



Provision of Eye Care for the
Critically Ill Adult
NSWHealth Statewide Guidelines for Intensive Care

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Disclaimer	<p>This clinical practice guideline (CPG) is aimed at providing the clinicians of NSW intensive care units (ICU) with recommendations to frame the development of policies and procedures related to the provision of eye care for the critically ill adult.</p> <p>This CPG is a distillation of several processes: an integrative review of the literature (available up to December 2006); an evaluation of how this literature applies to the NSW intensive care context; the extensive clinical knowledge of the guideline development network members (GDN); and a consensus development process.</p> <p>The CPG is not intended to replace the critical evaluation processes that underpin the development of local policy and procedure nor a clinician's judgment in an individual case.</p> <p>Users of this CPG must critically evaluate this CPG as it relates to local circumstances and any changes in the literature that may have occurred since the dates of the literature review. In addition NSWHealth clinicians must review NSW state government policy documents to identify any directives that may relate to this clinical practice. These guidelines will be updated every 3 years. These guidelines are intended for use in adults only.</p> <p>NSW Health holds copyright of this CPG. No permission is given to redistribute, publish or commercialise this material in any way. The user agrees that in the event that part of the material in this CPG is reproduced or quoted, either in whole or in part, that the copyright owners name and interest in the matter will be acknowledged.</p> <p>Permission MUST be granted to publish this CPG as a stand-alone document on a website other than those of NSWHealth. This permission may be obtained by contacting NSW Intensive Care Coordination and Monitoring Unit (ICCMU). Phone: 61 2 4734 1585 - FAX : 61 2 4734 1586 – Email: iccmu@wahs.nsw.gov.au</p>	

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Abbreviations and Acronyms

CI	Confidence interval
CNC	Clinical Nurse Consultant
CNE	Clinical Nurse Specialist
CONSORT	Consolidated Standards of Reporting Trials http://www.consort-statement.org/?o=1001
CPG	Clinical Practice Guideline
ETT	Endotracheal tube
EVP	External Validation Panel
GCS	Glasgow Coma Scale
GDN	Guideline Development Network
GOR	Grading of Recommendations
HDU	High Dependency Unit
ICC	Intensive Care Collaborative
ICC-CDC	Intensive Care Collaborative – Consensus Development Conference
ICCMU	NSW Intensive Care Coordination and Monitoring Unit
ICU	Intensive Care Unit
NHMRC	National Health and Medical Research Council
OR	Odds Ratio
PICO	Population Intervention Comparison Outcome
RCT	Randomised Control Trial
SR	Systematic Review

Executive Summary

The prevalence of ocular surface disorders in the critically ill is difficult to accurately quantify because of variation in definitions and assessment techniques. However, ocular surface disorders have been reported to occur in up to 60% of critically ill patients. Corneal ulceration and microbial keratitis are serious iatrogenic ophthalmological complications that may occur; although rare, catastrophic iatrogenic ophthalmological complications have also been reported and include corneal erosion, corneal rupture and blindness. The purpose of this guideline is to inform nursing practice related to the provision of eye care in critically ill patients and thus minimise the prevalence of ocular surface disorders in this group of patients.

This guideline has been developed from research available in the literature and it should be noted that much of the published work in this area is descriptive in nature. Where research has been undertaken to evaluate treatment methodological flaws were often present. This is not surprising given that many of these papers predate the Consolidated Standards of Reporting Trials (CONSORT) statement that takes an evidence-based approach to improve the quality of reports of randomised trials.

The available research was evaluated against the designations of levels of evidence stipulated by the National Health and Medical Research Council (NHMRC) (Table 1). Because these levels of evidence focus on evaluation of an intervention, many of the studies reviewed for this guideline could not be assessed against these criteria. For observational studies, levels of evidence could not be assigned because the study was not interventional. In such instances observational studies were reviewed and expert opinion used to inform recommendations. Recommendations were then assigned grades (Table 2) based on the best available evidence.

Table 1: Designations of levels of Evidence (NHMRC)	
Level of Evidence	Intervention
I	A systematic review of level II studies
II	A randomised controlled trial
III-1	A pseudorandomised controlled trial (i.e. alternate allocation or some other method)
III-2	A comparative study with concurrent controls: <ul style="list-style-type: none"> • Non-randomised, experimental trial • Cohort study • Case-control study • Interrupted time series with a control group
III-3	A comparative study without concurrent controls: <ul style="list-style-type: none"> • Historical control study • Two or more single arm study • Interrupted time series without a parallel control group
IV	<ul style="list-style-type: none"> • Case series with either post-test or pre-test/post-test outcomes • Systematic review • Survey • Descriptive or Survey • Observational • Case Reports

Table 2: Grade of Recommendation (GOR) (NHMRC)	
Grade of recommendation	Description
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Body of evidence is weak and recommendation must be applied with caution
Consensus Opinion	Where no evidence could be applied consensus opinion developed by: <ol style="list-style-type: none"> 1. Formulation of recommendation through discussion 2. Assignment of agreement by individual participants (Likert 1-9) 3. Consensus set at median of 7

