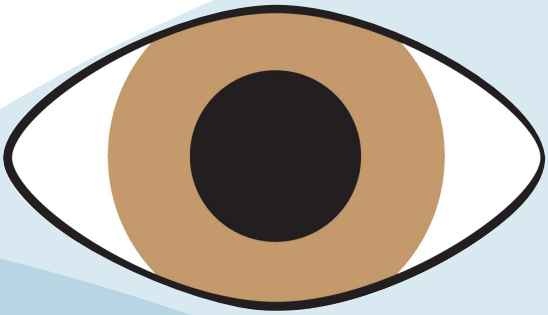
ACI NSW Agency for Clinical Innovation

ICCMU Intensive Care Coordination & Monitoring Unit

IC Manual
best practice guidelines for intensive care

Eye Care for Critically Ill Adults



GUIDELINE PROVENANCE

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Disclaimer

- This clinical practice guideline (CPG) is aimed at providing clinicians working in NSW hospitals' intensive care units (ICU) with recommendations to frame the development of policies and procedures related to the eye care practices in adult ICUs.
- This CPG is a revision of 2007 eye care guideline and includes: 1) an update of the evidence base; 2) an evaluation of how this literature applies to the NSW intensive care context; 3) the extensive clinical knowledge of the guideline development network members (GDN); and 4) a consensus development process.
- The CPG is not intended to replace the critical evaluation processes that underpin the development of local policy and procedure nor does it replace a clinician's judgment in an individual case.
- 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 conducted. In addition, NSW Health clinicians must review NSW State Government policy documents to identify any directives that may relate to this clinical practice.
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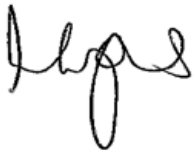
FOREWORD

Eye care is an essential component of nursing care for critically ill patients who are particularly vulnerable to eye injury because their illness and treatment can compromise ocular protective mechanisms.

The purpose of this guideline is to provide intensive care clinicians with best practice recommendations so that the evidence-based treatment and care can be delivered and patients can receive the therapy they need.

Developed under the auspices of the Intensive Care Best Practice Manual Project, this guideline highlights the ability of the Agency for Clinical Innovation (ACI) to facilitate strong working relationships with clinicians as well other executive branches of the Ministry.

On behalf of the ACI, I would like to thank Susan Pearce, Chief Nursing and Midwifery Officer for providing state executive sponsorship for the project and funds for the Project Officer. I would also like to extend my appreciation to the LHD executives for facilitating the participation of LHD staff in developing these guidelines, which I commend to you the clinicians of NSW.



Dr Nigel Lyons
Chief Executive, Agency for Clinical Innovation

ABOUT THE ACI

The Agency for Clinical Innovation (ACI) works with clinicians, consumers and managers to design and promote better healthcare for NSW. It does this by:

- Service redesign and evaluation – applying redesign methodology to assist healthcare providers and consumers to review and improve the quality, effectiveness and efficiency of services.
- Specialist advice on healthcare innovation – advising on the development, evaluation and adoption of healthcare innovations from optimal use through to disinvestment.
- Initiatives including Guidelines and Models of Care – developing a range of evidence-based healthcare improvement initiatives to benefit the NSW health system.
- Implementation support – working with ACI Networks, consumers and healthcare providers to assist delivery of healthcare innovations into practice across metropolitan and rural NSW.
- Knowledge sharing – partnering with healthcare providers to support collaboration, learning capability and knowledge sharing on healthcare innovation and improvement.
- Continuous capability building – working with healthcare providers to build capability in redesign, project management and change management through the Centre for Healthcare Redesign.

ACI Clinical Networks, Taskforces and Institutes provide a unique forum for people to collaborate across clinical specialties and regional and service boundaries to develop successful healthcare innovations.

A priority for the ACI is identifying unwarranted variation in clinical practice and working in partnership with healthcare providers to develop mechanisms to improve clinical practice and patient care.

