaints as well as complainant's feelings and motivations. SS: 1007 complaints RR: 49% DS: Complainants who had written to 20 hospitals	Complaints were seldom about clinical treatment alone (11%) most (72%) included a clinical component and dissatisfaction with personal treatment. Lack of detailed information and staff attitudes were identified as important criticisms. Recommendations for staff training on communicating with distressed and dissatisfied patients.
Vincent et al / 1994 / UK [32]	P, S Level 4 COSD 7	SV: Impact of litigation (obstetricians and gynecologists O/G) PO: Prevention of injury	A questionnaire was sent to all doctors in the North Thames region. Respondents were asked to rate on five point scales the main causes of accidents and the effect of litigation on them personally and professionally. Only the O/G's results have been reported. SS: 63 RR: 84% DS: Senior O/G's	It was found that 75% (47/63) of the O/G's in the area had been involved in some kind of litigation. Of those 47, 53 had had an award made against them. Communication between patients and staff was seen as the main cause of accidents. Inadequate supervision of junior staff was also seen as important.
Hicks et al / 1993 / UK [33]	P, S Level 4 COSD 7	SV: Hospice management of patients receiving chemotherapy PO: Improving patient quality of care	Retrospective analysis of data was conducted using the notes of patient who received hospice and chemotherapy care concurrently. SS: 52 patients over 15 months. RR: Unspecified DS: Hospital patient database as well as medical and nursing case notes.	It was found that 24 out of 52 referral forms had no mention of chemotherapy, hospital records or photocopied notes were available for 14/52. These findings illustrate the poor quality of communication between professionals. The limited understanding of patient care was found to cause significant difficulties for

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4.3.2 Communication and Feedback – Health Literature Summary Tables

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				patients. One third of patients died 1 week after ending their chemotherapy.

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4.3.3 Communication and Feedback – Non- Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
Nicol / 2001 / Australia [34]	P, CS, Level 4	Hazardous industries / oil and gas processing plants SV: Improved inter-and intra company communication, recruitment of company staff to ensure corporate memory SC: Avoidance of plant processing disasters	This paper examined the circumstances around the Longford gas explosion where 2 people died and several were injured. It recommends changes to the plant, employment and system issues for its ongoing sustainability.	Strategies include improved communication within the company and its contractors, identification of safety and engineering hazards, recruitment of younger engineers to ensure corporate memory is continued throughout the lifetime of the organisation, development of a continuous hazard identification system and availability of engineering, operating and maintenance skills at all times.
Cox et al / 2000 / UK [35]	P, S Level 4 COSD 7	Offshore mining SV: Communication issues SC: Improving the safety of the work place	The paper examines a two-part process of developing a survey instrument (a series of focus groups and employee survey) to assess employee perceptions of the safety culture in offshore work environments. SS (employee survey): 221 RR: 63% DS: Questionnaires, focus groups, behavioral observations, situational audits of onshore and offshore personnel in 3 separate organizations	The survey results found that communication issues, supportive environment and employee involvement were the three areas of greatest need for improvement. Significant differences were found between drilling teams who rated lower evaluations on communication, supportive environments and personal priorities compared with production teams and managers. This may be due to drilling teams belonging to another sub-culture within the organisation with different communication channels.

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McDonald et al / 2000 / Ireland [36]	P, S Level 4 COSD 7	Aviation SV: Communication SC: Compliance to safety procedures	This study examined the attitudes about safety and compliance with procedures within 4 organisations. SS: management: 33, technicians, crew management and other support staff: 286 RR: Unspecified DS: In-depth interviews (management) and a cross sectional survey (other staff)	The data from this study was used to further develop a model for safety management systems. It found marked differences between organisations' expressed commitment to safety, standards, planning and organisation, monitoring, feedback and change. Sub-groups within the organisation were relatively homogenous with key groups such as technicians having a strong commitment to safety.
Hofmann et al / 1998 / USA [37]	P, S Level 4 COSD 7	All Industries SV: Role of safety climate and communication in accident interpretation SC: Safety intervention for workers	This cross sectional study surveyed sampled 2 groups. Sample 1 – 2,566 outdoor workers in a utility company. RR: 49.4% Sample 2 – 1318 workers from different divisions of the same utility company. RR 49.5% Sample 3 - surveys were also sent to 83 supervisors with a RR of 99%.	The results for both samples indicated that contextual factors such as climate safety and communication on accident interpretations significantly influenced accident attributions. Organisational factors about communicating negative events such as industrial accidents can positively affect staff to create a learning environment and improved safety measures.
Simard et al / 1997 / Canada [38]	P, S Level 4 COSD 7	Manufacturing SV: Cooperation in workgroups, compliance with safety rules, supervisor's control SC: level of supervisor's perception of risk to occupational injury	This is a cross-sectional survey examining the determinants of safety compliance behaviour. SS: not clearly stated but represents 1062 workgroups from a random sample of 97 manufacturing plants.	Social relationship variables on the shop floor are the strongest predictor of safety compliance. These social relationships are influenced by managerial decisions and actions.

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			RR: Unspecified DS: Self-completed questionnaires of managers and supervisors.	
Rundmo et al / 1998[10] / Norway	P, S Level 4 COSD 5	Mining SV: Off shore oil rig workers perception of safety and risk of injury SC: Worry about platform movements	This cross-sectional survey examines the level of worry and concern about safety. SS: 179 RR: 100% on the first shift. RR was difficult to calculate on the 2 remaining shifts as employees overlapped shifts DS: Employees over 3 shifts	There is a relationship between perception of being unsafe and unsafe work practices. Mental imagery and rationalistic approaches improved worry and concern using videos and direct contact with an independent contractor (not company manager) explaining the event and possible consequences.
Appelburg et al / 1996 / Finland [39]	P, S Level 3-2 COSD 3	Industry non-specific SV: Interpersonal conflict at work SC: work disability, martial conflicts, neuroticism, life dissatisfaction and general health status	This population based cross-sectional survey used a national sample of twins to identify interpersonal conflict as a predictor of work disability. SS: 15,348 RR: 84% DS: Existing twins register	Predictors for work disability: for men are monotonous work (RR1.61), neuroticism (RR 1.96), life dissatisfaction (RR 1.63) and stress of daily activities (RR 1.66); for women are interpersonal conflict at work (RR 1.56) and simultaneous marital and work conflicts (RR 2.54).
Hoffman et al / 1996 / USA [40]	P, S Level 3-3 COSD 7	Chemical processing plant SV: Group process, safety climate, intentions to approach others in the work group and perceptions of role overload SC: Frequency of reporting unsafe work practices	This cross sectional survey conducted in a chemical processing plant representing the 21 working groups at all levels of operation. SS: 204 RR: 92% DS: Anonymous questionnaire given to all employees	Role overload (performance is affected by inadequate time, training and resources) was significantly associated with unsafe behaviours. Individual interventions within the group process to mediate unsafe behaviours were not significant. The group process was not significantly associated with accidents. The

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Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
				safety climate was significantly associated with between - team differences in unsafe behaviours. Workers perceptions of a safety climate were significantly associated with unsafe behaviours.
Skogstad et al / 1995 / Norway [41]	P, S Level 3-2 COSD 7	Aviation SV: Satisfaction with communication between flight crew and cabin crew SC: Effective safety management and job satisfaction	This cross sectional self-report survey of cabin and flight crew was completed by members of SAS Norway. SS: 1240 RR: 84% DS: Questionnaire, cabin and flight crews	Half of the sample was dissatisfied with the communication and information exchange between cabin and flight crews. Frequency of meetings, supervision and support issues, and support schemes showed a significant relationship with information exchange and cooperation between the two types of crews. The frequency of changing crews was identified as stressful for 86% of the sample.
Anonymous / 1994 / Australia [42]	P, CS, Level 4	Food processing SV: Unsafe work practices and hazards in the work place SC: Decrease in occupational injury	This case study outlines the strategies used by a major food manufacturer in reducing occupational injury in the workplace, improving a culture of safety through the development of an occupational health and safety (OHS) policy including clear roles and responsibilities and the development of an occupational health and safety committee.	These strategies improved communication between all levels of the workforce particularly the large number of women from non-English speaking backgrounds. Controlling hazards at their source by early risk assessment, periodic inspections, integration of management in OHS initiatives and training in OHS. Days lost as a result of workplace injures

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				per 100 employees has decreased from 330 in 1991/92 to 26 for 1993/94.
Cooper et al / 1994 / UK [43]	P, S Level 3-3 COSD 5	Manufacturing SV: unsafe work practices SC: occupational injury and accidents	This is an intervention study that examines the effects of goal setting and feedback on reducing work-place accidents and injury in a manufacturing plant employing 540 people. SS: 171 RR: 32.6% DS: Production plant workers	The study used observers to assess workers' safety against predefined checklists detailing the safety criteria. The study results showed that the provision of goals and feedback is not enough to improve workers safety in a complex environment evident by increases in injury rates when there is high absenteeism and poor communication between management and staff.
Pate-Cornell / 1993 / USA [44]	P, CS Level 4	Mining SV: Off shore oil rig workers SC: Death	This paper describes the lessons learned from the offshore platform Piper Alpha accident that killed 167 people in 1988.	Key issues relating to human factors were under trained operators in under experienced people running operations, negative experiences of past near-misses and a culture of ignoring safety incidents and not rectifying problems. Poor communication between workers from one shift to the next.
Clarke / 1993 / Hong Kong [45]	P, CS Level 4	Transport - Railways SV: Safety management system (SMS) SC: Maintaining and improving safety standards	This paper outlines the implementation of a SMS. The SMS includes policy, safety tasks, safety responsibility statements, safety audit, work group audit, activity audit, safety communications, safety training, quality initiatives and	Fourteen safety tasks were nominated; information, safe systems, buildings, plant and software systems, protective equipment, fire and security, human resources, communication on safety, contractors and visitors, design

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4.3.3 Communication and Feedback – Non- Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			the role of the safety department.	and project management, accident reporting and investigation, safety inspections, safety performance monitoring, funding for safety and review, as crucial to the SMS improving safety standards.

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4.3.4 Recommendations

The literature identified that communication breakdown is, in many cases, a critical factor in disasters, preventable accidents and adverse events. The literature also indicates that high staff turn-over, inexperienced staff and personal factors such as low self-esteem, irritability from tiredness and interpersonal conflict are contributing factors to ineffective and inappropriate communication. There still remain gaps in the literature particularly focusing on interventions that promote improved communication and the reduction of adverse events. Further research is needed using more robust methods which may provide promising strategies to improve incident reporting, the reduction of adverse events and the improvement of staff morale. These include:

1. Automated or semi-automated alerting systems for staff to identify potential risk associated with patient care
2. Organisational structures that improve social relationships among colleagues providing direct patient care
3. Feedback on performance and safety issues that increases teamwork and performance.

4.4 Hours of work, shift work, number of staff and fatigue

4.4.1 Hours of work, shift work, number of staff and fatigue – summary findings

There were 36 health and 30 non-health papers included in this review that examined the relationship between staff working hours or fatigue and patient safety. The following tables provide a description of the types of papers.

		Health	Non-Health	TOTAL
Published papers		35	29	64
Unpublished papers		1	1	2
Type of paper	Literature Review	1	2	3
	Guidelines	1	1	2
	Case Studies	3	4	7
	Research Study	31	22	53
Levels of Evidence	1	0	0	0
	2	3	0	3
	3	14	10	24
	4	19	19	38
Hierarchy of Study Design (Applicable to research studies only)	1	1	0	1
	2	2	0	2
	3	2	2	4
	4	1	0	1
	5	9	9	18
	6	1	1	2
	7	15	11	26
	8	0	0	0

Papers that reported health professionals' working hours, rostering and staffing mix and a relationship between patient safety contained the following central themes:

- Fatigue is a major concern for health professionals working long hours or rotating shifts. Fatigue affects performance particularly the speed at which procedures are undertaken, alertness and vigilance to identify problems and affects mood which is likely to interfere with effective communication. Fatigue is commonly an issue reported for medical officers. Some papers explored the introduction of maximum hours at work and workload. Driving accidents on the way home from work were also a risk for fatigued staff.
- Contributing factors for adverse events were found to be high workload due to the high acuity of patients, inappropriate staffing mix particularly with regard to number of registered nurses and non-registered nurses. Papers identified a range of quantifiable patient outcomes in relation to nurse-patient ratios. Inadequate ratios in one paper [46] showed an affect with increased patient re-admission rates at 30 days after discharge. Another paper [47] identified low registered nurse to patient ratios

increased the likelihood of patients acquiring a urinary tract infection or pneumonia, thrombosis or pulmonary compromise after surgery. A large study undertaken in the United States [48] reported that when the registered nurse to patient ratio increased to 87.5% there is a reduction in medication errors and patient complaints. Once the ratio exceeded this point these errors increased indicating that the assessment of an appropriate staff mix such as registered and non-registered nurses, is an important consideration in reducing adverse events.

- Rostering of staff was also identified as a contributing factor to adverse events. Enabling a longer sleep at night can be associated with improved clinician performance, improved quality of care, fewer errors and few missed calls.

Fatigue was a major focus in the non-health related papers. The following themes were explored repeatedly in a number of papers:

- Condensed working hours into a longer shift and shorter working week appeared to be of benefit to both the organisation and individual worker. The studies report an increase in productivity, improved job satisfaction and greater flexible for leisure time.
- In industries where working long hours are part of the job such as aviation pilots and truck driving, the effects of fatigue result in serious safety issues. These effects include drowsiness, confusion, decreased alertness and a greatly increased likelihood of making a serious potentially fatal error.
- Shift workers are more likely to have motor vehicle accidents particularly when coming home from the shift. The most dangerous times for fatigue with shift workers are when changing from day to night shift and from night shift to day shift.
- The effects of fatigue are commonly reported to include physical conditions such as headaches, back pain, nose congestion as well as mood changes including irritability.
- Some studies indicate that inexperienced operators are more likely to have accidents as a result of fatigue compared to more experienced operators. Other fatigue related accidents may result from truncated and fragmented sleep patterns.

4.4.2 Hours of work, shift work, number of staff and fatigue - Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
JCAHO / 2002 / USA [49]	P, G Level 4	SV: Numbers of nurses PO: Patient length of stay, health outcomes	This guideline document synthesizes the literature and makes recommendations to alleviate the nursing crisis in USA hospitals. Citations: 132	Recommendations include: addressing the retention of nursing staff; improving compensation and pay rates for nurses; reducing the burden of paperwork and administrative duties; have zero-tolerance policies for abusive behaviours by physicians and other health care professionals; and, set nurse / patient staffing ratios based staff competency and skill mix applicable to patient mix and acuity.
Goodman et al / 2002 / USA [50]	P, S Level 3-2 COSD 5	SV: Numbers of neonatologists PO: Neonatal mortality	A retrospective analysis that used national birth outcome data, neonatal intensive care beds and numbers of neonatologists by hospital unit was examined to determine the relationship between neonatal mortality and numbers of neonatologists. SS: 3,892, 208 newborns over 500grams RR: N/A DS: Data was used from the American Medical Association (AMA) and the American Osteopathic Association as well as surveys of beds to calculate supply of neonatologists and neonatal intensive care beds.	Increases in the number of neonatologists were not associated with greater reductions in neonatal death.