Table 3: Recommendations for Practice	
Recommendation Statement	Grade of recommendation
1. Intensive care nurses must assess each patient for the risk factors of iatrogenic ophthalmologic complications	D
2. It is recommended that all intensive care units monitor the rates of iatrogenic ophthalmological complications	D
3. Observation for iatrogenic ophthalmologic complications should be performed at least weekly in intensive care patients	D
4. Referral must be made in a timely manner for any suspected iatrogenic ophthalmologic complications in intensive care patients	D
5. Assessment of the ability of the patient to maintain eyelid closure should be performed daily on intensive care patients	D
6. Eyelid closure should be maintained in intensive care patients who cannot maintain complete eyelid closure	D
7. If eyelid closure cannot be maintained passively then mechanical methods should be used	C Expert opinion
8. All patients who cannot achieve complete eye closure independently and unconscious or heavily sedated patients should receive two hourly eye care (cleaning with saline soaked gauze and the administration of an eye specific lubricant)	C Expert opinion

Clinical Practice Guideline

1. Introduction

Normal physiological mechanisms provide protection against eye injury and infection. The conjunctiva, the thin protective layer of epithelium that forms a mucous membrane covering the anterior surface of the eye, protects the eye from mechanical injury and invasion from microorganisms. The cornea lies immediately under the conjunctiva and is essential to admitting and refracting light to the lens. It is therefore vital for sight. As the cornea is avascular it is very slow to heal if injured. Severe conjunctival injuries and infections may cause corneal opacity and blindness.

Tear formation, eyelid closure, and blinking are also essential components of the outer eye defence mechanisms. Tears maintain a moist environment for the surface epithelium of the cornea. Tears also lubricate the eyelids, wash away foreign material and cell debris, prevent adherence of organisms to the ocular surface, and transport oxygen to the outer eye surface. Tears contain proteins such as immunoglobulin, lysozyme and lactoferrin that inhibit bacterial growth. Tears also are the medium of transport for leucocytes in the event of injury or infection. Eyelid closure and blinking provide a mechanical barrier to injury and prevent the drying out and desiccation of the corneal epithelium. The action of blinking facilitates the distribution of tears to the whole of the ocular surface.

Eyelid closure during sleep is an active process involving contraction and relaxation of eyelid muscles. This active contraction and relaxation is lost with heavy sedation and use of muscle relaxants. The blink reflex is also lost. Incomplete lid closure leads to drying of the mucosal surface and desiccation of the corneal epithelial tissues resulting in ulceration. This is called exposure keratopathy. The resulting lesions can range from punctate epithelial erosions involving the exposed inferior third of the cornea to more extensive erosion termed macroepithelial defect. The disruption to the epithelial surface increases the risk of bacterial infection.

Critically ill patients frequently have impaired ocular defence mechanisms as a result of metabolic derangements, mechanical ventilation, sedation, paralysis and decreased level of consciousness. The ICU also presents an environment rich in pathogens that may contribute to the increased exposure of the ocular surface to micro-organisms. For these reasons meticulous nursing care is required to minimise the development of iatrogenic ophthalmological complications (Table 7 Glossary, page 18), which, if not resolved, may result in serious visual impairment.

Eye care for intubated and ventilated patients receiving sedation or muscle relaxation is considered routine nursing practice. However it has been shown that practice varies greatly between intensive care units in terms of the frequency and method of eye care. Eye care has generally involved a regimen of cleaning the eyes every 2 to 4 hours with sterile water or normal saline and the installation of a lubricating liquid such as methycellulose. Eye ointment has also tended to be used where there is evidence of eye injury or the risk of injury is thought to be increase, for instance where conjunctival oedema is present. Where there is evidence of conjunctival or corneal exposure, methods such as eye taping, padding, application of ointment, and application of polyethylene film have been described (Table 4: Eye care methods used by cited authors). However, from the available evidence it is unclear if any of these methods contribute to ocular surface protection separate from their contribution to eyelid closure. It is also unclear from the available evidence which of these is most effective in maintaining eyelid closure.

2. Scope

Eye care is an important aspect of nursing management of critically ill patients and those patients in whom ocular protective mechanisms are compromised. Risk factors that contribute to the development of iatrogenic ophthalmological complications include an inability to close the eye, decreased level of consciousness, sedation, paralysis, and metabolic derangements. This guideline is most relevant for those patients who are at increased risk for iatrogenic ophthalmological complications, particularly those who are unable to control eye opening and closure.

3. Purpose

This guideline has been developed to provide intensive care clinicians with recommendations to guide the development of local policy/procedures related to eye care for critically ill patients.

4. Target Clinicians

This guideline is for the use of all intensive care clinicians. This guideline will also be useful for any clinician who is responsible for the care of any patient in whom protection of the ocular surface cannot be achieved by independent complete eyelid closure. It is assumed that users of this guideline have knowledge of anatomy and physiology of the eye as well as ocular protective mechanisms that may become compromised during episodes of critical illness and its treatment.

5. How guideline was developed

This guideline was developed by the Eye Care guideline development network (GDN) comprised of expert intensive care nursing clinicians and academics with the ICCMU Intensive Care Collaborative project.