Table 1: Guideline development network members

GUIDELINE MANAGEMENT TEAM		
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1. EXECUTIVE SUMMARY

Ocular surface disease (OSD), due to superficial corneal exposure, has been reported to occur in up to 60% of critically ill patients [1-3]. Lagophthalmos or incomplete eyelid closure is thought to be the primary mechanism underlying the development of this condition [4-7].

The purpose of this guideline is to inform intensive care practice related to the provision of eye care for critically ill patients. The underlying aim of the guideline is to minimise the prevalence of ocular surface disorders in this group of patients.

Projected outcomes for this guideline include:

- Facilitation of the diffusion of evidence-based eye care recommendations into clinical eye care practice
- To support the early detection of eye disease, timely referral for conditions, and systematic delivery of eye toilet and treatment
- Improvement of patient quality of care by routinely addressing iatrogenic ophthalmologic issues, ensuring that on discharge from the unit, visual compromise is not added to existing co morbidities [8].

This guideline has been developed from a limited research base supporting the provision of eye care for the critically ill adult. It provides an update to the 2007 Eye Care Clinical Practice Guideline (CPG), and literature reviewed has been sourced from studies published between 2007 and July 2013. The methodological quality of relevant studies found on iatrogenic ocular surface disorders among intensive care patients has been variable. This has been influenced by differences in definitions used, assessment techniques and study design. To date, published studies have largely been descriptive, yielding limited evidence to support specific nursing eye care practices. The available research was evaluated against the designations of levels of evidence stipulated by the National Health and Medical Research Council (NHMRC) [9].

SECTION	RECOMMENDATION	GOR
	Assessment	
1	Eye health assessment should be part of routine patient physical assessment practice and be performed on admission and then routinely at the beginning of the new nursing shift. The initial assessment should include input from the patients' family to identify pre-admission ocular conditions and treatment and to identify the need for ophthalmology review.	D
2.	Admission and ongoing assessment should include, but is not limited to the following: • risk factors for OSD • ability for patient to maintain complete eyelid closure • evaluation of eye and eyelid cleanliness • corneal dryness or discolouration • eye care interventions • effectiveness of eye care interventions.	C

Table continues on page 2

Table continued from page 1

SECTION	RECOMMENDATION	GOR
3.	An assessment by intensive care medical staff should be undertaken when the following are found: • signs of infection • patients with red eyes and/or general sepsis • cornea that is dull and cloudy, or with white lines or spots visible.	C
4.	Where red eyes are identified, with or without exudate, bilateral swabs for culture should be taken.	C
5.	Eyelid closure should be maintained to protect the eyes of intensive care patients who are unable to independently maintain complete lid closure.	B
6.	All patients should receive regular eye cleaning to remove debris, secretions, dried ointment and/or other ocular medications.	D
7.	For all patients with, or at risk of lagopthalmos, second hourly eye care must be undertaken to prevent drying of ocular epithelial surfaces, and reduce the risk of infection. Interventions include: • cleaning of the eye (with saline soaked gauze) • closure of the eyelid by use of either • ocular lubricant, or • creation of a moisture chamber by use of polyethylene wrap The frequency of eye cleansing should vary with the frequency of eye intervention required.	C Consensus
8.	If eyelid closure cannot be maintained passively then mechanical taping methods should be used to close the eye.	C Consensus
9.	If eye infection is suspected, consideration should be given to commencing broad-spectrum topical antibiotic treatment until the result of swabs are available.	D
10.	Clinicians should take care to ensure that patient eyes are not exposed to aspirates during tracheal or oropharyngeal suction procedures.	D
11.	Medical Officers should assess the patient for iatrogenic ophthalmologic complications (at the micro epithelial level) at least weekly in intensive care patients with a length of stay greater than seven days using readily available practical methods.	D
12.	Patients should be referred for specialist ophthalmological consultation where • clinical practices fail to achieve sustained eyelid closure within 24 hours and/or • when iatrogenic ophthalmologic complications are identified, or • patient response to treatment is limited.	C Consensus
13.	Clinicians are to undertake a risk assessment to identity the risk of contamination and mucosal or conjunctival splash injuries when caring for patients PPE (including goggles/face shield/gloves and gown/apron) as per NSW 2007 Infection Prevention control policy should be worn according to the risk assessment.	PD2010_058