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4.4.2 Hours of work, shift work, number of staff and fatigue - Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
Aiken et al / 2002 / USA [46]	P, S Level 3-2 COSD 7	SV: Numbers of nurses PO: Mortality and failure to rescue (deaths following complications) among surgical patients	A cross-sectional study of nurses' hours of work, job satisfaction and burnout that compares patient outcome data. SS: Nurses - 10,184 RR: 52% DS: Data from 168 hospitals	The study identifies a significant relationship between high patient-to-nurse ratios and 30-day mortality rates, nurse burnout and job dissatisfaction. An increase of a 7% risk of patient mortality was found for each additional patient added to the nurses' average workload highlighting the role of nurses as an around-the-clock surveillance system for the hospital to detect and intervene when patients' health deteriorates.
Kovner et al / 2002 / USA [47]	P, S Level 4 COSD 5	SV: Staffing hours PO: Venous thrombosis / pulmonary embolism, pulmonary compromise after surgery, urinary tract infection, pneumonia	A cross-sectional analysis of hospital outcome data using a data set of between 534 – 570 hospitals over a 7-year period. Examination of the association between registered nurse hours and adverse patient outcomes for 4 post-surgical complications was undertaken. SS: 530 – 570 hospitals for each of the years from 1990 1996 with 187 hospitals having data for all seven years RR: N/A DS: Annual Hospital Association (AHA) annual survey of hospitals, National Inpatient Sample	An inverse relationship was found on 4 of the patient outcomes with an increase in nurse, physician and resident intern hours. Significance at $p<0.5$ level for pneumonia only.
Tucker et al / 2002 / UK [51]	P, S Level 3-1 COSD 2	SV: Neonatal Intensive Care Units (NICU's) PO: Improvement in neonatal care and hospital mortality	Non-randomized controlled trial whose primary outcomes were hospital mortality, mortality or cerebral damage, and	Data was available from 99% of infants. Mortality was raised with increasing workload in all types of NICU's. Assessment

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4.4.2 Hours of work, shift work, number of staff and fatigue - Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			nosocomial bacteraemia. The aim of the study was to assess whether patient volume, staffing levels, and wok-load are associated with risk-adjusted outcomes, and with costs of staff wellbeing. SS: 13, 515 infants RR: N/A DS: 54 randomly selected NICU's	of increased staffing levels closer to those in adult intensive care may be more appropriate.
Wolfe et al / 2002 / Australia [52]	P, S Level 3-3 COSD 5	SV: Rural Australian hospital emergency department (ED) PO: Reducing adverse patient events (ADE)	A before and after intervention design was used to determine if medical record screening and review could detect and reduce ADE's in ED's. SS: 20,050 patients attended the ED in the allocated time period. RR: N/A DS: ED at Wimmera Base hospital 300km from Melbourne	An ADE was confirmed in 1.24% of all attendances with 32% being major and 68% being minor. Over two years the number of ADE's fell from 84 to 12. Thus the study concludes that ADE's in ED's can efficiently be detected and their rate reduced using retrospective medical record screening together with clinical review, analysis and action to prevent recurrences.
Davis et al / 2002 / Australia [53]	U, S Level 4 COSD 7	SV: Implementation of a patient sitters PO: Prevention of patient self-harm	A quality improvement activity was undertaken using patient sitters observing patients at risk of self-harm in an acute hospital setting. SS: 6 patients RR: Unspecified DS: Staff surveys	Of the six patients in this activity, there were no falls, no absconding or other self-harm incident while the sitter was present. Patients were observed to be less agitated with the sitter present.
Sovie et al / 2001 / USA [54]	P, S Level 3-2 COSD 5	SV: Hospital restructuring and its impact on nursing staff PO: Quality of care	Prospective cross sectional survey looking at the effect or restructuring on delivery of patient care using selected patient outcomes (full rate,	The study found that increased hours worked per patient per day were associated with lower fall rates, lower urinary tract infections and higher

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4.4.2 Hours of work, shift work, number of staff and fatigue - Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			nosocomial pressure ulcer, urinary tract infections, and patient satisfaction). DS: 29 university teaching hospitals (300 beds) SS: Unspecified RR: Unspecified DS: Department level data collected following a Donabedian model from each hospital	general levels of patient satisfaction (from 79% to 81%) as well as specifically with pain management.
Weinburg et al / 2002 / USA [55]	P, S Level 4 COSD 4	SV: Reduced staff on weekends PO: Impact on the rate of falls and medication errors	Prospective quality indicator data was collected during a 6-month period in a 14 bed sub-acute unit. The majority of the patients were admitted for rehabilitation following a bone fracture or stroke. SS: 31 patients RR: N/A DS: All sub-acute unit residents admitted to the unit were monitored for the presence of the specific outcome measures	Significant differences were found between patient care during weekdays compared to weekends. Essential documentation in the nurses' notes was less on weekends (0.3% vs 3.8%), the falls rate was increased on weekends (019% vs .77%) and no difference was found in medication errors. Nursing staff levels was less on the weekends (3 vs 4).
Trafford / 2001 / USA [56]	P, CS Level 4	SV: Hospitalised patient use of private nurses or sitters PO: Quality of patient care	This single case study looks at the effect of a private nurse or sitter on the effect of quality of patient care.	One patient recovering from a leg operation hired a sitter at his own expense, he also did this when he underwent a heart operation. The patient said that to improve the quality of care the only thing he could do was have somebody there 24 hours a day. He felt he could not get the service he required from the hospital.

4.4.2 Hours of work, shift work, number of staff and fatigue - Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
Boodman / 2001 / USA [57]	P, CS Level 4	SV: Fatigue in hospital interns PO: Accident and injury prevention	This article presents 3 case studies in order to look at the problem of fatigue among medical interns.	For example a plastic surgery resident had been working more than 50 hours without sleep when they started to perform colon surgery and briefly nodded off with the instruments in their hand. Problems of fatigue for interns must be addressed by hospitals to improve quality of care.
Acute Hospital Portfolio – Review of National Findings / 2001 / UK [58]	P, S Level 4 COSD 7	SV: Ward staffing PO: Increased quality of care	This study looks retrospectively at ward staffing and collects information on patient complaints, pressure ulcers and patient accidents. SS: Data from 3600 wards. RR: N/A DS: The database was created by the Audit Commission	It was found that ward staffing is the largest single budget item, with large wards costing less per bed on average. Most accounting systems were not standardized. Trying to standardize the amount of money on ward staffing is a complex task because all trusts have mixes of different types of wards and patients. Although data on patient complaints and accidents is collected it is not reported.
Hendrix et al / 2001 / USA [59]	P, S Level 3-3 COSD 7	SV: Nurse staffing levels for optimal long term care PO: Increased quality of patient care	This study is a cross section of multiple observations at a point in time (1994) for all US nursing homes. The study attempts to define optimum staffing levels whereby quality is optimized, personnel are conserved and public burden is minimized. SS: 12,000 nursing homes RR: Unspecified DS: Databases plus an online reporting system in nursing	Data revealed that approximately 60% of US nursing homes were using fewer registered nurses than and 100% were using fewer nurses' assistants than optimal measured using a nurse sensitive patient outcome of decubitus ulcers.

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4.4.2 Hours of work, shift work, number of staff and fatigue - Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			homes	
Patton et al / 2001 / USA [60]	P, CS Level 4	SV: Sleep deprivation among resident physicians PO: Effects on adverse events	This paper used 2 case studies. One case study examines the legal implications of a woman who died whilst being treated in the emergency department by inexperienced, unsupervised and sleep-deprived resident medical officers. The second case study examines the case of a rail worker who was made to work 27 hours and fell asleep while driving and collided into a car on his way home from work. The victims of the accident successfully sued the rail workers' employers. The paper examined the legal implications for sleep-deprived doctors such as direct hospital liability for fatigue-related resident malpractice, vicarious liability of teaching hospitals for torts of fatigued residents, informed consent and the duty to disclose skill and status risks.	The woman died and her father attempted to use this case to reform legislation around the safe working hours for doctors. As a result legislation was passed to restrict medical staff and postgraduate trainees' work hours to 12 consecutive hours per on-duty assignment in hospitals with over 15,000 unscheduled visits to the emergency service annually. Post-graduate trainees shall not exceed 80 hours per week over a 4-week period and shall not be scheduled to work more than 24 hours.
Needleman et al / 2001 / USA [61]	P, S Level 3-3 COSD 7	SV: Numbers of registered nurses per patient PO: Outcomes Potentially Sensitive to Nursing (OPSN) which were urinary tract infections, skin pressure ulcers, pneumonia, DVT, length of stay, mortality, failure to rescue, upper GIT bleeding, complication of the CNS, sepsis, shock, wound infection, pulmonary failure, metabolic derangement	Analysis of hospital patient discharge data and financial reports or hospital staffing surveys were undertaken to identify the relationship between level of registered nurse staffing level and OPSN. SS: A total of 3357 hospitals in 11 states were used in various stages of the analysis containing 12,261,737 records.	Total hours of inpatient hospital nursing time averaged 11.4 hours / day. Registered nursing hours averaged 7.8 hrs / day. An association was found between urinary tract infections, pneumonia, length of stay, upper GIT bleeding and shock in medical patients and only failure to rescue in major surgical patients. Higher

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Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			RR: N/A DS: hospital database systems	RN staffing was associated with 3-12% reduction in OPSNs. Low to high overall nurse staffing variables (RN, aides and licensed practical / vocational nurses) was associated with 2-25% reduction in OPSN rates.
Moreno et al / 2001 / The Netherlands [62]	P, S Level 3-2 COSD 3	SV: Organ system failure and nursing workload at discharge PO: Mortality	This prospective cohort study examined whether post–intensive care unit (ICU) discharge mortality is associated with the presence of and severity of organ dysfunction/failure just before ICU discharge. SS: 4621 patients including 2958 discharged alive	13.4% of patients died in ICU, 32.8% died before hospital discharge. From the remaining 4000 6% were discharge home, 74% to the general ward and 9% to other ICU care. Results showed that it is better to delay the discharge of a patient with organ dysfunction /failure from the ICU unless adequate monitoring and therapeutic resources are available.
Reed et al / 2000 / UK [63]	P, S Level 3-3 COSD 6	SV: Inpatient care of mentally ill people in prison PO: Improved quality of health care	Experimental study using semi-structured inspections conducted by a doctor and a nurse to investigate the facilities for inpatient care of the mentally ill. SS: 348 beds RR: N/A DS: 13 prisons with inpatient beds	No doctor in charge of inpatients had completed any specialist training with only 24% of nursing staff having mental health training, and 32% non-nursing trained health care officers. Most patients were unlocked for around 3.5 hours per day with the average length of seclusion being around 50 hours. Prison facilities were often poor, low staff numbers with insufficient training. In-mates spent too long secluded and without appropriate

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4.4.2 Hours of work, shift work, number of staff and fatigue - Health Literature Summary Tables

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				psychological intervention compared with care expected elsewhere.
Morris et al / 2000 / Australia [64]	P, S Level 4 COSD 7	SV: Anesthesia and fatigue PO: Incident monitoring	A retrospective analysis was done using the Australian Incident Monitoring Study (AIMS) database. Reports, which listed fatigue as a contributing factor, were examined. SS: 152 reports (2.7% of all reports, total reports = 5600) RR: N/A DS: AIMS database	Of the fatigue positive reports other contributing factors included haste (45%), inattention (37%), failure to check equipment (35%), fault of technique (29%), distraction (19%), pressure to proceed (9%), other stress (10%), Drug label (10%) and other equipment problems (10%). The papers suggest that definitive prospective studies be targeted at these related interventions.
Tarnow-Mordi et al / 2000 / UK [65]	P, S Level 2 COSD 7	SV: Staff workload in an Intensive Care Unit (ICU) PO: Hospital mortality	This retrospective analysis was based on a prospective cohort study of all admissions to the ICU in a hospital in Scotland with the objective of studying mortality rates in relation to the workload of hospital staff. SS: 1050 patients RR: N/A DS: ICU staff	Variations in mortality can be partly explained be excess ICU workload. Patients exposed to high ICU workload are more likely to die than those exposed to lower workload. The 3 measures of ICU workload most strongly associated with mortality were peak occupancy, average nursing requirement per occupied bed per shift, and the ratio of occupied to appropriately staffed beds.
Schulmeister / 1999 / USA [66]	P, S Level 4 COSD 7	SV: Nurses description of chemotherapy medication errors PO: Reducing patient medication errors	Descriptive survey which contained 24 demographic and open-ended questions. The aim of the study was to expand the knowledge on errors in chemotherapy medication.	Chemotherapy medication errors were reported to have occurred in the workplace of 63% of the respondents and 140 errors were described. Errors included under/over

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			SS: 620 randomly selected oncology nursing members RR: 160 (26%) DS: Oncology nursing society members employed in direct patient care positions	dosing, schedule and timing errors, omission of drugs, infusion rate errors and therapy given to the wrong patient. Trends in the workplace identified by nurses as contributing to the error rate include: increased acuity of patients, inappropriately qualified nurses, reduction in the number of registered nurses providing direct patient care.
Peterson et al / 1999 / Australia [67]	P, S Level 4 COSD 7	SV: Pharmacists attitudes towards dispensing errors PO: Medication error reduction	A prospective cross sectional survey of pharmacist's attitudes towards dispensing errors was undertaken in Tasmania. SS: 419 surveys RR: 49.9% DS: Registered pharmacists in Tasmania	82% of pharmacists felt that dispensing errors were on the increase, 17% felt they weren't and 3% were unsure. Pharmacists felt that 150 prescription items per day were a safe number. Factors contributing to high error rates included high prescription volumes, fatigue, overwork and interruptions.
Cohen et al / 1999 / Canada [68]	P, S Level 4 COSD 5	SV: Nursing workload associated adverse events in post-anesthesia care unit (PACU) PO: reduction in patient adverse events	Patients were observed and assigned points according to the Project Research in Nursing (PRN) workload system. SS: 2031 patients RR: N/A DS: The data from the PRN were merged with the data from the hospital's anesthesia database.	Patients without any adverse events had on average a number of 29 points, going up the scale to critical respiratory event at around 54 points. It was found that the rate of postoperative adverse events affects the amount of nursing staff resources needed in the PACU.
Blegen et al / 1998 / USA [48]	P, S Level 3-3 COSD 5	SV: Numbers of nursing staff PO: Reduction of adverse patient outcomes (medication errors, patient falls, urinary and	Retrospective analysis of medical records and staffing levels in a large university	Hospital units with high patient acuity had low levels of medication errors. When

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		respiratory infections, skin breakdown, patient complaints and mortality)	teaching hospital over a 12-month period. SS: around 3000 beds across the hospitals RR: N/A DS: Data from 39 units in 11 hospitals	controlling for patient acuity an inverse relationship was found between registered nurse (RN) hours and medication errors, decubiti and patient complaints. A direct association was found between total hours of care from all nursing personnel, complaints and mortality. As the RN proportion of care rose to 87.5% there was a lower incidence of adverse outcomes. However these outcome rates rose when the level of RN care increased beyond this level.
Hunt et al / 1998 / UK [69]	P, S Level 3-3 COSD 7	SV: nurse to patient ratio PO: Mortality within 30 days of emergency admission and readmission within 30 days of hospital discharge	Analysis of nursing full-time equivalent data and hospital bed occupancy (nurse / patient ratio) was used to examine the association with patient outcomes. SS: 49 hospital trusts RR: N/A DS: Data was obtained from the Information Services (ISD) Division of the Common Services Agency for the NHS in Scotland	The paper explores the possibility of using routinely collected data using multiple regression analysis. There was no significant association between nurse / patient ratio and mortality but an inverse relationship was found between nurse / patient ratio and patient 30-day readmission rate.
Marck et al / 1998 / USA [70]	P, S Level 4 COSD 7	SV: Staffing numbers PO: Safety concerns and complaints	A review of telephone calls in a 10-month period to a registered nurse organisation providing telephone advice and support. SS: 575 telephone calls RR: N/A DS: Telephone calls to the	Of the 575 calls, 30% (168) were related to safety concerns in Alberta state covering concerns about patient care, inadequate staffing and inappropriate skill mix. There has been a five-fold

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			AARN	increase in calls relating to safety concerns between this review and one previously (3 years prior).
Kovner et al / 1998 / USA [71]	P, S Level 3-3 COSD 5	SV: Nurse staffing levels PO: Adverse patient events following surgery	Retrospective analysis of hospital discharge data and nurse staffing levels. SS: 589 acute-care hospitals in 10 states in the USA. RR: N/A DS: Hospital records from a	Full-time equivalent registered nurse to total hospital inpatient days was shown to have a significant inverse relationship for urinary tract infections after major surgery (p< 0.001) and pneumonia after surgery (p< 0.001). A less robust but significant inverse relationship was shown for thrombosis after major surgery (p< 0.01) and pulmonary compromise after major surgery (p< 0.05).
Smith-Coggins et al / 1997 / USA [72]	P, S Level 2 COSD 1	SV: Adaptation to night shift for emergency physicians PO: Reduced adverse outcomes by improved physician performance	A double-blind, active placebo-controlled study conducted on attending physicians in a University hospital emergency department. The intervention involved a fatigue countermeasure program used for commercial airline pilots involving an education component, a regular work schedule and fatigue countermeasure strategies. SS: 6 physicians RR: Unspecified. DS: Emergency physicians	Overall, physicians' vigilance reaction times and times for intubation of the mannequin were slower on night shift with no difference in the performance on EGC analysis. Mood rating was more negative on night shift. The experimental group used the fatigue countermeasure 85% of the time and did not affect physician performance.
Kirkcaldy et al / 1997 / Germany [73]	P, S Level 4 COSD 7	SV: Safe working hours for medical officers PO: Accidents at work and on the road	This is a cross-sectional survey of medical officers using a postal questionnaire that examines their accident behaviour and its relationship to	Doctors who worked more than 48 hours in a week were 5 times more likely to experience a car accident and reported significantly higher

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			job stress and working hours. SS: 2500 RR: Unspecified, 8000 questionnaires were mailed out and the first 2500 completed that arrived back were used as data DS: Practicing doctors	levels of job-related stress.
Brown et al / 1996 / Canada [74]	P, S Level 4 COSD 5	SV: Number of ambulance crew size PO: Differences in intervention and time on the scene	A review of data for advance life support calls for ambulance assistance for seizures and chest pain for two 1-month periods comparing the procedures and time on the scene with 2 and 3 person ambulance crews. SS: 126 cases RR: N/A DS: Two person team emergency medical services (EMS) professionals and Three person team EMS professionals	No difference was found in the total number of calls and types of procedures used. Significant differences were found between the 2 team sizes with on-scene times. Two-person crews were longer by an average of 8.4 minutes for seizures and 1.8 minutes for chest pain compared to 3-persons crews.
Booker et al / 1995 / USA [75]	P, S Level 4 COSD 5	SV: Seasonal patterns of hospital medication errors in Alaska PO: Prevention of medication errors	Length of daylight is evaluated in relation to medication errors in a medical center (140 beds) in the far north of Alaska. This data was collected prospectively over 5 years. SS: 262 errors RR: NA DS: All nursing staff	The data showed that 58% of all medication errors occurred during the first quarter of the year. Medication errors were 1.95 times more likely in Dec than Sept. Thus medication errors appear to follow a pattern that is closely associated with the annual cycles of daylight and darkness.
Edge et al / 1994 / USA [76]	P, S Level 4 COSD 5	SV: Specialised compared to non-specialised inter-hospital transport staff PO: Intensive care related adverse events	Data was collected over a 2 and 3-year period looking at patient outcomes and the	Significant differences were found ($p < 0.05$) between adverse events in the

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4.4.2 Hours of work, shift work, number of staff and fatigue - Health Literature Summary Tables