6. How to use the guideline

Clinical judgement should be exercised when applying the principles described in this guideline. Wherever ophthalmic damage has occurred the directions of the ophthalmologist should take precedence over the guidelines outlined in this document.

7. Format of guideline

Recommendations are set out in this guideline with an explanation. The evidence used to support these statements is fully presented the integrative literature review following the guideline.

8. Level of evidence taxonomy and how expert opinion was developed

The Australian NHMRC taxonomy for grading the level of evidence of a study and grading a recommendation for practice was chosen by the Academic Facilitators (see below) for its ease of use and application to the Australian clinical context. The assignment for a level of evidence for an individual paper was performed at the consensus conference and/or by the principal authors. The grading for a recommendation was assigned at the consensus conference using the consensus process outlined on page 15. If a recommendation did not have an evidence base the recommendation was based on the clinical opinion of the guideline network members.

9. Infection Control

Prevention of infection is an important aspect of any clinical practice and guideline users are directed to NSWHealth Policy directive (PD2007_036) and local policy to identify the infection control elements of this clinical practice. This includes but is not limited to: use of personal protective equipment, hand hygiene, disposal of equipment and medical waste and isolation of infectious patients. Areas of particular note include:

- a. 2.1 Standard Precautions
- b. 2.2 Additional Precautions
- c. 5.4 Blood and body substance spills

10. Occupational Health and Safety

Guideline users are directed to local policy and procedures related to occupational health and safety to ensure operator safety whilst completing procedures.

11. Academic Facilitators

Convenor, Academic Facilitators	Professor Doug Elliott Director of Research, Faculty of Nursing, Midwifery and Health University of Technology Sydney, NSW
Oral Care GDN	Associate Professor Patricia Davidson Professor of Cardiovascular and Chronic Care School of Nursing and Midwifery, Curtin University of Technology, NSW
Eye Care GDN	Ms Andrea Marshall Sesqui Senior Lecturer in Critical Care Faculty of Nursing and Midwifery, The University of Sydney, NSW
Suction of an artificial airway GDN	Dr Bridie Kent Director of Clinical Nursing Research School of Nursing - Faculty of Medical and Health Sciences University of Auckland
Stabilisation of an endotracheal tube GDN	Professor Wendy Chaboyer Director, Research Centre for Practice Innovation, Griffith University, QLD Associate Professor Anne Gardner Professor, School of Nursing, Midwifery and Nutrition, James Cook University
	Professor Sandy Middleton School of Nursing Australian Catholic University, National - North Sydney Campus, NSW
Arterial catheter GDN (nursing management)	Dr Tina Jones Manager, Australian Centre for Evidence Based Clinical Practice, Flinders Medical Centre Senior Lecturer, Faculty of Health Sciences, Flinders University, SA
CVC GDN (nursing management)	Dr Judy Currey Senior Lecturer, School of Nursing, Deakin University, Melbourne

The Academic facilitators were identified through professional networks and were not paid to participate in the ICC project however ICCMU paid the costs of travel and accommodation for the ICC-CDC. Apart from Professor Elliott the other academic facilitators did not join the ICC project until June 2006. Five meetings were held, four by teleconference and one the day prior to the ICC-CDC. Tasks completed during these meetings included:

1. Assignment to a particular GDN
2. Discussion regarding the most appropriate levels of evidence and recommendation taxonomy
3. Format of the consensus conference (ICC-CDC)
4. Process of developing recommendations and reaching consensus
5. Process for writing guidelines and peer reviewed publications

Recommendations for Practice

	Recommendation	Grade of Recommendation
1	Intensive care nurses must assess each patient for the risk factors of iatrogenic ophthalmologic complications.	D

Rationale

The risk factors for iatrogenic ophthalmologic complications are related to incomplete eyelid closure. The following situations compromise eyelid closure: reduced conscious level, tracheal intubation, prolonged admission to ICU and significant metabolic derangement (Hernandez & Mannis 1997; Hilton et al. 1983; Imanaka et al. 1997; Mercieca et al. 1999; Parkin et al. 1997). Patients may have pre-existing co morbidities, which can contribute to the risk of iatrogenic ophthalmologic complications.

	Recommendation	Grade of Recommendation
2	It is recommended that all intensive care units monitor the rates of iatrogenic ophthalmologic complications.	D
3	Observation for iatrogenic ophthalmologic complications (at the microepithelial level) should be performed at least weekly in intensive care patients using readily available practical methods (for example, the instillation of fluorescein and use of a cobalt blue pen torch).	D
4	Referral must be made in a timely manner for any suspected iatrogenic ophthalmologic complications in intensive care patients.	D

Rationale

The occurrence of iatrogenic ophthalmologic defects/abnormalities in intensive care patients can include but are not limited to: microbial keratitis, corneal ulcers and keratopathy. Such conditions may lead to more serious complications such as corneal rupture and the requirement for corneal transplant. According to the research reviewed, corneal defects were common in the intensive care patient population with poor eyelid closure. Secondary ocular complications occurred rarely but with devastating consequences (Hernandez & Mannis 1997; Hilton et al. 1983; Imanaka et al. 1997; Kirwan et al 1997; Mercieca et al. 1999; Ommeslag et al. 1987; Parkin et al. 1997).