Table continues on page 3

Table continued from page 2

SECTION	RECOMMENDATION	GOR
14.	Clinicians are to adhere to the Five Moments of Hand Hygiene [10].	PD2010_058
15.	Equipment for eye care must be kept in its own container separate from other patient hygiene equipment. These containers should be passed through ward cleaning procedures on a regular basis	D
16.	Occupational health and safety principles must be followed including: • use of personal protective equipment, and • ergonomic use of equipment, such as appropriate bed height for staff when treating patients.	C Consensus
17.	Eye care interventions should be included as part of a comprehensive patient care plan.	C Consensus
18.	All ICUs must ensure clinical staff are competent in the delivery of appropriate eye care.	D
19.	All clinical staff must maintain contemporaneous documentation of eye health and interventions. A flowchart, checklist or check box tool is suggested, which should be completed on shift handover for this purpose.	D
20.	All ICUs should monitor the effectiveness of eye care delivered by monitoring for iatrogenic ophthalmological complications. This could include: • review of adverse events as reported • audit of practice • review of ICU eye consults • review of health of donated corneas • point prevalence studies	D

2. INTRODUCTION

Eye care is an important aspect of the nursing management of critically ill patients, especially for those patients whose ocular protective mechanisms may be compromised [11]. Dryness of the cornea and disruption to corneal epithelial surface lining may result in sequelae of corneal abrasion, erosion, infection, ulceration, scarring, rupture or blindness [8]. The intensive care patient is at increased risk for any of these events due to having a co-existing compromised immune response and being exposed to environmental factors and pathogens [12]. Additionally, for the critically ill patient, lagopthalmos, or incomplete eyelid closure, is an important clinical sign contributing to the development of ocular surface disease (OSD) [13-15].

Purpose

This guideline has been developed to provide intensive care clinicians with recommendations to guide eye care practice for critically ill patients.

Projected outcomes for this guideline:

- Facilitation of the diffusion of evidence-based eye care recommendations into clinical eye care practice.
- To support the early detection of eye disease, timely referral for conditions and systematic delivery of eye toilet and treatment.
- Improvement of patient quality of care by routinely addressing iatrogenic ophthalmologic issues, ensuring that on discharge from the unit, visual compromise is not added to existing co morbidities [8].

Scope

Guideline development addresses clinical practices aimed at maintaining/optimising the eye health of critically ill adults nursed in intensive care units (ICUs) in NSW. In particular, practice recommendations are most relevant for patients at increased risk for iatrogenic ophthalmological complications due to a compromise in level of consciousness and/or impaired ability to control eye opening and closure. Guideline development has been based on the assumption that readers possess a working knowledge of anatomy and physiology of the eye.

Target clinicians

This guideline is for the use of all intensive care clinicians, especially for clinicians responsible for the care of any patient in whom protection of the ocular surface cannot be achieved by independent complete eyelid closure. Clinicians who use this guideline must ensure they have a working knowledge of anatomy and physiology of the eye, as well as of ocular protective mechanisms that may become compromised during episodes of critical illness and treatment.

Guideline development

This guideline is a revision of 2007 Eye Care Clinical Practice Guidelines [16]. A guideline development network (GDN) group was formed in November 2011 to review the original guideline, and the primary authors undertook an updated literature review (Appendix 1). Provisional recommendations based on the available evidence were developed and revised by GDN members. Subsequent to this, the revised guideline was written and the revised clinical practice guideline (CPG) sent to the GDN members who assigned their level of agreement with recommendation statements. The guideline narrative was also revised based on group feedback. Due to the delay in publishing the guideline another search was undertaken covering literature published between 1/1/2012-8/7/2013 (Appendix 10). Because no controlled studies were identified no changes were made to the guideline.