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		experienced by paediatric patients	association between staffing skill mix using 2 hospitals' inter-transport service. SS: 141 patients RR: unspecified DS: Patient transported between two tertiary pediatric ICU's	specialised and non-specialised (staff who worked in ICU but not specifically dedicated to inter-hospital transportation) care team. Specialised teams have fewer adverse events.
Haw et al / 1994 / USA [77]	P, S Level 4 COSD 5	SV: Absenteeism of senior medical officers in a psychiatric unit PO: Suicide	Retrospective analysis of regional suicide data over a 9-year period and examination of psychiatric hospital events. SS: 34 current patients who committed suicide. RR: N/A DS: Riverside Health Authorities Mortality Database (1987-1989) and from the Office of Population and Census Surveys (OPCS) for 1981 to 1986.	A cluster of 14 suicides was found in a 12-month period and a "temporal" association could be found between the timing of these suicides and significant "life events" of the hospital in particular a period of uncertainty about the hospital's future and higher rates of senior medical officer absenteeism.
Laine et al / 1993 / USA [78]	P,S Level 2 COSD 3	SV: Restricted working hours PO: Quality of patient care (in hospital mortality, length of stay, medical complications, delays in ordering tests and procedures, transfers to ICU's, resuscitation attempts, discharge disposition)	Retrospective cohort study to examine the impact on patient care of a New York state regulation that restricted medical house staff working hours. SS: 281 RR: 94% DS: Patients hospitalised on the same general medicine teaching service of The New York Hospital	Results showed that restricted medical house staff working hours were associated with delay in test ordering (17% v 2%) and in-hospital complications (35% v 22%). No significant differences were found in the more serious outcomes such as in-hospital mortality, length of stay, discharge disposition or transfers to ICU's.
Barone et al /1993 / USA [79]	P, S Level 4 COSD 7	SV: Reduction in surgical staff PO: Quality of patient care	This prospective cross sectional study looked at whether patients suffered any loss to quality of care when 24	Of the 659 trauma patients, 86 had undergone surgery within 12 hours. Patient injuries were found to be similar with no

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4.4.2 Hours of work, shift work, number of staff and fatigue - Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			hour surgical staff were not in a level 2 trauma center. SS: 659 trauma patients RR: N/A DS: 1 level 2 trauma center compared to 3 affiliated level 1 trauma centers	differences found in mortality rates. No unexpected adverse event could be ascribed to the lack of 24-hour or staffing in the level 2 trauma center.
Mann et al / 1993 / USA [80]	P, S Level 3-1 COSD 2	SV: Effect of shift work and sleep deprivation on Emergency Departments (ED) radiology errors PO: Improved patient care	The non-randomized control trial compared the performance of the usual (control) shift with the performance of the 'night stalker ' (night shift rotation) shift. SS: 26,421 cases were reviewed RR: N/A DS: After hours ED	The 'night stalker' was found to be averaging around 5.75 hours sleep on night stalker days compared with the resident who was averaging around 2.75 hours sleep with 2 interruptions. The 'night stalker' shift improved the patient quality of care and appropriateness and timeliness of patient care. The night stalker made fewer errors and had fewer missed calls daily.
Leung et al / 1992 / USA [81]	P, L Level 3-3	SV: Sleep deprivation experienced by doctors PO: Inadequate assessment and slower response to monitoring devises	This literature review examines 14 studies assessing the effects of sleep deprived doctors.	The quality of the papers is varied and makes it difficult make clear conclusions. Generally the studies indicate that sleep deprivation has an effect on clinical performance and deterioration in mood.

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4.4.3 Hours of work, shift work, number of staff and fatigue – Non-Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
Caldwell et al / 2002 / USA [82]	P, S Level 4 COSD 7	Aviation SV: Fatigue SC: On-the-job alertness	A cross-sectional study of self-completed survey of military aviators and crew examining the impact of sleep and perception of performance. SS: 361 RR: 95% estimate DS: Military aviation crew	The average hours of sleep is 6 - 7 hours, at least 1 hour less than the recommended 8 hours of sleep. Approximately 45% of respondents have dosed off to sleep while on duty, 49% of pilots and 25% of crew have cancelled or declined a mission because of fatigue, 81% of pilots and 90% of crew thought that fatigue was the reason for increases in aviation accidents/incidents and approximately 60% of respondents felt that their safety was compromised by fatigue or lack of adequate rest.
National Occupational Health and Safety Commission / 2002 / Australia [83]	P, L Level 4	All types of industries SV: Staff fatigue SC: Safety and performance implications	A review of the literature defines the scope and the magnitude of the problems relating to staff fatigue and workplace safety. Papers Reviewed: 129	Industries that identify fatigue as a major problem are construction, transportation, mining and the health sector. This review outlines fatigue management strategies which includes: performance management, subjective rating of fatigue, readiness-to-perform and fitness-for-duty tests, use of hardware technologies and software technologies, regulatory and non-regulatory approaches. It also outlines the recommended hours of work standards for industries that

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4.4.3 Hours of work, shift work, number of staff and fatigue – Non-Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
				have such standards.
Australian Council of Trade Unions / 2002 / Australia [84]	P, S Level 4 COSD 7	13 different industries SV: Long working hours SC: Productivity and occupational injury	A qualitative analysis of 54 semi-structured interviews with individuals working in 13 different industries. SS: 54 individuals and their partner (if they had one) RR: Unspecified DS: Interviews with workers	The analysis focused on the effect of long working hours on the quality of family and social relationships. The section on work safety identified that in most cases the participant experienced a work related injury as a result of fatigue which included falling asleep at the wheel of a car or truck, taking longer to perform a procedure, not being as alert to safety signals and signs.
Lilley et al / 2002 / New Zealand [85]	P, S Level 3-3 COSD 7	Forestry SV: hours of work, pay, fatigue SC: occupational injury	This cross-sectional study using a self-administered questionnaire examined the predictors of working conditions and work place injury. SS: 367 forestry workers RR: 97% DS: Self-report from forestry workers	The most significant predictors of work place injury or near-miss injury events were fatigue due to long working hours.
Australian Industrial Relations Commission (AIRC) / 2002 / Australia [86]	P, G Level 4	Construction, forestry, mining, hospitality, health, retail, public service, teachers, aviation SV: fatigue SC: occupational injury and accidents	This report is the full bench decision of the AIRC containing the arguments for and against amending 14 awards on reasonable working hours, overtime and meal breaks.	The document presents legal arguments providing a range of references to national and international studies comparing hours of work and standards for protecting workers rights and workers safety. The ACTU claims for a test case standard were rejected with the exception of conditions relating to working overtime.

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4.4.3 Hours of work, shift work, number of staff and fatigue – Non-Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
Rosenberg et al / 2001 / Israel [87]	P, S Level 4 COSD 7	Aviation/ Military SV: Military aviator fatigue SC: Fatigue prevention	This study used a voluntary survey questionnaire regarding 14 current primary, secondary and tertiary fatigue prevention initiatives. SS: unspecified RR: 37% DS: Flight squadron commanders in the Israeli air force	The most popular primary prevention (87%) dealt with reservist pilots. The most popular secondary measure (88%) was to utilize a stimulant drug such as caffeine or amphetamines. Leading the list of tertiary prevention measures (77%) was that squadrons debrief the incidence of aviator fatigue.
Sussman et al / 2000 / USA [88]	P, CS Level 4	Railway transport SV: Hours on the job SC: Railway accidents	This case study has a focus on 3 rail disasters where the engineer / train driver was asleep while driving the train.	The paper explains the impact of sleep quality, the breaks required between shifts and the issues related to legal requirements for off-the-job time and incident under-reporting of fatigue related accidents. A minimum of 12 hours between shifts is required under USA federal laws.
Phillips / 2000 / Australia [89]	P, S Level 4 COSD 7	Seafaring SV: Fatigue of staff SC: shipping and fishing boat accidents	A retrospective analysis of Incident at Sea Reports. SS: 44 RR: N/A DS: Accident investigator's reports	Of the1 injury, 1 tank over-pressurization, 21 groundings and 21 collisions, 38 incidents were associated with watch keeping and sleepiness. Truncated and fragmented sleep patterns for watch keepers and an unfavourable sleep environment on fishing boats contributed to accidents.

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4.4.3 Hours of work, shift work, number of staff and fatigue – Non-Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
Oron-Gilad et al / 2000 / Israel [90]	P, S Level 4 COSD 7	Military SV: Fatigue among military truck drivers SC: Accident prevention	This prospective study used focus groups and a large-scale survey with the objective of detecting fatigue in military truck drivers. SS: 314 male truck drivers RR: 93% DS: Military truck drivers' self-report	The focus groups showed that most drivers had fallen asleep at the wheel at least once in the past. On the survey 39% of drivers reported falling asleep at the wheel. Results showed that quality of sleep was more important than enforcing night sleep and prohibiting night drives as part of fatigue management. It was also found that mandatory service drivers (young, less experienced drivers, lower military rank) fall asleep more often and to a greater extent than other drivers. Thus results indicated that it is important to provide drivers with more-in-vehicle, accessible countermeasures to alleviate fatigue.
Simons et al / 2000 / The Netherlands [91]	U, S Level 3-3 COSD 5	Aviation SV: The effects of early starts on sleep, alertness and vigilance SC: Accident prevention	This prospective time series analysis measured captains flying short haul operations during two 4 week periods. Subjects were equipped with a palm top computer and an actigraph for objective and subjective measurement of sleep parameters, alertness and performance on a vigilance dual task. SS: 6 RR:N/A	It was found that pilots reporting before 6am had a significantly shorter total sleep time, impaired sleep quality, and impaired performance both pre-flight and at top of descent.

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4.4.3 Hours of work, shift work, number of staff and fatigue – Non-Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			DS: Pilot self-report	
Williamson et al / 2000 / Australia [92]	P, S, Level 3-1 COSD 4	Transport SV: Effects of alcohol and fatigue SC: Road crash risk	This case control study developed measures to determine the effects of fatigue compared to alcohol consumption on a series of eight psychological tests on long haul truck drivers and other workers in the transport industry (controls). Participants stayed awake for 28 hours in one occasion and on the second occasion drank alcohol until their blood level rose to 0.1%. SS: 39 RR: N/A DS: Employees volunteered from both the transport industry and the army	Performance deficits due to alcohol were evident for all eight tests. Performance due to sleep deprivation was evident in most but not all tests. Sleep deprivation had no effect on the Visual Search test or the Logical Reasoning test. Performance deficits equivalent to 0.5% blood alcohol concentration were seen at 17-19 hours of sleep deprivation.
Shanley et al / 1999 / USA [93]	P, CS Level 4	Chemical processing SV: Fatigue and shiftwork SC: Accident prevention	The case study describes a system approach used by a large chemical processing company that has a large proportion of shiftworkers. The organisation implemented a series of two types of education programs for workers and family and the other for managers.	The company identified that at any one time 200 shiftworkers had control of over US$7 billion of company assets for two-thirds of the plant's operating hours. The company was concerned about the impact of shiftwork on staff health and life expectancy. Following the education program employees reported improved sleep, improved family life, less fatigue and less gastrointestinal problems.

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4.4.3 Hours of work, shift work, number of staff and fatigue – Non-Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
Smith et al / 1998 / UK [94]	P, L Level 4	All types of industries SV: 8 and 12-hour shifts SC: safety in the workplace	The literature review examines the implications of effects the different length of shift on a range of personal and performance issues. The paper contains 85 citations.	The paper concludes that 12-hour shifts do not automatically induce a significant decrement in safety.
Health and Safety Executive / 1998 / UK [95]	P, S Level 4 COSD 7	Manufacturing SV: Size of organisation SC: Differences between large and small organisations and rates of injuries	A review of rates of fatal and non-fatal work place injuries reported under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR) between 1996/97 and 1997/98. SS: 86,761 employee injuries that can be attributable to organisation size. RR: N/A DS: Injury statistics databases	Small workplaces (50 or less employees) have twice as many fatal and amputation injury in the workplace than large organisations. The rate of non-fatal injury is smallest in smaller workplaces.
Gander et al / 1998 / USA [96]	P, S Level 3-3 COSD 5	Aviation SV: Fatigue experienced by pilots SC: reduction of sleep loss on over-night cargo operations	This cohort of B-727 crew members was examined for physical effects of fatigue experienced by long flights over at least one time zone. SS: 34 RR: N/A DS: Observations of simulated flight	Sleep quality during the day was not as good as at night. Total sleep time was 1.2 hours shorter per 24-hour on duty days. Crew members ate snacks and had increased reports of headaches, congested nose and burning eyes during the long hauls.
Gander et al / 1998 / New Zealand [97]	P, S Level 4 COSD 7	Transport SV: Fatigue management program for tanker drivers SC: Accident prevention	A prospective questionnaire was sent to all tanker drivers working for six Australasian companies addressing sleepiness levels and the prevalence of other risk factors, and possible effects of shift characteristics.	Twenty-one percent of drivers reported snoring every night and one third of had a large neck size > 42 cm. (Previous studies have shown that accident rates 42% higher among drivers with large necks compared with those with

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4.4.3 Hours of work, shift work, number of staff and fatigue – Non-Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			SS: 163 drivers RR: 70% DS: Drivers' self-report	small necks.) A driver education package was developed, management education on driver fatigue, company medical examinations and rostering guidelines were developed. No simple solution was found to fatigue management in trucking operations.
Gander et al / 1998 / USA [98]	P, S Level 3-3 COSD 5	Aviation SV: fatigue experienced by pilots SC: avoid adverse events	This cohort of pilots use a logbook to record their sleep, heart rate, feelings of fatigue, hours on at work for multiple short haul flights of 4.5 – 5.5 hours in a duty day averaging 10.6 hours over a 3-4 days of work. Comparisons were made between patterns during working periods and days-off. SS: 44 RR: N/A DS: Pilot self-report	Sleep during a working week was on average an hour shorter. Pilots experienced more headaches, nose congestion and back pain and had greater difficulty in getting to sleep. Their consumption of caffeine and snacks was greater while on duty.
Vega et al / 1997 / USA [99]	P, S Level 4 COSD 5	Policing SV: Hours of work in a week SC: Quality of policing and productivity	A postal questionnaire was completed by police officers who had worked a 40-hour week over 5 days for 1 year and in the subsequent year worked 3 13-hour and 20-minute shifts a week for one year. Productivity data was used from a police activity database. SS: 34 RR: 40.5%	An increase in productivity was found when police officers worked the compressed week. Increases were found in the number of cases handled and availability to respond to call for service. Ninety one per cent of respondents were positive about the compress working week. Respondents also believed that there was more opportunity to gain

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4.4.3 Hours of work, shift work, number of staff and fatigue – Non-Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			DS: Police officers' self-report	additional employment, although the rate for this was less during the period of compressed week than in the 5-day working week period. There was more time to devote to family members and leisure activities.
Luna et al / 1997 / USA [100]	P, S Level 3-3 COSD 5	Aviation SV: Night shift SC: Performance and aircraft safety	Cohort of air traffic controllers was examined for sleep, mood, subjective assessment of fatigue and general activities during a 2.5 shift cycle period covering 2 weeks of duty shifts, post-shift, day-of-shift and duty location. SS: 43 RR: Unspecified DS: Air traffic controllers' self-report	There was significantly more sleep, fatigue, less vigour and confusion, while on night-shift compared to day-shift.
Samel et al / 1997 / Germany [101]	P, S Level 3-3 COSD 5	Aviation SV: Hours of flight times SC: Performance and aircraft safety	Cohort of flight crew were examined for sleep, task load, fatigue and stress measured by EEG, ECG, motor activity and subjective ratings during and after a 9-hour and 15-minunte flight, 13-hour and 30-minute layover and 9-hour and 53-minute return flight. SS: 22 flight crew RR: N/A DS: Pilots' self-report	Layover sleep was shortened by 2 hours. 2 consecutive night shifts had a total of 9.3 hours sleep loss. Increasing level of fatigue was evident in-flight and was more pronounced on the return flight home base measuring critical levels. Drowsiness, low state of vigilance and alertness were evident in both night flight but more pronounced on the return flight.