	Recommendation	Grade of Recommendation
5	Assessment of the ability of the patient to maintain eyelid closure should be performed daily on intensive care patients.	D
6	Eyelid closure should be maintained in intensive care patients who cannot independently achieve complete eyelid closure.	D
7	If eyelid closure cannot be maintained passively then mechanical methods should be used.	C Expert opinion

Rationale

Incompetent eye closure is a major contributor to the occurrence of iatrogenic complications. Interventions, which achieve closure or cover the eye and maintain corneal moisture, appear to reduce the incidence of complications (Bates et al. 2004; Cortese et al. 1995; Koroloff et al. 2004; Lenart & Garrity 2000; Sivasankar et al. 2006) and are summarised in Table 4. An important consideration regardless of the technique used is to achieve proper alignment of the eyelids to ensure complete closure. It is also essential to ensure that the eye is free from foreign objects such as eye lashes. As the skin surrounding the eye is delicate and sensitive care must be taken to prevent injury when mechanical means are used to close the eyes.

Table 4: Eye care methods used by cited authors	
Author	Method
Bates J et al. 2004 Clinical Intensive Care	Taping application of gel membrane
Cortese D et al. 1995 American Journal of Critical Care	Methylcellulose lubricating drops Polyethylene film to create moisture chamber
Koroloff N et al. 2004 Intensive Care Medicine	Hypomellose drops Lacri-lube ointment Polyethylene cover
Laight S et al. 1996 Intensive and Critical Care Nursing	Hypomellose drops OR Application of gel membrane
Lenart S & Garrity J 2000 American Journal of Critical Care	Artificial tear ointment OR Passive eyelid closure
Sivasankar S et al. 2006 Indian Journal of Critical Care Medicine	Ocular lubricants Eye taping Moisture chamber (saline moistened gauze) Swimming goggles

	Recommendation	Grade of Recommendation
8	All patients who cannot achieve complete eye closure independently and unconscious or heavily sedated patients should receive two hourly eye care (cleaning with saline soaked gauze and the administration of an eye specific lubricant).	C Expert opinion

Rationale

Lack of well-conducted studies on ICU patients to provide “evidence” for eye care should not influence practice where basic principles derived from ophthalmology can guide care. Eye lubrication and maintenance of adequate moisture levels are known to be major factors in preventing ophthalmological complications.

This recommendation was included following the external validation process.

Process of Guideline Development

The Eyecare Guideline Development Network (Eyecare-GDN) was established at the 'Getting evidence into practice' workshop held on June 14 2005 (<http://intensivecare.hsnet.nsw.gov.au/five/htm/education.php>). The expert clinical intensive care nurses were able to self-select which guideline to develop. In the period between June 2005 and December 2006 GDN meetings were convened via teleconference with ICCMU CNC coordinating the process. At the initial meeting the scope and state of current practice was established and the issues related to eye care were brainstormed. At subsequent meetings a clinical question and literature review protocol were developed and literature review tasks allocated. A data extraction tool was developed by project manager and academic lead (see appendix 1) and GDN member training completed during a scheduled meeting. The project manager collated the article reviews and these compilations were sent to GDN members some weeks prior to the Intensive Care Collaborative Consensus Development Conference (ICC-CDC). Prior to ICC-CDC an on-line forum was established to promote discussion of evidence with respect to specific questions arising from the broader PICO question (<http://intensivecare.hsnet.nsw.gov.au/six/blogcms/forum/>).

Midway through 2006 a group of critical care academics from Australia and New Zealand were identified as academic facilitators for each GDN (see Academic Facilitators p 11). A number of meetings were held to establish the final processes of guideline development in particular the taxonomy for levels of evidence and recommendations and consensus development (see Box A).

1. Description of Consensus Development Process

On Friday December 1 2006 the ICC-CDC was held where all of the GDNs met to develop the recommendations for practice under the facilitation of an Australasian critical care academic. Each GDN followed the processes outline in Box A.

Box A: Process of consensus development at ICC-CDC

1. Establish current practice
2. Revisit clinical question
3. Review papers
 - a. Include relevant papers
 - b. Assign level of evidence for each paper
4. Recommendation
 - a. Develop statement
 - b. Assign grade of recommendation from literature or expert opinion
5. Assign agreement using Likert Scale (1-3 disagree, 4-6 neutral and 7-9 agree)
6. Review voting - consensus is a median of ≥ 7
7. Revisit process once only if consensus not reached

2. Guideline construction

The authors constructed this guideline using recommendations developed by those Arterial GDN members present at ICC-CDC and those formulated in January 2007. A summary of the events that occurred at the ICC-CDC were collated and distributed by the academic facilitator to absent GDN members to review and to subsequently comment and provide their consensus opinion on the wording of those recommendation statements developed at this time.

3. External Validation Panel

External validation of the guideline was conducted in April 2007 by an external validation panel (EVP) using a limited Delphi round.