How to use the guideline

Clinical judgement should be exercised when applying the principles described in this guideline. Where ophthalmic complications have occurred, the directions of the ophthalmologist should take precedence over the recommendations outlined in this document.

Format of guideline

Recommendations and relevant explanatory literature are presented. Detailed evidence used to support statements may be found in the integrative literature review (Appendix 1).

Rating of the evidence for recommendations

The Australian NHMRC taxonomy 2009[17] was used for grading the level of evidence of a study and grading a recommendation for practice. The assignment of a level of evidence for an individual paper, and the grading of a recommendation was done by the principle authors. If a recommendation did not have an evidence base, the clinical opinion of the guideline network members has been used to inform guideline recommendations.

Table 2: NHMRC grading of recommendations

GRADE OF RECOMMENDATION	DESCRIPTION
A	Body of evidence can be trusted to guide evidence
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	Consensus was set as a median of ≥ 7

NHMRC [18]

Glossary

Bacterial keratitis	Inflammation of the cornea secondary to bacterial infection
Chemosis	Swelling of the conjunctiva, often preventing eyelid closure.
CI	Confidence interval
CNC	Clinical nurse consultant
CNS	Clinical nurse specialist
CONSORT	Consolidated Standards on Reporting Trials http://www.consort-statement.org/?o=1001
Corneal abrasions	Superficial disruption to corneal epithelial lining. Common conditions may be secondary to foreign body or contact lens use.
Corneal erosion	Small/punctate or changes/break in the corneal epithelium creating a breach in the defence mechanisms of the cornea, leaving it vulnerable to pathogenic organisms. Left untreated, corneal erosion may result in ulceration and scarring and compromised vision.
CPG	Clinical practice guideline
Dry Eye	Lack of normal eye tear film and lubrication. Corneal defences are compromised due to lack of IgA and other immune mediators.
ETT	Endotracheal tube
EVP	External validation panel
Exposure keratitis/	Inflammation of the cornea, either sterile or microbial, may result in epithelial breakdown.
Filamentary keratitis	A condition caused by the formation of epithelial filaments of varying size and length, attached at one or both ends of the cornea. Patients often experience a foreign body sensation, grittiness, discomfort, photophobia, eyelid twitching, increased blinking or pain.
GCS	Glasgow Coma Scale
GDN	Guideline development network
GOR	Grading of recommendations
HDU	High dependency unit
Hypopyon	An accumulation of pus in the anterior chamber of the eye
ICC	Intensive care collaborative
ICC-CDC	Intensive care collaborative – consensus development conference
ICCMU	NSW Intensive Care Coordination and Monitoring Unit
ICU	Intensive care unit includes all types of units designated as such in NSW. May include units currently designated as ICU, HDU, critical care units
Injection	Conjunctival redness
Keratopathy	Ocular surface breach predisposing to corneal infection, inclusive of any corneal disease, dysfunction or abnormality.
Lagophthalmos	The inability to close or poor closure of the eyelids.
Microbial keratitis	Inflammation of the cornea secondary to bacterial, viral or fungal infection. May result in corneal ulceration and perforation.

Neurotrophic keratopathy	A degenerative disease characterised 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, and perforation secondary to poor healing.
NHMRC	National Health and Medical Research Council
Ocular SurfaceDisease (OSD)	General term covering conditions of superficial corneal exposure. These may range from micro/punctuate lesions to larger geographical defects de-epitheliazing the cornea.
OR	Odds ratio
PICO	Population intervention comparison outcome
Punctate epithelial keratopathy	Micro epithelial defects to the corneal surface
RCT	Randomised control trial
SR	Systematic review