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4.4.3 Hours of work, shift work, number of staff and fatigue – Non-Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
Fell et al/ 1996 / Australia [102]	P, S Level 3-2 COSD 4	Transport SV: Driver fatigue SC: Minimising road accidents	This is a case control study using a telephone interview to examine the prevalence and characteristics of driving fatigue in a sample who had a previous driving incident and those who did not (controls). SS: 301 RR: Unspecified DS: Drivers' self-report	Shift workers have a higher prevalence of driver-fatigue related accidents in the city. People traveling on work trips have a high prevalence for fatigue related accidents in commuter times.
Emonson et al / 1995 / USA [103]	P, S Level 4 COSD 7	Aviation (Military) SV: Fatigue SC: Effectiveness of performance, aircraft safety	A self-report questionnaire was completed by air force flight crew deployed in operation Desert Shield / Desert Storm to assess the use of amphetamines to overcome fatigue on-duty. These operations involved flying east-ward for 15 hours across a minimum of 7 time zones, without auto-pilot and completing multiple air-to-air refueling. SS: 464 RR: 70% DS: Pilots' self-report	Of the respondents, 65% used amphetamines during operations. Most frequent indications for use were aircrew fatigue and mission type. 58 - 61% considered their use as beneficial or essential to operations. Dextroamphetamine 5mg 4/24 was used without side effects.
Smith et al / 1995 / UK [104]	P, S Level 3-3 COSD 5	Nuclear SV: Shiftwork effects on nuclear power workers SC: Staff safety	This prospective study used a hand held computer to record levels of alertness, cognitive task performance and workload ratings every 2 hours over selected shifts. SS: 22 workers RR: 50% to 72% depending on the task	Workload remained stable across shifts. Night shift was associated with poor quality and shorter sleeps with significantly lower levels of alertness and poorer performance on components of the performance measures. No major difference by shift type

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4.4.3 Hours of work, shift work, number of staff and fatigue – Non-Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			DS: Shift workers' self-report	or time on shift interaction effects were found.
Beilock / 1995 / USA [105]	P, S Level 4 COSD 7	Transport SV: Hours of service and speed limit violations among tractor – trailer drivers SC: Accident prevention	A prospective survey plus interviews were conducted among long distance truck drivers on the way into or out of the Florida peninsula. SS: 498 RR: 84% DS: Truck drivers' self-report	Results showed that depending upon the average speed limit scenario, up to 56% of drivers had violation suspect schedules or violation inducing schedules. Solo drivers, refrigeration drivers, regular route drivers and those with longer trips were much more likely to have violation suspect schedules. The average driver drives 46 hours per week and works a total of 58 hours.
Williamson et al / 1995 / Australia [106]	P, S Level 3-2 COSD 5	All industries SV: Time of shift SC: Fatalities at work	An analysis of coronial reports were examined over a 2-year period. Accidents were examined by type of human error that related to the fatality and the shift in which the accident occurred. SS: 1020 cases RR: N/A DS: Coronial reports	Examination revealed that fatal accidents more than doubled on night shift when controlling for the proportion of workers on duty. Behavioral factors were the most common causes, errors in automatic processing (skill-based error) were the most common and were not specific to shift time, Rule-based errors were more common during the day and knowledge-based errors were the most common in afternoon and night shifts.
Duchon / 1994 / USA [107]	P,S Level 3-1 COSD 6	Mining SV: Extended Workdays SC: Decreasing worker fatigue	For this comparative study data were collected in 2 phases. The control group was kept on the usual 8 hour shifts. In phase 1	Results indicated unanimous acceptance and improved sleep quality with the 12 hour shifts. Fatigue sensitive

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Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			experimental crew was on 8 hr backward rotating. For phase 2, 4x4 12hour shift schedule was introduced. SS: 31 experimental and 10 control subjects were used (100% male) RR: N/A DS: Mine workers self-report	behavioral and physiological performance measures showed either no change or improvement with the 12 hour shifts.
French et al / 1994 / USA [108]	P, S Level 3-2 COSD 5	Aviation (Military) SV: fatigue SC: Effectiveness of performance, aircraft safety	This cohort study examines the experience of crew members in three simulated B-1B bomber missions lasting 36 hours with 33 – 35 hours rest between missions. SS: 32 RR: N/A DS: Flight crew self-report	Subjective fatigue, anger, confusion, depression and tension were significantly greater in the first mission then with subsequent missions. Recovery from the missions occurred within 48 hours of the third mission.
Parkes / 1993 / UK [109]	P, S Level 4 COSD 5	Offshore installations SV: Shift work SC: Alertness	Offshore operators were examined for the effects of a 2-week offshore shift cycle on their cognitive performance. SS: 31 RR: Unspecified DS: Offshore operators' self-report	Alertness and cognitive performance were most affected adapting from night shift to day shift and again adapting from day shift to night shift. Disruptive effects included changes in mood, sleep loss, low alertness and slowing of cognitive performance.
Salter et al / 1993 / USA [110]	P, CS Level 4	Military SV: Safe sleeping SC: Injuries and death	This paper describes 4 incidents of army soldiers experiencing an injury while sleeping. These related to sleeping around a vehicle, inside or on a vehicle, in an apparently "safe" area and in	Soldiers were not seen by their colleagues and experienced either injury or death by being run over or from moving parts or a tank. The paper recommends the development of guidelines to assist army

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Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			open areas.	personnel when in the field. The paper suggests that standards be written on the location of where soldiers should sleep. The average number of hours on duty before a sleep-related accident was 16.8hours, indicating a high level of fatigue.
Phillips et al / 1992 / UK [111]	P, S Level 4 COSD 7	Manufacturing (Paper products) SV: Shift work SC: Occupational injury	This paper examines the factors that affect adaptation to shift work on a rotating roster using a self-report questionnaire. SS: 239 RR: 48% DS: Factory workers in a manufacturing plant	Sixteen percent of the 239 in the sample reported having an injury since starting shift work. Significant predictors of workers' ability to adapt to shift work included drowsiness the next day, difficulty going to sleep, preference for meals at fixed times and ability to skip a night's sleep.
Feyer et al / 1992 / Australia [112]	P, S Level 4 COSD 7	Transport SV: Work practices and fatigue in long distance drivers SC: Accident prevention	This paper used a prospective survey plus interviews to look at work practices and fatigue in the long distance road industry. SS: 960 long distance truck drivers (658 – questionnaire and 302 – interviews) RR: Unspecified DS: Truck drivers' self-report	Results showed that the most common type of operation involved single drivers (89%), with most being employees of medium to large companies (76%), mean distance covered 1259.8km with mean duration 27 hours and 78% of drivers did some unloading. Most drivers (73.3%) reported feeling fatigued. Shorter trips with more flexibility in timing and scheduling were related to lower levels of fatigue.

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4.4.4 Recommendations

The papers in this review that focus on nurse staffing levels enhance our understanding of nurse to patient ratios and its effect on patient outcomes. Given the large amount of resources that are required to provide patient care, the development of cost effective, efficient and safe models of care is of priority. The literature in both the health and non-health areas indicate that too few and too many of the same type of staff can lead to poor patient outcomes. Increasing this area of research to include staffing models that are collaborative from a range of professions, use a rostering system that is conducive to continuity of care yet enables adequate rest and sleep for clinicians can make a significant contribution to safe staffing and the promotion of patient safety.

There are some other promising areas for further research which are:

1. Condensing the working week to enable longer shifts with more time away from work
2. Examining the impact of doctor to patient and allied health worker to patient ratios and the impact on adverse events
3. The development of a model that promotes continuity of care rather than continuity of carer through the use of use of feedback and programming (such as the use of guidelines, policies and procedures)
4. The development of strategies that enable the inexperienced practitioner to work safely in the delivery of patient care such as specific education on mentoring, promotion of feedback and the use of checklists or protocols to clearly define roles and responsibilities
5. The promotion of effective messages on managing shiftwork, personal life and sleep.

4.5 Competence, supervision and staff mix

4.5.1 Competency, supervision and staff mix – summary findings

There were 91 health and 27 non-health papers included in this review that examined the characteristics of competent staff, staff supervision and staff mix and the relationship with patient safety. The following table provides a description of the types of papers.

		Health	Non-Health	TOTAL
Published papers		90	27	117
Unpublished papers		1	0	1
Type of paper	Literature Review	6	0	6
	Guidelines	4	2	6
	Case Studies	30	13	43
	Research Study	52	12	64
Levels of Evidence	1	0	0	0
	2	4	0	4
	3	21	4	25
	4	66	23	89
Hierarchy of Study Design (**Applicable to research studies only**)	1	3	0	3
	2	1	1	3
	3	5	0	5
	4	0	1	1
	5	13	3	16
	6	5	0	5
	7	24	7	31
	8	0	0	0

Papers that examined the characteristics of competent staff, staff supervision and staff needs and its relationship on patient safety contributed a substantial volume of information to this review. In relation to health, a large proportion of papers examined drug related adverse events, an area in the broader literature already well explored. A number of themes emerged relating primarily to competent staff and these are not only confined to staff knowledge and skills but also to the systems and environment in which staff work. The following points emerged:

- Hospitals that have been reviewed because of high levels of patient complaints and adverse events were identified to have problems around care coordination, poor management, poor documentation and a limited or absent system for reporting adverse events.
- Patients have, in certain conditions, a considerably high risk of being re-admitted to hospital if discharged from hospital with a number of unstable conditions. One study [113] quantified the risk of death or readmission to hospital as being five times greater than the rest of the population if there were two or more instabilities in the patients' condition on discharge.

- Inexperienced or temporary staff, especially junior medical officers, pose an increased risk to patient safety if not adequately supervised. Supervision is critically important as well as having clear processes for communication and role delineation.
- Patients who need an inter-hospital transfer may be placed at a higher risk of experiencing adverse events if the transport teams are not specialised in inter-hospital transfers for the acutely ill.
- Delays in diagnosis may have a major impact on the longer term wellbeing of the patient in a number of clinical situations particularly acute myocardial infarction.
- The development of communication processes for patients with low literacy levels or limited English skills may reduce adverse events. Diagrams, illustrations, symbols and signs may assist in helping patients understand hazards and environmental dangers in a clinical area.
- Staff abuse of patients is clearly a serious issue and papers cited in this review identify the inability of other staff to intervene when aware of these behaviours.

Papers relating to staff working in non-health industries and related to worker competency, supervision and worker needs provided similar content to the health papers however the commercial imperative was foremost in the analysis. Lost worker time was often reported as a company cost and papers would often describe the responsibility staff had in protecting and maintaining company assets. The following themes were identified:

- Inexperienced staff may contribute to accidents. Outsourcing inexperienced workers above employees because of potential cost saving may increase risk of accident and injury.
- There is an economical imperative to identify and eliminate design faults quickly which includes the implementation of rules and guidelines as well as improving structures to ensure commercial viability.
- Poor judgment together with reduced visibility and ineffective communication can lead to very serious, sometimes fatal accidents such as rail and aviation disasters.
- A failure to perceive, comprehend and project situations where safety and accident prevention is required may increase workers' risk to creating an accident.

The non-health industry literature contained a larger number of papers that focused on finding solutions to unsafe worker practices. These included:

- The implementation of an occupational health and safety program within the organisation. This program has the following characteristics of leadership, organisational policy, hazard risk assessment and continuous improvement. One company [114] greatly reduced there lost time injury rates as a result of implementing such a program.
- The use of technology to prepare people for potentially hazardous situations such as simulated mining experiences.

- The use of computer feedback on performance. This has been used in the aviation industry and was found to increase teamwork and performance.
- The use of video to improve visibility. This is a recommendation for large mining trucks where there was a risk to people on the ground of being run over.
- Improving the preparation of workers for their roles such as a computerised site entry education program. The program was suggested for people working in confined spaces and would include emergency and rescue procedures.

4.5.2 Competency, supervision and staff mix – Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
Australian Council for Safety and Quality in Health Care / 2002 / Australia [115]	P, CS (series) Level 4	SV: Credentialing, role and responsibilities and quality monitoring processes PO: Serious adverse events and poor outcomes for women and their families	This report outlines an inquiry into health care delivery and hospital processes of a major tertiary hospital. The review involved information from over 1600 patient files, 293 written submissions, interviews from 70 former hospital staff, consultant's reports, comparisons between other hospitals' performance data, Case Studies: 106 transcripts from current and former hospital staff.	Findings included system issues relating to sub-standard care coordination, poor management of emergencies and high-risk cases, lack of supervision of junior doctors, sub-standard documentation and non-existent systems for reporting adverse events.
Piotrowski et al / 2002 / USA [116]	P, G Level 4	SV: Competency PO: Death and morbidity	This paper provides a set of guidelines or standards developed as a result of fatal errors in an intensive care unit. It uses examples of patient case studies describing the use of specific check lists in minimizing errors. Citations: 18	The paper provides data on compliance rates with the standards by professional group. The paper is not able to describe the impact of standards and check lists on patient outcomes due to data and methodological limitations.
Halm et al / 2002 / USA [113]	P, S Level 3-2 COSD 3	SV: Inappropriate hospital discharge PO: Improved quality of health care	The prospective observational cohort study used information on daily vital signs and clinical status, to define and validate a simple, usable measure of clinical stability on discharge for patients with community acquired pneumonia. SS: 680 patients RR: N/A DS: patients with community-acquired pneumonia	Results showed that 19.1% of patients left the hospital with one or more instabilities. Instability on discharge was associated with higher risk adjusted rates of death or readmission and failure to return to usual activities. Patients with 2 or more instabilities had a 5 five fold greater risk-adjusted odds of death or readmission.

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Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
Paavilainen et al / 2002 / Finland [117]	P, S Level 4 COSD 7	SV: Identification of child maltreatment in hospitals PO: Prevention of child patient mistreatment	This prospective cross sectional survey looked at how nurses and physicians rated their ability to identify child (under 18) maltreatment (physical, sexual, psychological) by a parent of caregiver. SS: 513 RR: 62% DS: Total population of staff caring for children	Of the respondents 40% estimated that they had never treated a child maltreatment case and 2/3 believed that if they did they would be able to identify the issues. However 71% rated identification of child maltreatment as difficult. Staff believed that the most distinct signs to identify maltreatment by were fractures, multiple bruises, and frequent injuries.
Davidson et al / 2002 / UK [118]	P, S Level 4 COSD 7	SV: Management of ectopic pregnancy PO: Improved quality of healthcare for pregnant women	A prospective audit was carried out on women diagnosed with ectopic pregnancy, casenotes were obtained as well as a questionnaire sent to all specialist registrars and consultants within the unit asking about operative skill and confidence in managing ectopic pregnancies. SS: 50 ectopic pregnant women and 36 physicians RR: N/A DS: specialist registrars and consultants	The ectopic pregnancy was removed laparoscopically in 62% of cases with 80% being discharged on the first postoperative day. In a minority of cases elements of substandard care were present including failure to operate when ectopic pregnancy was found on ultrasound. Fewer than 50% of physicians reported competency in laparoscopic management of ectopic pregnancy.
McDonnell et al / 2002 / USA [119]	P, S Level 4 COSD 7	SV: Hospital admissions from preventable adverse drug reactions (ADR's) PO: Prevention of medication errors	A retrospective chart review over an 11 month period at a university hospital was conducted to assess the potential preventability of ADR's directly related to a patients hospital admission. SS: 437 ADR's RR: N/A	Of the 437 ADR's, 158 were found to be directly related to hospital admissions with 97.4% due to drug exposure. 62.3% of these were considered preventable with 24% considered life threatening. Most ADR's resulted from inadequate

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			DS: patient charts	monitoring of therapy (67%) or inadequate dosing (51%). Patient non-compliance (33%) and drug interactions (26%) were also common causes.
Durie / 2002 / Australia [120]	P, S Level 4 COSD 7	SV: Incidents related to arterial canulations PO: Prevention of medical errors	This report used data from the Australian Incident Monitoring Study (AIMS –ICU) database to identify common problems and factors associated with use and maintenance of arterial lines. SS: 251 reports outlining 376 accidents RR: N/A DS: AIMS database	Of the incidents identified 15% described line insertion problems, 66% line use and maintenance problems and 19% patient injuries. As a result of the incident 49% of patients suffered no ill effect, 28% minor effect and 15% major adverse effect. This study highlights the need to use meticulous insertion techniques, line set up, securing, frequent line assessment and the early removal of lines that are no longer necessary.
Dean et al / 2002 / UK [121]	P, S Level 4 COSD 6	SV: Prescription errors in hospital inpatients PO: Prevention on medical errors	A prospective study which interviewed pharmacists at a UK teaching hospital to establish the prevalence of mistakes made, causes of errors and methods of error reduction. Pharmacists identified prescribing errors and notified the research team. The team invited the doctor to be interviewed, complete a questionnaire and the medical record was examined. SS: 88 errors / 44 doctors RR: Not specified DS: Doctors who worked at a	Skill based slips were most frequent (57%), rule based mistakes (39%) and violations (4%). Seventy per cent of the time doctors blamed being busy and 30% being interrupted.

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			UK teaching hospital	
Pronovost et al / 2002 / USA [122]	P, CS Level 4	SV: Safety in an intensive care unit (ICU) PO: Preventing patient adverse events	This single case study is used as an example to outline the complex chain of medical and administrative system failures that can result in an adverse event.	After an uncomplicated surgical procedure, a 72 yr old man developed hospital acquired pneumonia and was admitted to ICU for oxygen support, while in the ICU he developed atrial fibrillation with a rapid ventricular response. Because the patient's heart rate was 163 beats per minute it was decide he would be treated with medication. Esmolol was administered and the patient suffered cardiac arrest but was successfully resuscitated. System failures are identified.
Farbstein et al/ 2001/ USA [123]	P, CS Level 4	SV: Medication safety in hospitals PO: Prevention of medical errors	This is a series of 6 case studies used to identify 16 best practices to reduce adverse drug events across a network of 6 hospitals.	Illustrates both long/short term strategies in place such as review of clinical order entry, computer systems, dispensing stations on wards, bedside bar coding and monthly meetings to facilitate the safety process.
Kahn et al / 2001 / USA [124]	P, S Level 4 COSD 5	SV: Ambulance driver competency PO: Fatalities	This is retrospective analysis with the objective of describing fatal ambulance crash characteristics. SS: 339 ambulance crashes involving fatalities RR: N/A DS: Road accident database from 1987 – 1997	Most fatalities occurred whilst the ambulance is driving in an emergency. The majority to fatalities occurred with pedestrians and not in the ambulance. The most serious and fatal injuries in the ambulance were in the rear, to improperly restrained occupants. Although the rate of ambulance officers with a poor driving record is similar to

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				the driving population, the paper concludes that ambulance officers should have a higher level of competence.
Shojanania (eds) et al / 2001 / USA [125]	P, L Level 3	SV: Technical skill, clinical decision-making PO: Adverse events	This systematic literature review is a substantive volume of work using a minimum of level 3 evidence for inclusion. It synthesizes evidence on 55 topic areas	The study identifies a range of clinical interventions that improve patient outcomes however, is limited in identifying staffing variables that impact on patient safety.
Kinley et al / 2001 / UK [126]	P, S Level 2 COSD 1	SV: Scope of nursing practice PO: Improved patient care	This prospective randomized control trial also included qualitative assessment of patient care, staff perceptions and economic evaluations. SS: 1907 patients (1874 completed) who presented for assessment prior to general anesthetic RR: Unspecified DS: Four NHS hospitals in the UK	The study found that the use of appropriately trained nurses (ATN's) was acceptable to patients, and cost neutral in pre-operative assessment in elective general surgery.
Hebl et al / 2001 / USA [127]	P,S Level 4 COSD 6	SV: Effect of weight on treatment PO: Equality of patient care	Six cell randomized design where physicians evaluated a patient's medical chart (average weight, overweight, obese) who presented with a migraine headache. Physicians indicated how time was spent and which of the 41 tests/procedures would be conducted. SS: 122 physicians in 1 of 3 hospitals located in Houston, Texas RR: Unspecified	Physicians spent less time with heavier patients, prescribed more tests, and viewed them more negatively on 12 of 13 indices. The study concluded that physicians in Houston are playing an important role in the lowering of the quality of health care that overweight and obese people receive.