3a. Formation of Panels

Expert clinicians to serve as panel members (n=48) for all guidelines were identified using professional networks and associations and were allocated to a specific guideline using two processes. Firstly there were nine panel members who were approached directly because of their acknowledged expertise with a particular practice (including research or professional role). Secondly other panel members were randomly allocated to a specific guideline by placing all names into a hat and assigning names sequentially to each guideline until names and panel positions were exhausted. Panel members completed a conflict of interest form which included demographic data.

EVP role	Name	Position and Facility	Qualifications
Nursing academic	Dr Fiona Coyer	Senior Lecturer Nursing Faculty Queensland University of Technology	RN, RM, ENB100, PGCEA (Surrey), PhD (QUT)
Nursing academic	Professor Paul Fulbrook	School of Nursing and Midwifery Australian Catholic University - Queensland	RN, PhD, MS, PGDE, BSc(Hons)
Clinical nurse	Karen Chronister	Acting Area Critical Care Coordinator HNEAHS	RN ICC
Clinical nurse	Michelle Foster	NUM ICU Gold Coast Hospital	RN MN(Critical Care)
Ophthalmology nurse expert	Cheryl Moore	Nurse Educator Sydney Eye Hospital	RN MN(Nurse Education) Ophthalmology Certificate
Ophthalmology medical specialist	Professor Peter McCluskey	Director Department of Ophthalmology Liverpool Hospital	MD FRANZCO
Intensive care medical specialist	Dr Barry Rigby	Director ICU - Tweed Hospital Associate Professor Griffith University	MBBS, AA(UK), DRACOG, FRACP FACEM
Intensive care medical specialist	Dr Thomas Solano	Staff Specialist POW	MBBS FRACP FJFICM

3b. Method of validation

Panel members received the draft guideline and the literature review (which included the data extraction tools completed by the GDN members) along with a recommendation agreement form. They were then asked to assign their level of agreement (Likert 1-9) with the recommendation statement. A median score of 7 was set for consensus to be reached. Table 6 sets out the results of the EVP process for this guideline.

Table 6	Eye Care EVP Consensus Results			
Recommendation Number	25 th	Median	75 th	Outcome
1	8	9	9	Validated
2	6.5	7.5	9	Validated
3	8.75	9	9	Validated
4	8.75	9	9	Validated
5	8	9	9	Validated
6	8.75	9	9	Validated
7	8	9	9	Validated

Table 7: Glossary	
Bacterial keratitis	Inflammation of the cornea secondary to bacterial infection
Chemosis	Condition in which the membranes that line the eyelids and surface of the eye (conjunctiva) are oedematous. The outer surface covering appears to have fluid in it. Often, the conjunctiva becomes so oedematous that the eyes cannot close properly.
Corneal abrasions	An erosion or open sore in the outer layer of the cornea
Corneal erosion	Punctate changes in the corneal epithelium
Filamentary keratitis	Patients presenting with filamentary keratitis generally report ocular discomfort ranging from mild foreign-body sensation to severe pain. Variable tearing and photophobia are likewise present. The condition may be unilateral or bilateral, depending upon the underlying etiology. Signs include ocular hyperaemia particularly in the limbal area, and possibly a pseudoptosis. The hallmark finding is the presence of mucus filaments within the precorneal tear film adhering to the corneal surface. These filaments are typically tadpole-shaped (the "head" adheres firmly to the corneal epithelium, while the "tail" floats freely within the tear film). Rose bengal or lissamine green dye makes the filaments more readily visible on biomicroscopy. Other findings may include a reduced fluorescein tear break-up time and a punctate epithelial keratopathy.
Hypopyon	An accumulation of pus in the anterior chamber of the eye
Injection	Conjunctival redness
Lagophthalmos	The inability to close, or poor closure, of the eyelids
Neurotrophic keratopathy	A degenerative disease characterized by decreased corneal sensitivity and poor corneal healing. This disease leaves the cornea susceptible to injury and decreases reflex tearing. Epithelial breakdown can lead to ulceration, infection, melting, and perforation secondary to poor healing.
Punctate epithelial keratopathy	Microepithelial defects to the corneal surface

Integrative literature review

Introduction

The search for literature to inform this guideline was undertaken within the context of the GDN and completed in two stages. Firstly individual GDN members conducted a preliminary literature search to identify the normal mechanisms that prevent eye injury and the problem of iatrogenic eye injury in the intensive care. Following this a structured research question was developed and individual members searched the literature for information pertinent to the five sub questions.

Results of search strategies

Structured research question:

What clinical practices are effective in preventing ophthalmological complications?

P Population (of interest)	All ICU patients with subgroup of patients at most risk		
I Intervention	prevention		
C Control (group)		N/A	✓
O Outcome (measured)	complications		

Search strategy 1

Databases:	Pubmed, OVID		
Key words:	Pubmed: intensive care prevention eye complications OVID MEDLINE and CINAHL: intensive care & prevention & eye (subheadings selected) (combined search)		
Publication years:	all		
Other search filters:	None		
English language only			
Adult	16		10 paediatric

How many articles first hit? 12 (Pubmed), 5 (OVID CINAHL), 9 (OVID medline)

Structured research question:

What guidelines have already been implemented and how effective have they been?