3. BACKGROUND

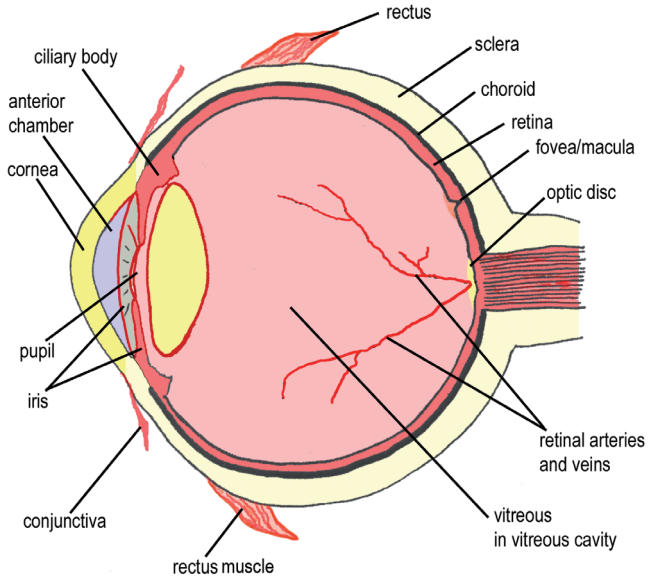
Summary of normal anatomy and physiology of the anterior ocular surface

The ocular surface is protected from injury and infection by a number of structures including: (refer Figure 1)

1) retractable eyelids, which have a mucous membrane covering that is continuous with the eyeball, and epithelium of the sclera, cornea and conjunctiva. Eyelids mechanically protect the eyes from dehydration and injury [19].
2) an opaque sclera, which ensures that light transmitted to the globe enters only through the transparent corneal covering of the pupil [19].
3) an avascular cornea, which functions to admit and refract light. If injured, it may be slow to heal. Five layers of corneal tissue (superficially epithelium changing to deeper endothelial tissue) provide a protective barrier against abrasion and erosion, and also provide a permeability barrier against eye pathogens [20], and
4) conjunctival epithelium, which extends from the eyelid margins anteriorly, sharply turning on itself to cover the sclera, creating a moist sac. This sac is continuous with the epithelium lining the ducts of tear producing glands, and plays a central role in the defence of ocular surface microbial injury [20]. The conjunctiva has a rich blood supply. If damaged, redness and swelling may be present. Tissues may protrude between the eyelids, exacerbating the effects of lagopthalmos, and resulting in corneal opacity and vision loss [20].

Proper functioning of the above structures, and transparency of the cornea are therefore essential requirements for eye surface protection and vital for vision [20, 21]. Under normal physiology, closure of the eyelids occurs, and is protective of the ocular surface, blink reflex and tear production are present, and the sclera and cornea appear bright and clear [19].

Figure 1: Horizontal section of a schematic eye



Images from Eye Care Emergency Manual, used by permission of ACI-Ophthalmology Network [22]

Function of tears and blinking mechanism

Complex physiology underlies the action of eyelid closure and blinking. These two actions provide a mechanical barrier to ocular injury, and prevent drying out and desiccation of the corneal epithelium by distributing tear film across the exposed surface of the eye [21, 23, 24]. Lacrimal gland production of tear film is inherent to healthy eye function [20]. Tear film contains bactericidal enzymes (lysozyme, lactoferrin), and proteins (IgA). Tears help to provide a defence against microbial colonisation by providing a medium for transport of leucocytes in the event of eye injury or infection [19]. Any increase in irritation from the cornea or conjunctiva will trigger a lacrimal reflex, resulting in an increased tear volume for the eye [20]. Blinking and tear production also aids in smoothing out corneal irregularities, protects the air-corneal interface and refractive surface of the cornea. It also supports the clearance of metabolic waste via nasolacrimal drainage mechanisms and enables oxygen delivery to the cells of an avascular cornea [19].