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			DS: Medical chart	
Morrison et al / 2001 / Australia [128]	P, S Level 4 COSD 7	SV: Nursing staff inexperience PO: Eradication of adverse patient experiences in intensive care units (ICU's)	Incidents related to nursing staff inexperience (NSI) were extracted from the Australian Incident Monitoring Study in ICU's (AIMS – ICU) database and analysed using descriptive methodology. The aim of the paper was to identify effects of incidents associated with NSI on quality of care and PO's. SS: 735 reports covering 1472 incidents were identified. RR: N/A DS: AIMS database	Of the incidents, 317 were related to airway ventilation, 219 procedure lines and equipment, 234 patient environment, 234 unit management. In 20% of the reports the result was a major undesirable patient outcome. Therefore when rostering and employing staff, NSI needs to be considered.
Tang et al / 2001 / Australia [129]	P, S Level 4 COSD 7	SV: Mental Health care for non-English speakers in Sydney PO: Quality of health care	A prospective survey was conducted to identify the factors affecting the provision of quality of care to people speaking a language other than English (LOTE) from a mental health perspective in two area health services in Sydney. SS: 488 health practitioners RR: 56% (271 practitioners) DS: Randomly selected health practitioners from two AHS's	It was found that only 39% of respondents were happy with the quality of care. Shortage of bilingual practitioners and inadequate organization of services were found to be the two factors affecting the provision of the quality of care.
Emerson et al / 2001 / UK [130]	P, S Level 3-2 COSD 2	SV: Hospital pharmacists PO: Reducing patient Adverse Events (AE's)	This prospective observational study examined the feasibility of pharmacist led intensive monitoring of adverse events (AE's) associated with newly marketed drugs. SS: 303 patients admitted to hospital who were prescribed newly marketed drugs during their inpatient stay in 1998	Of the patients taking new drugs there were 21 (7%) suspected ADR's detected. The types of AE's that occurred were broadly similar to those identified by general practice based prescription monitoring. However biochemical changes did feature more frequently than in

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			RR: N/A DS: Inpatients who were prescribed selected newly marketed drugs	general practice.
Bouvier – Colle / 2001 / France [131]	P, S Level 4 COSD 7	SV: Severe obstetrical haemorrhage PO: Patient quality of care	This research used a retrospective questionnaire survey design to determine what factors related to health services in France might explain substandard care of severe morbidity due to obstetric haemorrhage. SS: 165 women who had given birth in the previous year RR: Not specified DS: Three administrative regions in France	Of the 165 cases identified 51% were vaginal, 19% operative vaginal and 30% caesarean. The leading cause of hemorrhage was uterine atony, with 68% of cases receiving appropriate care, 24% inadequate care and 14% mixed care. The main factors associated with sub-standard care were lack of 24-hour on site anesthetist and low volume of deliveries.
Sheikh et al / 2001 / USA [132]	P, S Level 4 COSD 7	SV: Urban – Rural differences for Acute myocardial infarction (AMI) PO: Quality of care	Data from medical records was abstracted to see if the urban-rural differences in health care utilisation in Kansas exist in the quality of inpatient care for patients with AMI. SS: 2521 medical records RR: N/A DS: patients (65+) who had survived AMI from 12 urban, 31 semi-rural, and 76 rural hospitals	Patients with AMI received a lower standard of health care in rural hospitals. This was especially true for use of aspirin during hospital stay and at discharge, heparin, and IV nitroglycerin.
Sharma et al / 2001 / India [133]	P, S Level 4 COSD 7	SV: Transfusions PO: Prevention of medical errors	This paper used errors reported by the blood bank staff and the residents in charge of the patient. The study time frame was over a period of 1 year and classified based on the site of occurrence. SS: 123 errors	A total of 123 errors were detected, of these 107 (86-99%) occurred outside the blood bank and 16 (13%) inside the blood bank. Errors outside the blood bank broke down into bedside errors (99%) and in transit errors (6-

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			RR: N/A DS: Blood bank staff	9%). Errors included: a different blood group from the original sample, labeling errors such as overwriting the patients name, mismatch between vial and central registration number and patient's name and request form. Transit errors include detachment of patient's identification label and incorrect labeling of blood units.
Callum et al / 2001 / UK [134]	P, S Level 4 COSD 7	SV: Transfusion safety PO: Improved mortality rates	A prospective audit of transfusion related errors was performed to determine the ability of a no-fault medical event reporting system for transfusion medicine (MERS-TM) to identify the frequency and patterns of errors. SS: 819 events over a 19 month period RR: N/A DS: Reported errors by medical staff	No serious patient outcome occurred in the study period however 7.4% of blood transfusions were near-misses and were potentially life threatening or could have led to permanent injury. Of most concern were 3 samples collected from the wrong patient, 13 mislabeled samples, and 22 requests for blood from the wrong patient. The MERS-TM allowed the recognition, analysis of errors, determination of pattern errors, and monitoring for changes in frequency of errors after corrective was implemented.
Dunn et al / 2001 / USA [135]	P, CS Level 4	SV: Reduction in prescription errors PO: Increasing patient safety	Three case studies are used to provide examples of the hazards associated with the common Latin abbreviation of "qd" by showing copies of actual medication orders. Other	An example from a case study would be, 'upon second examination of the prescription, both pharmacists realised the recommended dosing interval of once daily

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			dangerous abbreviations are also discussed.	("qd") had been misinterpreted as 4 times a day ("qid")'. After re-labeling the prescription vial the patient was counseled.
White et al / 2001 / UK [136]	P, S Level 4 COSD 7	SV: Adverse events following acupuncture PO: Patient safety	A prospective survey was undertaken using intensive event monitoring to determine whether the benefits of acupuncture outweigh its risks. SS: 2178 adverse events occurring in 31,822 consultations. RR: Not clearly specified DS: 78 acupuncturists (all doctors and physiotherapists)	The incidence of adverse events was 684 per 10,000 consultations. The most common minor adverse events being bleeding, needling pain, and aggravation of symptoms (followed by a resolution of symptoms in 70% of cases). Avoidable adverse events included forgotten patients, needles left in patients, cellulitus and moxa burns.
Feldman et al / 2001 / USA [137]	P, CS Level 4	SV: Abuse of pediatric patients by hospital staff PO: Improve patient safety	This study reports on a retrospective series of cases from one pediatric hospital between 1982 and 1996, it also includes a children's hospital survey conducted from 1990 through 1995. The objective of this study was to describe a child protection team's (CPT) efforts to develop and implement a protocol for systematic and management of accusations that hospital staff have abused pediatric patients. Case Studies: 34 cases in hospital 1 and 27 hospitals in the survey (RR:25%)	Thirty four cases of child abuse by staff were reviewed. Seventeen of physical abuse cases included bruising, fractures, rough handling and verbal abuse and 18 sexual abuse complaints were made including touching and sexual statements. Complaints were substantiated in 23% of cases, with 1/3 of staff resigning or being fired. Results form the survey indicated that nearly 60% knew of allegations of abuse by staff members with only 19% having internal policy on how to handle such matters.
Brilli et al / 2001 / USA [138]	P, S Level 4 COSD 7	SV: Best practice in intensive care PO: Reducing medical error rates in intensive care units	This paper outlines models of best practice in the intensive care unit (ICU). It includes a	About twenty three per cent of patients were treated in an ICU utilizing full time intensivist

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			non-systematic review of the literature as well as data from the Committee on Manpower for the Pulmonary and Critical Care societies (COMPACCS, 1997). SS: COMPACCS – 5979 ICU's with 72,500 beds with 77% occupancy rate – 53,000 RR: NA DS: 31 health care professional and practitioners	model. In summary it concludes that one model is not unanimously supported as a model of best practice, however the best models all have common elements such as a multidisciplinary approach, physician component, nursing component, pharmacy component and respiratory therapy component.
Rex et al / 2000 / USA [139]	P, S Level 3-3 COSD 5	SV: Temporary nursing staff, inexperienced staff or experienced staff in unfamiliar work area. Delays in communication, garbling of communication or inability to verify accurate information PO: Serious adverse drug events	This study examines serious adverse drug events in a major tertiary hospital in a 29-month period. The paper describes the application of root cause analysis to create change and improve patient safety. SS: 23 ADE's RR: N/A DS: Staff employed at the hospital	In the 29-month period of review, the hospital had 23 serious adverse drug events. The main contributing factors in the root cause analysis were found to be 15 related to the use of temporary, inexperienced or experienced staffing working in unfamiliar work settings; and, 9 related to night, weekend or change of shift.
Kohn et al (eds) / 2000 / USA [140]	P, G Level 4	SV: Improving staff performance and creation of systems to reduce human error PO: Minimise the risk of adverse events in the health system	This extensive report reviews system errors in the health service delivery and provides recommendations that aim to build safer delivery of health care.	The report contains 8 major recommendations in the following areas: the development of a centre that has as its focus, the improvement of patient safety and the development of a research agenda; national mandatory reporting system; development of voluntary reporting programs; legal protection of data and for peer review; improve performance

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				standards and expectations of health care organisations; improve the performance standards and expectations for health professionals; increase attention on the pre and post marketing of drugs; ensure that patient safety is a clear aim within health service delivery; implementation of medication safety practices.
Glick et al / 2000 / USA [141]	P, CS Level 4	SV: Competency in diagnosing suspected conversion disorder in an emergency department PO: Wrong diagnosis and inappropriate treatment	This paper describes 6 case studies where patients presenting to an emergency department had significant neurological impairment and pain and were inappropriately treated. Cognitive and attitudinal factors by the physician and caregivers are examines.	The paper suggests 6 steps to minimize misdiagnosis which includes: the physician to be self-aware and reflective respecting difficult cases.
Wolff et al / 2000 / Australia [142]	P, G Level 4	SV: Leadership, competency PO: Adverse events	This paper provides a framework for dealing with complex medical errors and organizational factors to a successful clinical risk management program. Citations: 18	The framework is theoretical and is not supported with data. The framework is derived from previous work examining medical records for adverse events.
Khunti / 2000 / UK [143]	P, S Level 4 COSD 5	SV: General Practitioner competence PO: Death	This descriptive study describes the use of autopsy reports in improving diagnostic skills for GPs. SS: 651 consecutive deaths over a four year period RR: N/A DS: Six doctor inner city training practice	The study describes medico legal reasons as the most common for requesting an autopsy however there is value in requesting clinical autopsies to improve clinical care and reduce incorrect diagnoses or improve the detection of medical conditions.

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Health and Safety Commission / 2000 / UK [144]	P, CS Level 4	SV: Injuries in residential care homes PO: Injury prevention of employees and members of the public	This report describes the main types of injuries sustained by employees and staff across many residential care settings in the time period from 94/95 to 98/99. Case studies: 3	6435 injuries were reported of which 22 were fatal, 3743 (58%) were fatal and 2670 (41%) were over 3 day injuries. The key changes that were implemented included simplification of the RIDDOR system in terms of classification of injuries, inclusion of suicide and trespass on railways.
Hadfield / 2000 / UK [145]	P, S Level 4 COSD 7	SV: Accountability in clinical supervision (CS) PO: Reduction in pediatric medical errors	This is a qualitative, exploratory and descriptive study, using semi-structured interviews, which aims to gain an understanding from the 'users' perspective of the impact of CS on pediatric nurses. It reconstructs narratives in an investigative research format. SS unspecified RR unspecified DS female pediatric nurses	The paper describes CS, its impact on clinical practice and the expected commitment to CS. It also examines the importance of safety, impartiality, support, trust and respect in CS and states that the CS relationship is valuable for the development of good practice.
Espinosa et al / 2000 / USA [146]	P, CS Level 4	SV: Reduction in number of clinically significant errors on radiographs in the Emergency Department (ED) PO: Improved quality of care	This single case study looks at longitudinal data to review all clinically significant radiograph errors in the ED at monthly meetings.	With the meetings in place and case studies being used for teaching purposes the rate of false negatives fell from 3% to 1.2% and then to 0.3%. The study concludes that systems of radiograph interpretations that optimize physician skills can significantly reduce error rates.
Hourigan et al / 2000 / Australia [147]	P, S Level 4 COSD 7	SV: Decreasing patient treatment time PO: Quicker thrombolytic treatment for acute myocardial infarction, mortality	A comparative observational study using prospectively collected data. The intervention being that all patients with	Median door to needle times were less for patients treated in the ED (37 minutes) than in the CCU (80 minutes). Eighty

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			acute myocardial infarction receive treatment by the emergency department (ED) instead of the usual coronary care unit (CCU) SS: 89 RR: N/A DS: Patients in a coronary care unit and emergency department of an Australian teaching hospital	three per cent of patients were treated in less than 60 minutes. Overall mortality was similar in the ED and the CCU.
Schenkel / 2000 / USA [148]	P, L Level 4	SV: Patient safety in Emergency Departments (ED) PO: Reduction in medical errors	This article reviews the definitions, detection and presentation of error in medicine and emergency medicine (EM). Recommendations are made based on the current literature. Citations: 127	Recommendations are made for detection and reporting, teaching and prevention.
Thomas et al / 2000 / USA [149]	P, S Level 4 COSD 7	SV: Adverse events in elderly patients PO: Patient safety	This paper is a review of a random sample of medical records (2 stage process, stage I –nurses, stage 2- physicians) to detect adverse events. 2 study investigators then judged preventability. SS: 15,000 hospitalised patients discharged in 1992 RR: N/A DS: Hospital database	Results showed that the elderly (5.29%or 7419 adverse events) had significantly more adverse events than non-elderly patients (2.8% or 8901 adverse events). Reviewers felt that this was because of the clinical complexity of the care rather than age based discrimination.
Cote et al / 2000 / USA [150]	P, S Level 4 COSD 7	SV: Medications used for sedation in pediatric care PO: Prevention of adverse sedation events (ASE's)	This paper used both a survey of pediatric specialists as well as data from case reports to perform a systematic investigation of medications associated with adverse sedation events in paediatric	Ninety-five incidents were found to fulfill the incident criteria where the 4 reviewers agreed on causation. Sixty incidents resulted in death or permanent neurological injury. Adverse sedation events were

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4.5.2 Competency, supervision and staff mix – Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			patients. SS: 118 case reports RR: N/A DS: Survey/ case reports	frequently associated with drug overdoses and drug interactions, particularly where 3 or more drugs were used.
Frey et al / 2000 / Switzerland [151]	P, S Level 4 COSD 7	SV: Critical incident monitoring in a neonatal pediatric intensive care unit PO: Improve quality of care	This prospective survey examined the occurrence of critical incidents (CI's) in order to improve quality of care. SS: 467 admissions over a 1 year period RR: N/A DS: neonatal pediatric intensive care unit (ICU)	CI's were found to be very common in pediatric intensive care. There were 211 IC's, 30% major, 25% moderate and 45% minor. CI categories were management/environment 29%, drugs 29%, procedures 18%, respiration 14%, equipment dysfunction 7% and nosocomial infections 3%. Most severe was CI's involving to drugs.
Oliver et al / 2000 / UK [152]	P, L Level 4	SV: Hospital fall prevention programs PO: Patient safety	This paper reviews the literature with the objective of analysing hospital fall prevention programs to determine whether there is any effect on fall rates, to review the quality of those programs and to provide direction for future research. Papers Reviewed: 21 articles	Of the 21 only 10 contained sufficient data to allow calculations of confidence intervals. 3 papers were randomised control trials, 7 prospective studies with historical control. The remaining 11 studies contained data on fall rates only. To conclude individual components of interventions showed no significant benefit.
Van den Bemt / 2000 / The Netherlands [153]	P, L Level 4	SV: Drug related problems in hospitalised patients PO: Improved quality of health care	This paper reviews the literature related to drug related problems such as medication errors (prescribing, dispensing, administration) and adverse drug events. Papers Reviewed: 115 articles	Of the 115 articles found 31 were excluded. Of the remaining 84, 69 were original investigations and were 15 review articles. The paper looks at definitions, frequencies, costs, causes and methods for prevention of drug related problems.