P Population (of interest)	All ICU patients with subgroup of patients at most risk		
I Intervention			
C Control (group)		N/A	✓
O Outcome (measured)			

Search strategy 2

Databases:	Pubmed		
Key words:	Pubmed: intensive care guidelines eye OVID CINAHL: intensive care & guidelines & eyecare (subheadings) combined search OVID MEDLINE: intensive care & guidelines & eyecare (subheadings) combined search		
Publication years:	all		
Other search filters:	none		
English language only			
Adult	17		0 paediatric

How many articles first hit? 12 pubmed, 1 OVID CINAHL, 4 OVID medline

Search strategy 3

Databases:	Pubmed		
Key words:	intensive care eye		
Publication years:	all		
Other search filters:	none		
English language only			
Adult			

How many articles first hit? 284 (some not relevant)

Literature review process

Each GDN member reviewed a number of papers independently with most papers being reviewed by two or more members. The data extraction tool was used to ensure key elements of research design and papers were included.

Description of literature identified

Only seventeen papers were found with only seven suitable for grading according to NHMRC guidelines (see table 8 for details). A single systematic review was found however the application of this was determined to be limited because it did not address the specific research questions developed by the Eyecare-GDN. Table 9 includes the summary tables for the literature used to inform the development of recommendations. Table 10 contains those papers, which were reviewed but not used to develop recommendations for practice.

Literature synthesis process

GDN members sent the completed data extraction tools to the project coordinator for collation these into a master document that was sent to the GDN members for review a number of weeks prior to the consensus conference. An online forum was established to facilitate discussion of the literature around the specific sub questions. At the ICC-CDC the literature was discussed and a grade of evidence assigned according to the NHMRC taxonomy. Table 9 includes the summary tables for the literature used to inform the development of recommendations.

Taxonomy for level of evidence

Table 8: NHMRC Designations of levels of evidence with papers identified		
Level	Intervention	Number of papers located
I	A systematic review of level II studies	0
II	A randomised controlled trial	1
III-1	A pseudorandomised controlled trial (i.e. alternate allocation or some other method)	1
III-2	A comparative study with concurrent controls: <ul style="list-style-type: none">• Non-randomised, experimental trial• Cohort study• Case-control study• Interrupted time series with a control group	1
III-3	A comparative study without concurrent controls: <ul style="list-style-type: none">• Historical control study• Two or more single arm study• Interrupted time series without a parallel control group	3
IV	Case series with either post-test or pre-test/post-test outcomes	1
Other	Systematic review	1
	Survey	1
	Descriptive or Survey	2
	Observational	4
	Case Reports	2