Abnormal physiology

Any disruption to ocular epithelial tissue may compromise vision and predispose the cornea to infection and OSD [21, 25]. Mechanisms underlying the development of conditions such as corneal abrasion, erosion, or pathogenic invasion primarily relate to lack of eyelid closure and interruption to blinking reflex and blinking frequency [20, 21, 23]. In the ICU population the use of muscle relaxants and sedation have been identified as contributing to lagopthalmos and of placing patients at increased risk [1, 3, 23].

Epidemiology of ocular complications in the critically ill adult

Iatrogenic eye complications cover a range of OSD involving structures such as the cornea, sclera and conjunctiva. Pathologies may range from microepithelial corneal punctures (often associated with dry eye syndrome), to corneal abrasion, erosion, ulceration, infection and scarring [24]. Superficial keratopathy, that is, any breach of the ocular surface [1, 15, 21], in the ICU population, has been found to predispose to infection of the corneal epithelium (keratitis) [1, 19, 26]. This infection may present as microbial, bacterial or fungal in origin [14, 21, 23]. Keratitis in the presence of corneal exposure has been found to be a key factor in the development of ocular surface disease [1, 2, 14, 19, 27] and has resulted in serious complications such as vision loss, corneal rupture, and the need for corneal transplantation [1, 12, 21, 28, 29].

A high incidence of OSD among ICU patients has been reported with a range from 23%-60% of patients affected. Of these, exposure keratopathy has been found in 23%-40% [2, 26]. Superficial keratopathy has been found in 60% of patients sedated or on neuromuscular blockade [1]. Microbial keratitis has been found to be more prevalent than the non-ulcerative sterile form of keratitis (77% vs. 10%) [3]. (See Table 5.)

Why critically ill patients are at increased risk of ocular surface disorders

There are a number of causes of impaired ocular defence mechanisms in critically ill patients including:

- an alteration in level of consciousness, impacting on the blink reflex and lagopthalmos
- metabolic derangements
- immunosuppression
- mechanical ventilation
- medications such as sedatives, muscle relaxants and paralysis
- open suction technique
- systemic disease [2, 5, 13, 24].

The ICU environment is also a pathogen-rich environment. This may contribute to the increased exposure of the ocular surface to microorganisms [28]. Multi-resistant organisms associated with microbial keratitis include: pseudomonas aeruginosa, acinetobacter, staph epidermis, enterococcus, enterobacter, proteus mirabilis and klebsiella pneumonae [6, 21, 28]. Regular eye care has been found to reduce the developmnet of corneal abnormalities and infections in ICU populations [4, 14, 29]. Meticulous nursing care is therefore essential to prevent iatrogenic ophthalmological complications and potentially serious visual impairment [11, 24].

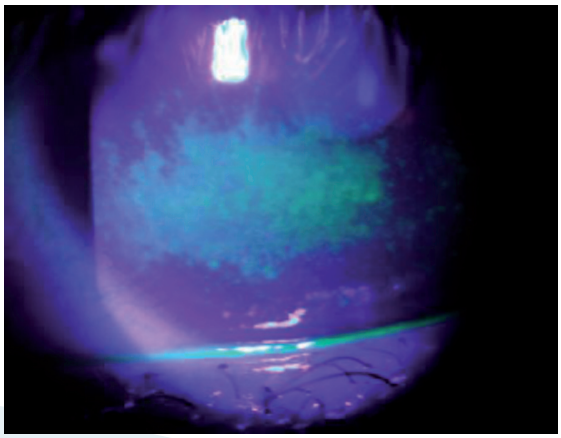


Figure 2: Dry eye

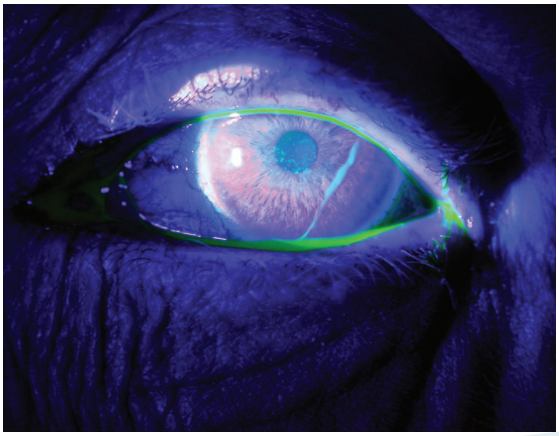


Figure 3: Dry eye

Images from Eye Care Emergency Manual, used by permission of ACI-Ophthalmology Network [22]