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HCCC / 1999 / Australia [154]	P, CS Level 4	SV: Surgical procedures PO: Quality of surgical care	This report reviews 22 patient cases who experienced adverse events after cataract surgery at Dubbo Hospital.	It was found that 12 of the 19 patients who underwent surgery experienced significant permanent damage to their corneas and visual impairment. Based on the evidence available it was found that the solution 'eyestream' caused the adverse events. The commission made recommendations in relation to surgery at Dubbo Hospital.
HCCC / 1999 / Australia [155]	P, CS Level 4	SV: Adverse events during surgery PO: Quality of patient care	This report investigates incidents in the operating theatre at Canterbury Hospital. SS: 24 patients were identified who had a total of 28 procedures with most of the patients being exposed to the wrong solution	A number of problems were identified to the supply of a solution containing phenol during Endoscopic Retrograde Cholangio Pancreatography ERCP) procedures to operating theatres. The report provides an outline of the systems failures that occurred and recommendations to prevent further adverse events during surgery.
Grant et al / 1999 / Australia [156]	P, S Level 3-3 COSD 6	SV: Implementation of a Rapid Assessment Team (RAT) PO: Reduced waiting times	During a 3-month period a RAT was implemented along with a computerized database to record waiting times. Statistics recorded included median waiting time, length of stay and % of patients seen within the acceptable waiting time. SS: n = 5877 RR: N/A DS: Doctor and triage nurse	The RAT reduced waiting times, 59% of patients were seen within the accepted time limit compared with 39% from the year before.
Pullen et al /	P, S	SV: Falls in hospitals	This prospective study	Results showed no increased

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1999 / European [157]	Level 3-3 COSD 5	PO: Prevention of patient falls	recorded all falls (time, place, risk factors, circumstances) in a geriatric hospital over a one year period. SS: 536 falls in a total patient population of 1617 RR: N/A DS: internal database of geriatric ward	frequency of falls were found at any particular times, patients were not suffering falls while receiving therapy or being examined, but rather while they were alone in their rooms. 97.9% of falls happened unobserved by staff.
Straand / 1999 / Norway [158]	P, S Level 4 COSD 7	SV: General Practice PO: Improved quality of prescriptions for the elderly	This cross sectional, descriptive study aimed to describe the drug prescribing in general practice for elderly patients. Patients' age, sex, encounters, indications for prescriptions and the occurrence of some predefined inappropriate drug prescriptions were used. SS: patients = 16874, prescriptions = 16774 RR: Not Specified DS: General Practitioners	Prescriptions were issued during 2/3 of all contacts and 63% of patients were female. On average, 99.4 prescriptions were made per 100 GP-patient contacts with 72.1% of prescriptions were repeat. Prescriptions for cardiovascular disease diagnosis made up 19% with insomnia/anxiety/depression making up 14%. The study concluded that inappropriate drug prescriptions for the elderly are common in general practice.
Reid et al / 1999 / USA [159]	P, CS Level 4	SV: Technical competence PO: Misuse of peritoneal dialysis (PD) cyclers	This paper describes 2 case studies involving the misuse of equipment for patients undergoing peritoneal dialysis.	The paper outlines the desirable design and instruction characteristics of the PD cycler machine.
La Duke / 1999 / USA [160]	P, CS Level 4	SV: Ambulance driver competence PO: Mortality and morbidity	A single case study that describes issues around patient safety when ambulance drivers use Emergency Operating Privileges which enables the ambulance to use lights and sirens, to speed, go through traffic lights and disregard	This case study focuses on factors relating to an ambulance road accident where a nurse was fatally injured. It recommends improvements in the design of ambulances to include minimizing sharp corners and

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			traffic laws. The paper cites an average of 385 ambulance accidents occurred each year (1993 -1999) resulting in 640 injuries in the state of New York.	objects, securing objects inside the vehicle, providing driver training and providing safety restraints for staff while treating patients.
Anonymous / 1999 / UK [161]	P, CS Level 4	SV: Staff corruption PO: Patient safety from abuse and assault both adult and child	This editorial is a summary of a larger report, the Fallon Inquiry. It looks at a single case study to revise issues of patient abuse and assault by medical staff, physician incompetence, and the lack of security in large hospitals.	Highlighted is the need for correct security and hiring procedures in all health care settings.
Keyes et al / 1999 / USA [162]	P, CS Level 4	SV: Supervision of junior staff PO: Improvement in the quality of health care	This single case study examines the quality of supervision of junior staff and its relationship to quality of health care.	The case study describes an elderly patient in the care of a junior resident who becomes comatose overnight and dies 2 weeks later as a result extensive abdominal bleeding. The case outlines the need for appropriate supervision and levels of responsibility with junior medical residents.
Jelinek et al / 1999 / Australia [163]	P, S Level 3-3 COSD 5	SV: Staffing and functional changes in an Emergency Department (ED) PO: Increased quality of patient care	This before and after study used a range of variables to measure the changes in the ED. SS: 35,000 per annum attendance with a 45% admission rate. RR: N/A DS: 573 bed in a teaching hospital in Western Australia	After making staffing and functional changes great improvements were found clinically. Decreased waiting times, complaints rates, misdiagnosed fractures, time to thrombolysis in acute myocardial infarction and shortened length of stay for patients with acute conditions. Data also indicated improvements in teaching and research.

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Leape et al / 1999 / USA [164]	P, S Level 2 COSD 1	SV: Pharmacist participation on physician rounds PO: Prevention of medication errors	This randomised control trial used a before and after comparison including a control group to measure the effect of pharmacist participation on medical rounds in the Intensive Care Unit (ICU) on the rate of preventable adverse drug events (ADE's) caused by ordering errors. SS: 75 patients (intervention) and 50 patients (control) RR: N/A DS: All admissions to the study unit	With the pharmacist making rounds with the ICU team, remaining in the ICU for consultation in the morning and on call throughout the day the rate of preventable ordering ADE's decreased from 66% before intervention to 3.5% after the intervention, with the control group remaining unchanged. Thus The presence of the pharmacist substantially lowered ADE's caused by prescribing events.
Malpass et al / 1999 / Australia [165]	P, S Level 4 COSD 7	SV: Adverse drug events (ADE's) PO: Morbidity/ mortality	This retrospective medical record review/ incident monitoring study used the Australian Incident Monitoring System (AIMS) and the Quality in Australian Health Care Study (QAHCS) databases to review patient ADE's. SS: AIMS – 6250 reports, 20% were ADE's (1303) QAHCS – 2352 reports, 17% were ADE's (394) RR: N/A DS: AIMS database	Using data from two different sources this study supports the findings of previous studies of ADE's concluding that errors in the use of medication are a significant contributor to injury and illness.
Graber / 1999 / USA [166]	P, S Level 3-3 COSD 5	SV: Expanding the goals of peer review to detect both practitioner and system error PO: Prevention of medical errors	A peer review committee performed all peer reviews for a medical service. Four areas were discussed, quality of care, practitioner negligence, system flaws as a contributing factor and elimination of system flaws. SS: 40 physicians	Comparison of results showed that the intervention did not change the identification of practitioner negligence (pre 21% to post 25%) but that it significantly increased the detection of system errors (pre 11.5% and post 45.5%) and

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			RR: N/A DS: Veterans Administration Medical Service	the number of improvement projects per year (pre 1 and post 12).
Bates et al / 1999 / USA [167]	P, G Level 4	SV: Frequency, consequences and prevention of Adverse drug events (ADE's) PO: Improved quality of health care	Descriptive data was gathered to assess medication errors and recommend guidelines for prevention of ADE's. This paper uses also uses data from a previous study at the Brigham Women's' and Massachusetts General Hospital in Boston (SS: n= 530) to outline the importance of medical errors and makes recommendations for strategies to be used preventing ADE's. Citations: 12	It was found that 1 in 100 medication errors resulted in an ADE with dose errors being the most common (53%). Seven general prevention strategies are looked at including standard processes for prescribers to enter medication orders directly into computer systems, medication bar coding and better monitoring and reporting systems for ADE's.
Fitzpatrick / 1998 / USA [168]	U, S Level 2 COSD 3	SV: Strategies for chest pain PO: Safe, early discharge for chest pain	Randomized prospective study using 2 cohorts of patients presenting to the emergency department (ED). Two studies were run simultaneously. Study 1 to validate the use of RS algorithms and 2 to cost effectiveness and safety of early discharge. SS: Not specified RR: Not specified DS: all first time chest pain patients presenting to the hospital – 12/1 to 5/597	Early discharge was found to be cost effective and but further research is needed on the safety of the procedure. ED staff correctly predicted patient risk 77% of the time and only underestimated in 5% of cases. Twelve per cent were inappropriate admissions and 21% were discharged inappropriately.
Taylor-Adams et al / 1998 / UK [169]	P, CS Level 4	SV - High workload, failure to identify clinical risk, competency, inadequate leadership, poor morale, inadequate supervision of junior doctors, inadequate communication PO: Postpartum haemorrhage	A single case study that describes a structured and systematic approach to the investigation of adverse events. The case study focuses on a woman experiencing a major	This descriptive study is limited to examination of one case. This paper provides a useful checklist (using 28 questions) described as Performance Influencing Factors (PIFs). The

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			postpartum haemorrhage and factors surrounding her in receiving treatment. The framework involves the examination of active failures, triggering factors and latent failures.	PIF includes availability to case notes, language/cultural problems, agreement on interpretation of test results and effectiveness of communication between the clinical team.
Stearley et al / 1998 / USA [170]	P, S Level 3-1 COSD 7	SV: Intra-hospital transportation PO: Decreasing mortality and morbidity	Monitoring and intervention data were collected for instances of patient transportation between a hospital intensive care unit and its radiology suite. A specially trained team was put in place and results compared with national studies on complication rates associated with intra-hospital transportation of patients. SS: 237 instances RR: N/A DS: Reports of instances during transportation	Patients moved by the specially trained transport team had a 15.5% overall complication rate (10.2% minor, 2.5% moderate and 2.8% severe). The reported national complication rates are as high as 75%.
Grilli et al / 1998 / Italy [171]	P, L Level 3 – 3	SV: Medical specialization PO: Mortality at 3 and 5 years, optimal treatment, number and type of surgical interventions, pain	A systematic review of literature that attempts to identify medical specialization and specialisation of hospital and differences in outcomes for cancer patients. Papers Reviewed: 56	The results are inconclusive due to the methodological flaws in the literature.
Senior / 1998 / Australia [172]	P, S Level 3-3 COSD 5	SV: Initiation of medical care before review by the consultant PO: Earlier treatment of patients experiencing a myocardial infarct	This is retrospective study which describes the use of auditing medical records to determine delays from presentation to the emergency department until receiving thrombolyic therapy.	The 5 strategies including availability of an ECG machine, changing staff protocols is thought to have reduced these delays from greater than 60 minutes to a mean of 43 minutes.

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			SS: 129 RR: N/A DS: Hospital medical records	
Bullard / 1998 / Taiwan [173]	P, S Level 4 COSD 5	SV: Compliance with laws during inter-hospital transfer PO: increase in patient safety during inter-hospital transfers	A prospective, cross sectional, observational study conducted at the Linkou Chang Gung memorial hospital from other health care centers, SS: 1056 patients transferred in 1997 RR: N/A DS: Reports of complications during inter-hospital transfers	357 were critically ill, and only 160 had received pre-transfer stabilization. Whilst being transferred major omissions included failure to intubate, no intravenous line, inadequate iv lines, lack of instruction. Most transfers were unaccompanied by physicians or nurses with phone contact only 10% of the time.
Wilson et al / 1998 / UK [174]	P, S Level 3-2 COSD 3	SV: Medication errors in pediatric practice PO: Reduction in medication errors	A 2 year prospective cohort study was undertaken using an adverse incident reporting scheme, with the objective of assessing incidence and consequences of medication errors, highlight sources of recurrent error and institute changes in practice to prevent their recurrence. SS: 441 reported medication errors in the study period RR: N/A DS: 682 patients were admitted for 5315 inpatient days	The data showed that errors were 7 times more likely to occur in the intensive care setting. Doctors accounted for 72% of errors with errors doubling when new doctors joined the medication rounds. Most errors (68%) were detected prior to drug administration. During the 2nd year of the scheme the incidence of all reported errors fell, administration errors and serious errors fell but the prescription error rate remained constant. To conclude errors occurred commonly in this study but adverse consequences were rare.
Lattimer et al / 1998 / UK [175]	P, S Level 2 COSD 1	SV: Nurse telephone consultation PO: Patient safety	A block randomised controlled trial over 1 year to determine the safety and effectiveness of	Nurses managed 49.8% of the calls during the intervention without referral to a general

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			nurse telephone consultation in out of hours primary care by investigating adverse events and the management of calls. SS: 14492 calls (7308 control, 7184 intervention) RR: N/A DS: Internal database of outcomes	practitioner (GP). A 69% reduction in telephone advice from a GP and a 38% reduction in patient attendance, 23% reduction in home visits were observed during the intervention. Nurse telephone consultation provided a 50% reduction in GP workload with no increase in adverse events.
Dale et al / 1997 / USA [176]	P, S Level 4 COSD 6	SV: Wristband Errors PO: Increased accuracy and quality of patient care	This study compared wristband errors for 204 small hospitals with the objective of finding the accuracy rates of patient identification. SS: 451,436 RR: unspecified DS: Hospital wristbands	Of the 451,436 wristbands examined 25,800 had errors identified (error rate for identification 5.7%). Of the errors reported 64.6% had no wristband, 12.4% had missing information, 12.1% had multiple wristbands with inconsistent information, 6.7% had illegible writing and 3.5% had erroneous information.
O'Hara et al / 1997 / Australia [177]	P, S Level 3-3 COSD 5	SV: Competency PO: External injury to patients including misadventures, abnormal reactions to surgical and medical procedures, drugs and biological substances causing an adverse effect.	This cross-sectional study describes the prevalence of adverse events in using a state-wide database of all public and private acute-care hospitals. SS: 1248021 separations RR: N/A DS: 135 public and 112 private hospitals	Five percent (62,949) of hospital separations had an adverse event recorded on the medical record. Surgical complications were the most frequent adverse event (80%), adverse drug effects (19.3%) and misadventures (1.7%). The most common misadventure was an accidental cut, puncture, perforation, haemorrhage (76%). This study provides comprehensive large scale prevalence rates. Caution

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				needs to be exercised on the variations between public and private hospitals as the seriousness of the adverse event is not measured and patients from a private hospital may transfer to a public hospital for care.
No author / 1997 / USA [178]	P, CS Level 4	SV: Nursing competence PO: death / suicide	This single case study describes the incident of a psychiatrically ill patient transferred from a psychiatric unit to an emergency department with heart problems. After staying in the emergency room for 48 hours, the patient left the area and was found soon after leaving the hospital in a dumpster. He had hanged himself.	The patient's wife sued the hospital for failing to provide adequate care. The nurse was blamed for not acting on the patient leaving the hospital and failing to call security.
Brown et al / 1997 / USA [179]	P, CS Level 4	SV: Patient controlled analgesia pumps PO: Patient safety and error reduction	This case report outlines 9 case studies in which patient controlled analgesia pumps were responsible for an adverse patient event. Three main areas are looked at namely, shipping insert (packaging), drug concentration mis-programming and device packaging.	For example one 42 year old women was found markedly sedated and with respiratory depression. It was found that the pump had been mis-programmed for a morphine concentration of 1.0 mg/ml instead of 5.0mg/ml, in which the patient received a 10-fold overdose.
Anonymous / 1997 / USA [180]	P, CS, Level 4	SV: Nurse knowledge of medication PO: Prevention of adverse drug reactions	Discussed in this paper is a single case study in which a drug was administered, the patient was not monitored correctly for an adverse effect which lead to the patient dying 70 days later.	The result of the case was ruled as 70% nurse fault and 30% physician fault. The courts decision was based on the general principle that it is a nurse's responsibility in caring for a patient to appreciate the

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				potential for an adverse drug reaction and to perceive when one is taking place.
Anonymous / 1997 / USA [181]	P, CS, Level 4	SV: Staff responsibility for patient escape PO: Prevention of patient self harm	Discussed in this paper is a single case study in which a patient was known to be an elopement and suicide risk, the patient escaped from the unit and was hit by a truck which killed him.	The court ruled that when a psychiatric patient has been assessed as potentially suicidal, suicide and elopement precautions must be undertaken at once (continuously monitored, or transferred to a more secure setting).
Anonymous / 1997 / USA [182]	P, CS, Level 4	SV: Standards for medical surgical nurses caring for a psych patient PO: Accident and injury prevention	Discussed in this paper is a single case study in which a psychiatrically ill patient was put into acute care hospital. He became paranoid and delusional and jumped out a 3 storey window suffering minor injuries.	The nurses were found to be not negligent as they were acute medical care nurses and had no training in psychiatric nursing.
Anonymous / 1996 / USA	P, CS, Level 4	SV: Staff conduct and reliability PO: prevention of sexual assault	This single case study outlines the incidence of sexual assault in a small 131 bed hospital.	Victims of the assaults settled out of court. Although all patients reported the assaults at the time they occurred their claims were not taken seriously. So identified is the need to listen to patients and run employee background checks.
Coroner's Office Victoria / 1996 / Australia [183]	P, CS Level 4	SV: Staffing level at night PO: Reduce the risk of death from fire	This single case study outlines the coroners report describes findings of the inquest into the deaths of 9 people with intellectual disabilities who lived in a residential care facility. The fire was thought to have started with 1 resident who, having a	A range of issues included the need for the state government to have up-graded the fire system in the facility, the staffing levels of 2 staff on night shift were identified as being deficient to adequately deal with a fire in a facility

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			fascination for lighters, set fire to his bed without understanding the consequences.	known to be high risk of fire, training of staff on evacuation and fire safety, identification and early management of the residents with fire-lighting behaviours.
Wright / 1996 / USA [184]	P, CS Level 4	SV: Illiteracy PO: Adverse events	This paper describes two case studies. One where a patient ignites his bed while on oxygen smoking a cigarette. He could not read the “no smoking” sign. The second case study provides an example of a casual cleaner not understanding the red waste bag labeled “radioactive waste”.	The paper concludes that the introduction of signs, audio and video instructions are an important aspect of risk management for staff and patients with low literacy levels.
Beckmann et al / 1996 / Australia [185]	P, S Level 3-2 COSD 6	SV: Australian Incident Monitoring Study in Intensive Care (AIMS-ICU) PO: Patient safety and quality of care	The AIMS-ICU is a prospective cohort study set up to develop, introduce and evaluate an anonymous voluntary incident reporting system for intensive care. SS: 536 reports, which identified 610 incidents RR; N/A DS: 7 ICU’s	Incident breakdown included airway (20%), procedures (23%), patient environment (21%), and ICU management (9%). Incidents were most frequently detected by rechecking the patient or the equipment or by prior experience. Incident monitoring was found to be a successful technique for improving patient safety in the ICU.
Short et al / 1996 / Hong Kong [186]	P, S Level 3-2 COSD 5	SV: Incident reporting in anesthesia PO: Improved quality of care	The role of an anesthetic reporting incident program in improving anesthetic safety was studied using a prospective reporting procedure. SS: incidents reported at 3 hospitals was 1000 over a 4	Results showed that 69% of incidents were considered to be preventable with human error contributing to 76% of all incidents, and violation of practice contributing to 30%. The program was effective in its ability to detect latent errors

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			year period RR: N/A DS: Incident reporting program in a Hong Kong hospital	in the anesthesia system, and when these were corrected it was found that incidents did not recur.
Spittal et al /1995 / UK [187]	P, S Level 4 COSD 7	SV: Critical incidents attributable to anesthesia PO: Reduction in medical errors associated with anesthesia	The study is a prospective analysis of adverse anesthetic events and their consequences in a general hospital with 300 surgical beds over one year. SS: 338 critical incidents RR: N/A DS: record of adverse events by anesthesiologists	Critical incidents were categorized into airway (29%) circulation (28%) patient (5%) equipment (31%) and pharmacology (7%). Incident frequency was 6.68% or 1 in 15. Morbidity was 0.53%. The study strongly recommends the monitoring of standards and procedures in anesthetics.
Leape et al / 1995 / USA [188]	P, S Level 3-2 COSD 3	SV: System analysis of adverse drug events (ADE's) PO: Prevention of patient ADE's	This study used a system analysis of events from a prospective cohort study to identify and evaluate the systems failures that underlie errors causing ADE's and potential ADE's. SS: 334 errors RR: N/A DS: All admissions to 11 medical and surgical units in 2 tertiary hospitals over a 6 month period	Results showed 334 errors that were detected as the causes of 264 preventable ADE's. Sixteen major systems failures were identified as the underlying causes of the errors. Most common errors were, dissemination of drug knowledge (29%), inadequate patient information (18%) with seven systems failures accounting for 78% of the errors.
Tammelleo / 1995 / USA [189]	P, CS Level 4	SV: Negligence on admission for nurses PO: Prevention of patient injuries and accidents	This single case study provides an example of a patient being admitted to hospital and then falling out of bed due to twisting. He sued the hospital for failure to exercise reasonable and ordinary care. The hospital denied the allegations saying that he had not filed an experts affidavit in	The court ruled that the patient was required to attach the experts affidavit to his claim.