Table 9: Summary tables of research papers included																																					
Short reference	Design/Method	Sample Description	Outcomes/findings	Methodological Quality																																	
Bates J et al. 2004 Clinical Intensive Care	RCT Patients were randomised to receive standard treatment in one eye plus either application of Geliperm membrane or eyelid taping.	Thirty-one critically ill, ventilated patients with loss of blink reflex for more than 24 hours	<ul style="list-style-type: none"> • Keratotherapy was seen in 23% (7/31) patients. • Corneal abnormalities were only observed in eyes where lagophthalmos was present. • Keratopathy developed in <ul style="list-style-type: none"> → standard care - 14% (4/28) → a gel membrane - 7% (1/14) → with taping - 0% (0/14). 	<ul style="list-style-type: none"> • Strategies were implemented to ensure assessors were blind. • Sample size calculations were not conducted a priori and statistically significant differences were not observed. • Randomisation was also used to determine which eye would receive the intervention. • Allocation concealment was not addressed. • Information about similarities/differences between groups is not provided, particularly in relation to risk factors. 																																	
Level of Evidence: III-1	Standard: daily cleaning of lids with saline and sterile gauze plus application of ocular lubricants at least twice per day																																				
Cortese D et al. 1995 American Journal Critical Care	RCT	Sixty comatose or semi-comatose critically ill patients with a poor or absent blink reflex.	<ul style="list-style-type: none"> • Eight of the 30 patients in the lubricating drop group had positive fluorescein staining indicating corneal epithelial injury. • Only one patient in the moisture chamber group had evidence of corneal epithelial injury. 	<ul style="list-style-type: none"> • Randomisation inadequately described. Details of who assessed patients for corneal epithelial injury is unclear therefore adequacy of blinding and allocation concealment cannot be determined. Compliance with treatment regimes in not articulated. • Did not address eye opening as a risk factor. 																																	
Level of Evidence: III-1																																					
Hernandez E et al. 1997 American Journal of Ophthalmology	Survey	Fifty randomly selected intensive care patients	<table border="1"> <thead> <tr> <th colspan="3">Superficial keratopathy – 20/50</th> </tr> <tr> <th></th> <th>Yes</th> <th>No</th> </tr> </thead> <tbody> <tr> <td>Intubated</td> <td>19</td> <td>15</td> </tr> <tr> <td>Non-intubated</td> <td>1</td> <td>15</td> </tr> <tr> <td colspan="3">P < .01</td> </tr> <tr> <td>ICU LOS > 1 week</td> <td>14</td> <td>10</td> </tr> <tr> <td>ICU LOS < 1 week</td> <td>6</td> <td>20</td> </tr> <tr> <td colspan="3">P = .03</td> </tr> <tr> <td>GCS ≤ 7</td> <td>12</td> <td>7</td> </tr> <tr> <td>GCS ≥ 7</td> <td>8</td> <td>23</td> </tr> <tr> <td colspan="3">p < .03</td> </tr> </tbody> </table>	Superficial keratopathy – 20/50				Yes	No	Intubated	19	15	Non-intubated	1	15	P < .01			ICU LOS > 1 week	14	10	ICU LOS < 1 week	6	20	P = .03			GCS ≤ 7	12	7	GCS ≥ 7	8	23	p < .03			<ul style="list-style-type: none"> • Small sample of intensive care patients from one ICU. • Data was collected in a setting where only one patient received any form of eyecare therefore does not likely reflect current prevalence of superficial keratopathy in this patient population. • Descriptive study that identifies risk factor that should be controlled for when evaluating eye care interventions.
Superficial keratopathy – 20/50																																					
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Short reference	Design/Method	Sample Description	Outcomes/findings	Methodological Quality
Hilton E et al. 1983 The Lancet	Retrospective chart review followed by prospective study of bacterial dispersion during tracheal suctioning	20 intubated patients	<ul style="list-style-type: none"> Patients with copious secretions had significantly higher bacterial colony counts on settle plates than those without. Colony counts were higher on the side opposite to the hand the nurse used to withdraw the catheter than on the same side. Nurses tended to withdraw the catheter diagonally across the patient's face, which may explain the selective involvement of the left eye. 	<ul style="list-style-type: none"> Study design poorly described. Strategies to control for cross-infection of blood agar plates not described. Patient population poorly described.
Level of Evidence Observational study – level of evidence not assigned				
Imanaka H et al. 1997 Anesthesia and Analgesia	Retrospective chart review and prospective observational study of the incidence of ocular surface disorders.	Retrospective review of charts from 143 consecutive ICU patients whose length of stay exceeded 7 days.	<ul style="list-style-type: none"> Ocular surface disorder was found in 28 of the 143 patients (20%) whose ICU stay exceeded 7 days. The incidence increased with continuous sedation (35% v 15%) and with continuous neuromuscular blockade (39% v 11%). In the prospective study 9 patients (60%) developed corneal erosion. Inability to fully close the eyes increased the incidence of corneal erosion (P<0.01). 	<ul style="list-style-type: none"> The retrospective study relied on macroscopic observation of ocular surface disorder and therefore may have underestimated problems in this group of patients. The small sample size in the prospective group providing a limited picture of this clinical problem in intensive care patients.
Level of Evidence: Level IV	Corneal erosion was examined using a slit lamp once a day.	Prospective observational study of 15 consecutive intubated and mechanically ventilated patients receiving IV sedatives or muscle relaxants continuously for more than 48 hours.		
Koroloff N et al. 2004 Intensive Care Medicine	RCT of the efficacy of hyproellose and Lacri-Lube combination v. polyethylene/Cling Wrap to prevent corneal epithelial breakdown	110 semiconscious intensive care patients with a reduced or absent blink reflex	<ul style="list-style-type: none"> Corneal ulceration was determined daily using corneal fluorescein stains and mobile slit lamp evaluation. No patients had corneal ulceration in the polyethylene cover group. Four patients had corneal ulceration in the hypromellose/Lacri-Lube group. 	<ul style="list-style-type: none"> Statistically significant differences between the two groups were not evident however only macroepithelial injury was assessed. More corneal ulcers occurred in the group receiving Lacri-Lube and this group also had more lagophthalmos. Compliance with the protocol was not assessed
Level of Evidence: II				

Short reference	Design/Method	Sample Description	Outcomes/findings	Methodological Quality
Lenart S and Garrity J 2000 American Journal of Critical Care	A prospective, randomised control trial	Fifty intensive care patients receiving either neuromuscular blocking agents of propofol during mechanical ventilation	<ul style="list-style-type: none"> • Nine patients had evidence of exposure keratitis in the untreated eye. • Two had corneal abrasions in both the treated and untreated eye. • Thirty-nine patients did not have corneal abrasions in either eye. • Artificial tear ointment was more effective in preventing corneal exposure than was passive eyelid closure (p=0.004) 	<ul style="list-style-type: none"> • This paper is does not report a RCT rather consecutive patients were enrolled and either their right or left eye was randomised to receive the intervention while the other eye served as a control. • Blinding was not possible and allocation concealment is not addressed. • Lagophthalmos was only assessed at the time of examination. • Protocol adherence was not addressed.
Level of Evidence: III-2				
Parkin B et al. 1997 British Journal of Ophthalmology	Pre-post case series	Nine critically ill patients requiring prolonged mechanical ventilation	<ul style="list-style-type: none"> • Following review of eye care procedures and adoption of recommendations the frequency of isolation of pseudomonas from the respiratory tract remained high at 3.8% but the conjunctival pseudomonas isolation rate significantly decreased from 0.8% to 0.05 % (p<0.001) 	<ul style="list-style-type: none"> • Very little detail of study design. • Sample size was reasonably small and thus did not allow for equivalence between groups.
Level of Evidence: III-3				
Sivasankar S et al. 2006 Indian Journal of Critical Care Medicine	<ul style="list-style-type: none"> • Randomised controlled trial • Medical Intensive Care Unit • Randomised to either an open chamber group (lubricants and taping of the eyes) • Or a closed chamber group (moistening of eyelids with sterile water soaked gauze and swimming goggles). 	124 critically ill patients with a GCS <10	<ul style="list-style-type: none"> • Incomplete eyelid closure was seen in 30% of patients. • Exposure keratopathy was noticed in 32% in the open chamber group and 8% in the closed chamber group (and was also more severe in this group). • There was no difference in the incidence of conjunctival oedema in both groups 	<ul style="list-style-type: none"> • Little information on process of randomisation, allocation concealment, or blinding. • Equivalence of groups could not be determined
Level of Evidence: III-1				