Eye care for the critically ill patient

Regular eye care for intubated and ventilated patients is considered routine nursing practice. Anecdotally however, it has been shown that practice varies greatly between intensive care units regarding the frequency and method of eye care undertaken. Historically, specific eye care practice has included regimens of cleaning the eyes with sterile water or normal saline every two to four hours [4, 15, 29, 30], twice daily [7] or daily [31]. Installation of a lubricating liquid, such as methylcellulose eye drops, has also been commonly used [7, 15, 29, 30, 32]. Eye ointment has been applied for high risk patients, or where evidence of eye injury may be apparent, such as when conjunctival oedema is present [2, 4, 5, 12, 30, 32-34]. For conditions of conjunctival or corneal exposure, methods such as passive eye closure [33], eye taping [2, 5, 15, 30], padding with gel membranes [2, 15, 29, 34], and creation of moisture closed chambers using polyethylene film [2, 4, 7, 30, 32] or goggles [5] have been described (see Table 3). From the literature review it is unclear if any of thee methods identified contributed to ocular surface protection, or to the maintenance of eyelid closure [33], as there has been a limited number of quality studies, and significant variability in the methods of eye care used in studies.

Table 3: Eye care methods used by authors

Author	Eye care method
Bates J et al. Clinical Intensive Care 2004	Routine eye care to all patients daily: cleaning lids with saline and sterile gauze daily, plus ocular lubricant at least twice daily. Corneal Care with adhesive to tape the eyelids closed. Geliperm/Polyacrylamide Gel Membrane Changed at regular intervals to prevent drying.
Cortese D et al. American Journal of Critical Care 1995	All patients eye toilet with n/s 2/24 Polyethylene Cover (PC) over the eyes to create a moisture chamber. Changed daily. Methylcellulose (hypromellose) lubricating drops 2/24.
Ezra D et al. Intensive Care Medicine 2009	• Lacrilube applied to inferior conjunctival fornix 6/24. • Geliperm dressing cut to completely cover the top and lower lid and applied onto the closed eye 4/24 or sooner if signs of drying. • Staff trained in eye care, particularly in early recognition of drying Geliperm.
Guler E et al. Journal of Clinical Nursing 2011	For all subjects, standard eye care with sterile n/s soaked gauze conducted twice daily. Then Polyethylene cover applied to one eye every 12/24, and Carbomer Methylcellulose drops 6/24 to the other eye.
Joyce N Joanna Briggs Institute (Systematic Review) 2002	Polyethylene Cover used. Hypromellose eye drops two drops 2/24 combined with 1–1.27cm Duratears ointment 4/24.
Koroloff N et al. Intensive Care Medicine 2004	• Standard care for both groups: 2/24 eye cleaning with n/s. • Lacri-lube ointment 2/24 plus 2/24 Hypromellose drops combination. • Polyethylene Cover/cling wrap placed over the eyes to create a moisture chamber. Micropore used to seal the edge. Changed every shift, or when necessary.
Laight S et al. Intensive and Critical Care Nursing 1996	Sterile water used for eye cleaning 2/24 for all patients. Hypromellose drops 1/24 – 6/24 with corneal dryness. Micropore used for mechanical eye closure. Gel membrane/ Geliperm covers applied on clean eye only, and assessed 2/24 for dryness and change.
Lenart S, Garrity J American Journal of Critical Care 2000	1.27cm Duratears artificial tear ointment 4/24.passive eyelid closure.
Rosenberg J et al. Critical Care Medicine 2008	Moisture chamber (MC); lubricating ointment.
Sivasankar S et al. Indian Journal of Critical Care Medicine 2006	• Closed moisture chamber created using swimming goggles and sterile water moistened gauze 12/24. • Open chamber method (ocular lubricant and mechanical eye closure using securing tape 12/24).
So H International Journal of Nursing Studies 2008	• All subjects received standard eye care: cleansing of the eyelids and surrounding skin 4/24 with n/s. • Lanolin/Durotears ointment: 1cm applied into the "V" pocket between the eyeball and lower lid of each eye 4/24. • Polyethylene cover/Gladwrap, tailored to cover the eyes from the eyebrow to the cheekbone, snuggly adhering to form a closed moisture chamber. Micropore adhesive tape use to secure edges of the wrap if the seal was not adequate. PC wrap changed daily, or when visibly soiled.