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			support of his claim.	
Tammelleo / 1995 / USA [190]	P, CS Level 4	SV: Supervision of nurse aides PO: Improved quality of care	This single case study describes a situation in which a nurse manager failed to report misconduct of a nurses' aid.	The court ruled that the nurse manager was required to report the behaviour and the nurse manager was dismissed from her position.
Tammelleo / 1995 / USA [190]	P, CS Level 4	SV: Sub-standard quality of care PO: Improved quality of health care	This single case study describes a situation in which a man was allegedly given sub-standard medical care, which led to the symptoms becoming worse. He had only one witness to support his allegations.	The witness was unable to testify.
Tammelleo / 1995 / USA [190]	P, CS Level 4	SV: Timeliness in nurses' notification of patients symptoms PO: Improved quality of health care	This single case study describes a situation in which a case of abdominal pain was not recognized as being caused by pregnancy.	The patient brought a wrongful death claim against the physician. The court found the physician negligent.
Evans et al / 1994 / USA [191]	P, S Level 3-3 COSD 5	SV: Hospitalised patients PO: Preventing adverse drug events	Prospective intervention study, which aimed to look at the effects of a computerised surveillance system in order to identify methods to reduce the number of type b (allergic or idiosyncratic reactions) ADE's in, hospitalised patients. SS: 79 719 hospitalised patients during a 44 month period. RR; N/A DS: Computerised reporting system of ADE's	Results showed that in the first study period 56 ADE's were identified during 120,213 patient days. In the second study period 8 occurred in 113,237 patient days, 18 during 107,868 patient days. Thus the study concluded that prospective surveillance of computer based medical records for known drug allergies and appropriate drug administration rates can reduce the number of type b ADE's.
Barry et al / 1994 / UK [192]	P, S Level 4 COSD 7	SV: Adverse events (AE's) during inter-hospital transfer of the critically ill PO: Improved quality of care	This observational study looked at children transferred over a six month period to determine what complications children	Results showed that 75% of the children had adverse clinical events during transfer. In 13 cases the event was life

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4.5.2 Competency, supervision and staff mix – Health Literature Summary Tables

Author / Year / Country	Type of document*	Staffing variables (SV) examined and patient outcomes (PO)	Study design / Summary description**	Comments / Findings
			have during inter-hospital transfer for intensive care and how often these complications occur. SS: 56 children RR: N/A DS: AE reports	threatening. Children who subsequently died were more likely to have had complicated transfers than who survived.
Cohen et al / 1994 / USA [193]	P, CS Level 4	SV: Dangerous abbreviations PO: Prevention of medication errors	Discussed in this paper are two case studies describing potential adverse events relating to drug administration.	A nurse misread 'IVR' to be 'IVP' and administered a drug incorrectly. The abbreviation 'IVR' was not usually used at this hospital as it was thought to be too confusing. The second case study discusses a situation in which a first year medical resident ordered an injection for a child that was too potent. The pharmacist thought it was unusual and questioned the doctor and the adverse event was averted.
Leape et al / 1993 / USA [194]	P, S Level 3-3 COSD 7	SV: Technical competence PO: Adverse events	A medical record review of 1133 patients with adverse events was examined by a physician to determine if these were avoidable and ranked them into categories of seriousness, and type of mistake in performance or thought. SS: 1133 RR; N/A DS: Medical records	The four most common types of medical error were error in diagnosis, technical error, drug error and inappropriate care. Over 75% were classified as preventable. The most common errors were drug related (19.6%), wound infections (13.6%), technical complication relating to surgery (12.9%).
Singleton et al / 1993 / Australia [195]	P, S Level 4 COSD 7	SV: Physical injuries and environmental safety in anesthesia PO: Reduced incidence of injury	This case report study uses the Australian Incident Monitoring Study (AIMS) to look at injuries to both staff and patients.	Of the first 2000 incidents reported to AIMS, 56 involved physical hazards or injuries to patients and staff. Theses

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			SS: 2000 RR; N/A DS: AIMS database	were categorised as oral trauma (17), operating table (10), dermal or epithelial injury (6), electrical hazards (6), patient transport (5), monitoring hazards (4), needlestick (4) and miscellaneous (4).
Van Der Walt et al / 1993 / Australia [196]	P, S Level 4 COSD 7	SV: Recovery room incidents PO: Prevention of accidents and injuries	This paper uses the first 2000 incidents reported on the Australian Incident Monitoring Study (AIMS). SS: 2000 RR; N/A DS: AIMS database	Of the first 2000 incidents, 6% occurred in the recovery room, over 2/3 involved respiratory system, 19% were cardiovascular, 3% involved the nervous system 9% were miscellaneous in nature.
Anonymous / 1993 / USA [197]	P, CS Level 4	SV: Nursing competence PO: Abduction of a baby	This single case study describes an incident of a nurse recognizing a woman's repeated attempts to hold a baby in a maternity ward.	The hospital had a clear policy on name badges for staff and this was communicated in a hospital protocol for patients and visitors. This alerted a visitor to whom the alleged abductor requested wanting to see the baby. A nurse recognized inappropriate behaviour and alerted security who then intervened.
Barboni et al / 1993 / Italy [198]	P, S Level 3-3 COSD 5	SV: Effects of a quality improvement project in emergency treatment of bronchospastic attacks (BA) in the Emergency department (ED) PO: Quality of patient care	This study was conducted in 3 phases. Phase 1 was a retrospective analysis of 20 cases. Phase 2 researchers assessed the treatment provided to patients experiencing BA and measured patient length of stay and outcomes such as a clinical condition on discharge. Phase 3 assessed the same	Results showed that after the implementation of the guidelines there was a 56% improvement in physician behaviour. An improvement was also shown in the outcome of patients treated for BA in the ED.

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			parameters as phase 2 but after the guidelines were implemented SS: Phase 1 – 22 cases, Phase 2 – 33 forms, Phase 3 – 59 forms RR: N/A DS: ED, General Hospital of Italy	
Bates et al / 1993 / USA [199]	P, S Level 3 COSD 3	SV: Incidence and preventability of adverse drug events (ADE's) PO: decrease in ADE's	Prospective cohort study in an urban tertiary care hospital, which evaluated the incidence and preventability of adverse events and determined the yield of several strategies for identifying them. SS: 2976 patients across seven units over a 37 day period RR: N/A DS: 7 units in an urban tertiary care hospital	Results showed that 73 ADE's were found, 27 were ADE's, 34 potential ADE's and 12 problem orders. Physicians were responsible for 72% of the incidents with the remainder divided evenly between nursing, pharmacy, and clerical. Of the 27 ADE's, 5 were life threatening, 9 were serious, 13 were serious. 56% were judged as preventable.
McKee et al /1992 / UK [200]	P, L Level 4	SV: Junior Medical Doctors PO: Increased quality of patient care	The study uses a literature review and interviews with junior doctors to look at effect of the current system of hospital medical staffing (junior doctors) on quality of care. SS: 62 interviews were conducted but number of articles reviewed was not stated RR: Not specified DS: Junior doctors from four national health service hospitals in South East London.	The paper suggests that the current use of junior medical doctors decreases the quality of patient care through mistakes associated with inadequate supervision and tiredness. It concludes that the system needs to change in order to provide supportive working environments for junior doctors.
Bulau / 1992 / USA [201]	P, CS Level 4	SV: Failure to treat a technology dependent infant in a home healthcare setting PO: Accident prevention	This single case study presents the history of a situation that was mismanaged and resulted	During the discovery phase of the lawsuit, several significant issues were identified

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			in a very large payout for the patient who was severely impaired neurologically as a result of poor crisis intervention. It highlights individual responsibility in providing safe high care quality in the home.	regarding the standard of care for providing skilled nursing services, staff qualifications, and nursing staff supervision. Standard of care, lack of case management, lack of a plan of care, lack of an admission nursing assessment, lack of physician orders, unsafe client environment and lack of emergency care were all found to contribute to the mismanagement of the case.

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Fowler / 2002 / UK [202]	P, S Level 4 COSD 7	Transport SV: Workplace control measures SC: Reduce risk	This study used a mail-out questionnaire to companies from each identified industry. The main objectives being to gain information about workplace transport safety, including the number of vehicles on site, safe work systems and use of protective equipment. SS: 2000 RR: Not specified DS: questionnaire sent to companies	All companies reported having implemented some measures to control workplace safety with 52% already having conducted a workplace risk assessment.
Anonymous / 2002 / France [203]	P, CS Level 4	Aviation SV: Causes of the 2000 Concorde crash SC: Accident and death prevention	This single case study looks at the causes of the 2000 Concorde crash at Charles de Gaulle airport that killed 109 passengers and 4 people on the ground.	The report states that a metal strip that fell off an earlier plane burst the Concorde's tyres. The explosion sent rubber debris toward the fuel tank and started a fuel leak and fire that caused the plane to crash. All Concorde aircraft have since been fitted with fuel tank liners of bullet proof Kevlar, a reinforced undercarriage and stronger tyres.
Anonymous / 2001 / Brazil [204]	P, CS Level 4	Mining – Offshore SV: Oil industry accidents SC: Accident and injury prevention/ Environmental protection	The single case study looks at the sinking of the world's largest oil platform (40 storeys high, costing $350 million). It also describes other accidents in the industry since 1980.	Two people were killed in the incident with another 9 missing presumed dead. The accident is the worst since 1984 were 36 people were killed in an explosion. There were concerns about the use of out-sourcing to inexperienced workers at the cost of saving money.

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Struttman et al / 2001 / USA [205]	P, CS Level 4	Logging SV: Fatal injuries in Logging SC: Prevention of fatal injuries	This case report looks at 7 case studies, which outline the fatal injuries caused by logs rolling off trucks. The deaths were identifies by the Kentucky Fatality Assessment and Control Evaluation Project.	From 1994 to 1998, 7 incidents were reported in which a worker was killed by a log rolling off a truck, accounting for 15% of deaths related to logging. Strategies identified to prevent such injuries occurring include limiting load heights on trucks, installing unloading cages at sawmills and prohibiting overloaded trucks on public roadways.
Swift / 2001 / USA [114]	P, CS Level 4	Manufacturing SV: Safety management SC: Prevention of lost time injury	This single case study looks at John Deere and his companies' commitment to OH&S practices. Inherent in his strategies is the management of preventable accidents. He established his OH&S program in 1975.	Since 1977 John Deere Domestic Facilities have received more than 440 National Safety Council Awards, 32 in 2000. Altogether it has reduced its lost time injury by 93%, 18% in 2001. For example, in the Davenport works facility there were 8.2 million hours of production time without a lost time injury. The program has the management of safety as its focus starting with leadership, hazard risk assessment, through to health and safety programs and managing change. The company goal is to now make his employees safe at home as well as on the job.
Menser / 2001 / Australia [206]	P, CS Level 4	Mining SV: Managing safety in mining SC: Prevention of lost time injury	This single case study looks at the CSIRO's mining division. The study describes several projects undertaken for improved safety in the	One of these projects is the development of the 3D virtual mine as a predictive tool, it allows complex geological, geophysical and geotechnical

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			workplace.	data to be displayed in 3D. This information can then be transferred quickly to decision-makers. The research team is currently working on the integration of time as the 4th dimension.
Bell et al / 2000 / USA [207]	P, S Level 3-3 COSD 7	Military: Army SV: Risk taking behaviours SC: Prevention of motor vehicle injuries	This descriptive study tracked personnel who had completed the risk appraisals for 6 years. They evaluated speeding, seat belt use, drinking patterns and demographics. SS: 99,981 RR: N/A DS: Army personnel who completed Health Risk Appraisal surveys in 1992	A total of 429 soldiers were hospitalized for motor vehicle injury. Associated factors included heavy drinking, drinking and driving, speeding, low seat belt use, younger age, minority race/ethnicity, and enlisted rank. Neither smoking nor gender was associated. The study suggests that programs targeting these behaviors that meet the needs of young and minority soldiers are needed.
Belke / 2000 / USA [208]	P, S Level 4 COSD 7	Chemical Processing SV: Accident risk from hazardous chemicals and facilities SC: Prevention of chemical accidents	The study draws together 15,000 facility reports into a new regulatory program called the Risk Management Program (RMP). The study aims to increase information chemical hazards and impact public facility risk. SS: 14828 facilities containing 20210 chemical processes RR: N/A DS: RMP info database	Information includes the facilities' accident history, accident prevention programs in place and the potential consequences of hypothetical chemical release. Accident rates for each type of chemical are outlined.
Bailey et al / 2000 / USA [209]	P, S Level 3-2 COSD 5	Aviation SV: Performance feedback for air traffic controllers SC: Improving performance	The study used a computer playback of performance under simulator conditions as a training tool in building effective	It was found that observing a computer playback enhances perspective of how their performance is affected and

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			air traffic control teams. SS: 240 adults participated (53% female). RR: Not specified DS: paid participants	affects others. This perspective enhanced teamwork and increased aircraft density that reached destination within the time limit.
Anonymous / 2000 / Australia [210]	P, CS Level 4	Transport - Railways SV: System failures and human factors in the Glenrock train crash SC: Prevention of accidents	This single case study examines the events and causes of the train collision at Glenrock, Sydney. It also looks at risk management procedures and safety improvements to prevent further accidents.	Causes and factors included; signal failure, limited visibility, delay of the other train, human judgment of the automatic signals and communications between drivers and the signal box.
Laitinen et al / 1999 / Finland [211]	P, S Level 4 COSD 7	Construction SV: Accidents on building/construction sites SC: Decreasing accident rates	Using observational methods this study monitored construction sites and compared results with accident figures form the same sites. Observed safety aspects included working habits, scaffolding, ladders, machines and equipment, protection against falling, lighting and electrical and order and tidiness. SS: 164 accidents, 1204 man years RR: N/A DS: 305 construction sites	A significant correlation was found between the observed safety index and the accident rate of the site groups. The sites with the lowest observed safety index had an average of a 3 times higher accident rate than the sites with the highest safety index.
Harrell / 1999 / USA [212]	P, S Level 4 COSD 5	Swimming pool lifeguards SV: competency of life guards SC: minimize adverse events of children in swimming pools	This observational study examines the scanning behaviour of lifeguards at public swimming pools SS: 4 lifeguards RR: N/A DS: three public swimming pools.	The study concludes that as the child-adult ratio in the pool increases the lifeguard scans are less frequent. The number of scans increased when the child-adult ratio decreased. When the total number of children increased lifeguard vigilance decreased primarily

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				due to rule violations of child and the issuing of reprimands.
Baron et al / 1998 / USA [213]	P, CS Level 4	Construction SV: Roadway 'flagger' safety SC: Accident and injury prevention	The 3 case studies describe injuries incurred by flaggers (fatal and non-fatal) by vehicles both on the work site and public vehicles. The paper suggests reasons for accidents such as noisy working environment e.g. becoming accustomed to noisy machinery.	The incidents are described as largely preventable with a more defensive flagger training program and more specific safety equipment such as the use of rear view video cameras on large trucks.
Anonymous / 1998 / Australia [214]	P, CS Level 4	Utilities/Electricity SV: Workplace safety SC: Reduction of lost time injuries and general accident prevention	This single case study describes how Northpower has involved all levels of staff in making safety a part of everyday work including their risk management strategies. Northpower employs 1200 staff.	The paper looks at the success of Northpower safety and risk management program, finding an 85% reduction in time lost injuries through implementation of strategies such as daily work site risk and hazard control assessment and monthly depot work practices meetings.
Wuerz et al / 1997 / USA [215]	P, S Level 3 - 2 COSD 2	Aviation SV: Instrument proficiency in helicopter Emergency Medical Situations SC: Decreasing accidents in EMS situations	Controlled experimental study using a full motion-visual helicopter simulator. Instrument proficient pilots (13) were tested against non-instrument proficient pilots (15). The helicopter crash rate is 3.1 crashes per 100,000. SS: 28 pilots RR: N/A DS: EMS pilots with commercial license (does not require a current instrument license) and previous simulator experience	Instrument proficient pilots managed more safely in instrument meteorologic conditions (IMC) or bad weather. The instrument proficient pilots (15%) lost control less often than the non-proficient pilots (67%).
Isaac / 1997 /	P, CS	Construction	This case study examines the	The analysis uses the models

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New Zealand [216]	Level 4	SV: Competency with design SC: Stability of construction	Cave Creek incident where 14 people died as a result of a viewing platform collapse.	of Reason to illustrate the active and latent failures associated with this disaster. Failures included poor construction of the platform, inadequate skill and support, concerns of the platform not investigated, lack of staff, and pressure of work for employees.
Sanchez et al / 1997 / Spain [217]	P, G Level 4	Mining SV: Development of emergency plans (EP) SC: Accident injury and prevention	This paper describes the first approach to developing a complete EP. It looks at the laws and regulations concerning the plan, risk analysis of the operations, human and material resources available and emergency management. Citations: 5	The EP was developed with specific characteristics for an underground coal mine and to those situations considered in high-risk analysis, for example a fire in a belt conveyor. However the EP is flexible and can be modified to be suitable for other coalmines.
Jones et al 1996 / USA [218]	P, S Level 4 COSD 7	Aviation SV: Situation awareness (SA) errors SC: Decrease in SA errors	This study describes SA errors in a flight environment using the Aviation System Reporting System (ASRS) database. Errors were classified into 3 categories. SS: 143 incidents (111 – flight crew, 32 air traffic controllers) RR: N/A DS: ASRS database	The results showed that Category 1 – failure to perceive the information (76.3)% was the largest area, then Category 2 – failure to comprehend the situation (20.3%) and Category 3 – failure to project the situation into the future (3.4%). Other problems included vigilance, automation problems and poor mental models.