Table 10: Summary table of research papers not included	
Full name of paper	Reasons for non inclusion
Farrell M & Wray F 1993 Eye care for ventilated patients. <i>Intensive and Critical Care Nursing</i> 9, 137-141	Survey of ICU practice Poor study design Descriptive paper Does not meet NHMRC grading criteria
Joyce N 2002 Eye care for the intensive care patient/ A systematic review. <i>The Joanna Briggs Institute for Evidence Based Nursing and Midwifery, Systematic Review No 21</i> . Adelaide, SA.	Review did not address specific research questions raised by the GDN
Kirwan J et al. 1997 Lesson of the week: Microbial keratitis in intensive care. <i>British Medical Journal</i> 314, 7078, 433-434.	Case report Does not meet NHMRC grading criteria
Laight S 1996 The efficacy of eye care for ventilated patients: outline of an experimental comparative research pilot study. <i>Intensive and Critical Care Nursing</i> , 12, 16-26.	Paper reports the design of the project. No real results presented Does not meet NHMRC grading criteria
Mercieca F et al. 1999 Ocular surface disease in intensive care unit patients. <i>Eye</i> 13, 231-236.	observational study only Does not meet NHMRC grading criteria
Ommeslag D et al. 1987 Eye infections caused by respiratory pathogens in mechanically ventilated patients. <i>Critical Care Medicine</i> 15, 1, 80-81.	Case reports Does not meet NHMRC grading criteria
Suresh P et al. 2000 Eye care for the critically ill. <i>Intensive Care Medicine</i> 26, 162-166	Observational study Does not meet NHMRC levels of evidence

Reviews – systematic and narrative

- Use one per article which is a review of the literature.
- Please be brief. Cell size is locked so add text; use a smaller font size to fit your conclusions in.
- Where yes/no is asked for, text can be added to flesh out answer.
- Where a number exists, please refer to the expanded question.
- For the databases searched please add a tick and describe the hand search strategy.

1. Is there an explicit review plan documented?
2. Was an explicit search strategy documented?
3. Was an explicit article review method used?
4. Were points 1-3 covered adequately?
5. Does the summary of each reviewed study reflect the essential components of the study design, research process and analysis techniques?
6. Is the organisation of the reviewed studies chronological and logical?
7. Does the organisation of the reviewed studies lead the reader to the same conclusions as the authors?

Full Reference ⇒			
1 - Review Plan - yes/no		3 - Review Method - yes/no	
Clinical Question -		What was the article review method?	
→ Population -		Are all the relevant concepts and variables included? yes/no	
→ Intervention/s		5 - Summary yes/no	
→ Outcome/s		7- Organisation ⇒ Conclusions? yes/no	
2 - Search Strategy		4 Quality of the review –	
Keyword/s (list)		Limits (list)	
Search Time Line		Are the conclusions of the authors warranted? Yes/no & discuss	
Data Bases – adequate? Y/N		Please tick list below <input checked="" type="checkbox"/>	
CINAHL	Pubmed	Embase	Cochrane
Psych info	DARE	Hand search	Other

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[NHMRC](#):NHMRC additional levels of evidence and grades for recommendations for developers of guidelines PILOT PROGRAM 2005 - 2007
http://www.nhmrc.gov.au/consult/_files/levels_grades05.pdf accessed August 2006

Hilton E, Uliss A, Sameuls S, Adams A, Lesser M, L, Lowy F, D. 1983 Nosocomial bacterial eye infections in intensive-care units, *The Lancet*;1318-1319.

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Kirwan JF, Potamitis T, El-Kasaby H, Hope-Ross MW, Sutton GA. 1997 Microbial keratitis in intensive care; *British Medical Journal*;314:433-434.

Koroloff N, Boots R, Lipman J, Thomas P, Richard C, Coyer F. 2004 Randomised controlled study of the efficacy of hypermellose and Lacri-Lue combination versus polyethylene/Cling wrap tp prevent corneal epithelial breakdown in the semiconscious intensive care patient, *Intensive Care Medicine*;30:1122-1126.

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Ommeslag D, Colardyn F, De Laey J-J. 1987 Eye infections caused by respiratory pathogens in mechanically ventilated patients, *Critical Care Medicine*; 15(1):80-81.

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