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Cavenagh / 1996 / Australia [219]	P, CS Level 4	Mining SV: Safety plans implemented by BHP SC: Prevention of deaths	This single case study outlines a mining explosion at BHP's Moura Coal Mine (underground), which killed 11 people. After a second explosion a decision was made to seal the mine and the bodies were never recovered.	A six-point plan is being implemented following the accident. This plan involves; developing a risk management plan including an emergency response plan, developing a full time high level audit team, technical training for personnel engaged in hazardous activites, raising the profile of safety, changing the culture of BHP to value safety and funding additional research in safety.
Pettit et al / 1996 / USA [220]	P, S Level 4 COSD 7	All Industries/Confined Spaces SV: Deaths in confined spaces SC: Prevention of deaths	A cross sectional study which uses the National Traumatic Occupational Facilities 1980 to 1989 (NTOF) database to identify the number of deaths across industries that occur in confined spaces. SS: a. 585 fatal accidents claiming 670 victims. b. 572 trench cave-ins. RR: N/A DS: NTOF database	Fatalities were highest in manufacturing (152), agriculture (128), construction (90), transportation (77) and mining/oil/gas (63). Other data identify atmospheric conditions and loose materials. Trench cave ins caused a further 606 deaths with the construction injury accounting for 77%. The study recommends specific guidelines and site entry programs (eg entry and rescue procedures), to reduce the number of deaths.
Ashton / 1994 / Canada [221]	P, CS Level 4	Manufacturing SV: Enhancing safety culture SC: Promoting OH&S	This report uses 2 case studies to outline the effects human factors and safety attitudes have on OH&S.	For example when Dupont restructured in the 1980's productivity, profits and accident rates (1984, 0 lost time accidents, 1986, 5, 1998 8) increased. Dupont responded by implementing OH&S strategies and by 1991

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				lost time accidents were back down to 0.
Gully et al / 1995 / USA [222]	P, S Level 3-2 COSD 5	Traffic accidents SV: Accident type and frequency SC: Decreasing the number of preventable accidents	This time series analysis tested 47 police officers over a 4 year period using a driver performance measure (DPM). The purpose of the study was to investigate the relationship between driver behavior and accident involvement. SS: 47 police officers RR: Not specified DS: moderate sized police department	Results indicated that scores on the DPM predicted involvement in preventable accidents but not unpreventable accidents.
Shappell / 1995 / USA [223]	P, S Level 4 COSD 7	Military/ Naval SV: Flight deck injuries SC: Decreasing flight deck injuries	This study provides a review of injuries sustained by staff working on naval flight decks between Jan 1977 and Dec 1991. SS: 918 flight deck injuries were reported. RR: N/A DS: US Naval Safety Center Database	Injuries included 43 fatalities, 5 permanent total disabilities, 42 permanent partial disabilities and 828 major disabilities. Injuries included fractures, traumatic amputations, lacerations, dislocations, contusions, concussions, burns, crushing injuries, sprains and strains with 90% being attributable to human error.
Ribak et al / 1995 / Israel [224]	P, S Level 4 COSD 7	Aviation SV: Accidents among airport ground personnel SC: Accident prevention	This study examines injury-producing accidents among ground personnel. All accidents were reported from 1998 to 1992. SS: 2000 ground workers if the injury resulted in more than 3 days or more of absence. RR: N/A DS: Accident reports	The most common accidents were found to be slip, trips and falls (40.3%), lifting and carrying accidents (20,4%) and machinery accidents (18.7%). Transport accidents (12.8%) and chemical exposures (7.5%) were less common.

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Rundmo / 1994 / Norway [225]	P, S Level 4 COSD 7	Mining/Offshore Petroleum SV: Organizational factors and safety measures SC: Attitudes towards safety culture	A self-administered survey among offshore petroleum personnel was conducted. The survey used 5 companies, 8 installations. The study objectives were to determine the association between organisational factors and safety and contingency measures. SS: 915 RR: 92% DS: Employees of an offshore petroleum mine	Results showed that employee perception of greater management commitment, social support, and subjective evaluations of priorities of safety versus production goals were all important predictor variables for employee satisfaction with safety and contingency measures.
Jackson / 1994 / Australia [226]	P, CS Level 4	Manufacturing SV: Good design of manufacturing equipment SC: Accident prevention	This single case study looks at the design of equipment and its relationship to safety. It is stated that as people are primarily unreliable it is good design that will help to prevent accidents.	As part of new standards in safety the aims will be to eliminate hazards very early in the design process. The modern approach to safety is where both the designer and the employer will share the responsibility for safety whereas at the moment the primary responsibility rests with the employer.
Young / 1992 / USA [227]	P, G Level 4	Media SV: Safety Management SC: Accident prevention	This study describes the process of putting into place new safety procedures. 8 x 2 hour sessions of training were given as well as an 11 member steering committee set up. 100 accidents since start up were profiled.	The accident rate of the mill dropped from 9.09 reportable events in 1991 to 1.99 to in 1992. The report outlines the importance of safety procedures that suit the working environment.

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4.5.4 Recommendations

Staff performance is not only dependent on them having the knowledge and skills to do their job, their performance is also influenced by a number of other factors. These include the environment in which they work, their mental and physical health, their relationship with the people around them and their ability to communicate as well as a range of system related issues. The work done in the non-health industries provides some potentially useful research considerations. The use of technological aides to reduce errors is currently in use in the area of drug prescribing. This could be expanded to the area of clinical decision-making.

Of the health related papers the following strategies for reducing patient adverse events may warrant further consideration. These are:

1. The use of autopsy reports to review the detection and accuracy of diagnosis.
2. The effectiveness of multidisciplinary case meetings and review of test results to improve reliability and treatment diagnosis.
3. The implementation of specialist transport teams for inter-hospital transfers of acutely ill patients.
4. The implementation of organisational structures and resources to improve the speed between the patient's diagnosis and receiving their treatment.

5. RECOMMENDATIONS

Staff physical and mental health

The impact of long hours, shift work and stress are known to affect mood, mental health and emotional wellbeing. This also has an impact on clinical decision-making, alertness, vigilance and effective communication.

There are clear gaps in the literature given that few papers in this review focus on staff health and patient safety. There needs to be further research that provides a better understanding of the link between staff physical and mental health and patient safety particularly in the following areas:

1. Evidence-based guidelines for employing staff that provides a basis for assessing their fitness for practice
2. Understanding of the factors that affect staff mental health and effective clinical decision-making
3. Interventions that improve staff health which result in an increased capacity for improved performance particularly vigilance, resilience, alertness and effective communication.

Communication and feedback

The literature identified that communication breakdown is, in many cases, a critical factor in disasters, preventable accidents and adverse events. The literature indicates that high staff turn-over, inexperienced staff and personal factors such as low self-esteem, irritability from tiredness and interpersonal conflict are contributing factors to ineffective and inappropriate communication.

There still remain gaps in the literature particularly focusing on interventions that promote improved communication and the reduction of adverse events as the primary end-point. Further research is needed using more robust methods which may provide promising strategies to improve incident reporting, the reduction of adverse events and the improvement of staff morale. These include:

1. Automated or semi-automated alerting systems for staff to identify potential risk associated with patient care
2. Organisational structures that improve social relationships among colleagues providing direct patient care
3. Feedback on performance and safety issues that increases teamwork and performance.

Hours of work, shift work, number of staff and fatigue

The papers in this review that focus on nurse staffing levels enhance our understanding of nurse to patient ratios and its effect on patient outcomes. Given the large amount of resources that are required to provide patient care, the development of cost effective, efficient and safe models of care is of priority. The literature in both the health and non-health areas indicate that too few and too

many of the same type of staff can lead to poor patient outcomes. Increasing this area of research to include staffing models that are collaborative from a range of professions, use a rostering system that is conducive to continuity of care yet enables adequate rest and sleep for clinicians can make a significant contribution to safe staffing and the promotion of patient safety.

There are some other promising areas for further research which are:

1. Condensing the working week to enable longer shifts with more time away from work
2. Examining the impact of doctor to patient and allied health worker to patient ratios and the impact on adverse events
3. The development of a model that promotes continuity of care rather than continuity of carer through the use of use of feedback and programming (such as the use of guidelines, policies and procedures)
4. The development of strategies that enable the inexperienced practitioner to work safely in the delivery of patient care such as specific education on mentoring, promotion of feedback and the use of checklists or protocols to clearly define roles and responsibilities
5. The promotion of effective messages on managing shiftwork, personal life and sleep.

Competency, supervision and staff needs

Staff performance is not only dependent on them having the knowledge and skills to do their job, their performance is also influenced by a number of other factors. These include the environment in which they work, their mental and physical health, their relationship with the people around them and their ability to communicate as well as a range of system related issues. The work done in the non-health industries provides some potentially useful research considerations. The use of technological aides to reduce errors is currently in use in the area of drug prescribing. This could be expanded to the area of clinical decision-making.

Of the health related papers the following strategies for reducing patient adverse events may warrant further consideration. These are:

1. The use of autopsy reports to review the detection and accuracy of diagnosis.
2. The effectiveness of multidisciplinary case meetings and review of test results to improve reliability and treatment diagnosis.
3. The implementation of specialist transport teams for inter-hospital transfers of acutely ill patients.
4. The implementation of organisational structures and resources to improve the speed between the patient’s diagnosis and receiving their treatment.

6. APPENDICES

6.1 Websites Searched

Government Websites

Australian Government
http://www.fed.gov.au/KSP/

Commonwealth Department of Health and Ageing
http://www.health.gov.au/

NSW Department of Health
http://www.health.nsw.gov.au/

QLD Department of Health
http://www.health.qld.gov.au/

NT Department of Health & Community Services
http://www.nt.gov.au/health/

SA Department of Human Services
http://www.health.sa.gov.au/

VIC Department of Human Services
http://www.dhs.vic.gov.au/

Health Department of WA
http://www.health.wa.gov.au/

TAS Department of Health and Human Services
http://www.dhhs.tas.gov.au/

ACT HealthFirst
http://www.healthfirst.net.au/entry.ser

Australian Health Websites

Australian Centre for Evidence Based Clinical Practice
http://www.acebcp.org.au/

Australian College of Health Service Executives
http://www.achse.org.au/

Australian Council for Quality and Safety in Healthcare
http://www.safetyandquality.org/

Australian Council of Healthcare Standards
http://www.achs.org.au/

Australian Healthcare Association
http://www.aushealthcare.com.au/

Australian Health Policy Institute (University of Sydney)
http://www.usyd.edu.au/chs/ahpi/

Australian Institute of Health & Welfare
http://www.aihw.gov.au/

Australian Institute of Primary Care (La Trobe University)
http://www.latrobe.edu.au/aipc/

Australian Medical Council
http://www.amc.org.au/

Australian Medical Association
http://www.ama.com.au/

Australian Medical Workforce Advisory
http://amwac.health.nsw.gov.au/

Australian Patient Safety Foundation
http://www.apsf.net.au/

Australian Safety and Efficacy Register of New Interventional Procedures - Surgical
http://www.racs.edu.au/open/asernip-s.htm

Centre for Health Economics Research & Evaluation (University of Sydney)
http://www.chere.usyd.edu.au/

Centre for Health Program Evaluation
http://chpe.buseco.monash.edu.au/

Clinical Information Access Program (CIAP)
http://www.ciap.health.nsw.gov.au/

Clinical Risk Management (VIC Health)
http://clinicalrisk.health.vic.gov.au/

Clinicians Health Channel
http://www.clinicians.vic.gov.au/

Health and Community Services Complaints Commission (NT)
http://www.nt.gov.au/omb_hcscc/HCSCC/welcomehh.htm

Health Leaders Network
http://www.hln.com.au/

Health Rights Commission (QLD)
http://www.hrc.qld.gov.au/

Health Workforce
http://www.health.gov.au/workforce/

HealthInsite
http://www.healthinsite.gov.au/

Joanna Briggs Institute
http://www.joannabriggs.edu.au/

National Health & Medical Research Council
http://www.health.gov.au/nhmrc/

National Health Priorities & Quality
http://www.health.gov.au/pq/

National Health Priority Action Council
http://www.nhpac.gov.au/

National Institute of Clinical Studies
http://www.nicsl.com.au/

NSW Healthcare Complaints Commission
http://www.hccc.nsw.gov.au/

NSW Rural Doctors Network
http://www.nswrdn.com.au/

NT Remote Health Workforce Agency
http://www.ntrhwa.org.au/

Office of Health Review (WA)
http://www.healthreview.wa.gov.au/

Office of the Health Services Commissioner (VIC)
http://www.health.vic.gov.au/hsc/index.htm

Office of Safety & Quality in Health Care (WA)
http://www.health.wa.gov.au/safetyandquality/faq/index.cfm

Patient Safety
http://www.clinicalrisk.com/

Primary Healthcare Research & Information Service
http://www.phcris.org.au/

Private Health Insurance Ombudsman
http://www.phio.org.au/home.php

Public Health SA
http://www.health.sa.gov.au/pehs/Default.htm

Quality Branch (NSW Health)
http://www.health.nsw.gov.au/quality/

Quality Improvement Council (La Trobe University)
http://www.latrobe.edu.au/qic/

QLD Health Council on Safety and Quality in Healthcare
http://www.health.qld.gov.au/quality/qc.htm

QLD Centre for Public Health
http://www.sph.uq.edu.au/qcph/

Royal Australasian College of Medical Administrators
http://www.racma.org.au/

Royal Australian College of General Practice
http://www.racgp.org.au/

Royal Australian College of Physicians
http://www.racp.edu.au/

Royal College of Nursing, Australia
http://www.rcna.org.au/

Tasmanian Health Complaints Commissioner
http://www.justice.tas.gov.au/health_complaints/home.html

WA Centre for Remote and Rural Medicine
http://www.wacrrm.uwa.edu.au/wacrrm.nsf/docs/49S7YE?opendocument

Other Australian Websites

ACT Workcover
http://www.workcover.act.gov.au/

Australian Council of Trade Unions (ACTU)
http://www.actu.asn.au/

Australian Industrial Relations Commission
http://www.airc.gov.au/

Department of Employment and Workplace Relations
http://www.dewrsb.gov.au/

Risk Management (Standards Australia)
http://www.riskmanagement.com.au/

University of South Australia
- Work & Stress Research Group
http://www.unisa.edu.au/workstress/

- Group for Research on Employment and Workplace Change
http://business.unisa.edu.au/research/grewc/

- Sleep Centre Research
http://www.unisa.edu.au/sleep/research/main.htm

Workcover Corporation (SA)
http://www.workcover.com/

Workcover New South Wales
http://www.workcover.nsw.gov.au/

Workcover Queensland
http://www.workcoverqld.com.au/index.htm

Workcover Western Australia
http://www.workcover.wa.gov.au/

Workplace Health & Safety (QLD Government)
http://www.whs.qld.gov.au/index.htm

Workplace Standards Tasmania
http://www.wst.tas.gov.au/node/WST.htm

International Websites

Agency for Healthcare Research and Quality (US)
http://www.ahcpr.gov/

American College of Healthcare Executives (US)
http://www.ache.org/

Bureau of Health Professionals (US)
http://bhpr.hrsa.gov/

Centers for Disease Control and Prevention (US)
- Division of Healthcare Quality Promotion
http://www.cdc.gov/ncidod/hip/default.htm

Department of Health (UK)
www.doh.gov.uk

Department of Work and Pensions (UK)
http://www.dwp.gov.uk/

Food and Drug Administration (US)
http://www.fda.gov/

- MedWatch – The FDA Safety Information and Adverse Event Reporting Program (US)
http://www.fda.gov/medwatch/getforms.htm

Healthcaresafetyinfo.com (US)
http://209.213.127.236/index.cfm

Health Canada
http://www.hc-sc.gc.ca/

Health Workforce Advisory Committee (NZ)
http://www.hwac.govt.nz/

Institute of Medicine (US)
http://www.iom.edu/iom/iomhome.nsf?OpenDatabase

Institute for Healthcare Improvements (US)
http://www.ihi.org/

Institute for Safe Medication Practices (US)
http://www.ismp.org/

International Reform Monitor: Social Policy, Labour Market Policy, Industrial Relations
http://www.reformmonitor.org/

National Coordinating Council for Medication Error Reporting and Prevention (US)
http://www.nccmerp.org/

National Patient Safety Agency (UK)
http://www.npsa.org.uk/

National Task Force on Violence Against Social Care Staff (UK)
http://www.doh.gov.uk/violencetaskforce/index.htm

Quality Interagency Coordinating Task Force (US)
http://www.quic.gov/

Society of Office-Based Anesthesia (US)
http://www.soba.org/

U.S. Department of Labor Occupational Health & Safety Administration (US)
http://www.osha.gov/

World Health Organisation (WHO)
http://www.who.int/

Veterans Affairs – National Center for Patient Safety (US)
http://www.patientsafety.gov/

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