4. RECOMMENDATIONS FOR PRACTICE

Patient assessment

SECTION	RECOMMENDATION	GOR
	Assessment	
1	Eye health assessment should be part of routine patient physical assessment practice and be performed on admission and then routinely at the beginning of the new nursing shift. The initial assessment should include input from the patients' family to identify pre-admission ocular conditions and treatment and to identify the need for ophthalmology review.	D
2.	Admission and ongoing assessment should include, but is not limited to the following: • risk factors for OSD • ability for patient to maintain complete eyelid closure • evaluation of eye and eyelid cleanliness • corneal dryness or discolouration • eye care interventions • effectiveness of eye care interventions.	C
3.	An assessment by intensive care medical staff should be undertaken when the following are found: • signs of infection • patients with red eyes and/or general sepsis • cornea that is dull and cloudy, or with white lines or spots visible.	C
4.	Where red eyes are identified, with or without exudate, bilateral swabs for culture should be taken.	C

A limited numbers of studies have focussed on eye care assessment for the adult intensive care patient. Research areas have ranged from identifying risk factors for lagopthalmos [13], risk factors for OSD [13, 15] and studies on eyelid cleanliness and corneal dryness [15, 24]. Consensus support is given to a comprehensive patient history and assessment on admission and at regular intervals [11, 24] such as at shift handover as an essential component of clinical care. These recommendations are based on existing findings that critical illness, pre-existing conditions and intensive care treatment all contribute to an increased risk of iatrogenic eye complications for the critically ill adult.

To ensure that all-important information is obtained, and in keeping with good clinical practice, clinicians should approach family members for information regarding the patient's medical and surgical history. This history should include ocular conditions and treatment on admission, in order to assess the risks of and early recognition of OSD [11]. Highly effective eye regimes may be compromised by interruption to treatment. On admission, previous eye injury or surgery, the presence of an artificial lens, a history of cataracts, glaucoma and any other pre-existing eye treatment and medications, such as anticholinergic drops, should be elicited [35, 36].

A number of studies have focussed on the role of critical illness, pre-existing conditions and the treatment environment of intensive care as factors contributing to iatrogenic risk for eye complications. Critical illness commonly presents with a range of conditions potentially affecting ocular defence mechanisms. The following medical conditions have been investigated: immunosuppression [13], sepsis and trauma [6, 21], multi-organ failure [1, 6], burns [35], Guillian Barre Syndrome [37], myasthenia gravis [38], collagen disease and diabetes [36], neurological presentations [23, 39], and ocular conditions arising due to various complications of systemic disease [3, 39]. Pre-existing eye conditions also place this population of adult intensive care patients at greater risk, especially if interruption to existing treatment regimes were to occur by virtue of admission to the intensive care unit [8].

The patient treatment process within the intensive care environment may also create barriers to ocular health and integrity of eye function. The use of sedation and neuromuscular blockade has been identified as a precursor to lagopthalmos [5, 7], and this relationship has been shown to strengthen with an increased length of ICU stay [4, 7, 21] and an increased length in ventilation time [6, 12, 21]. Unconscious patients are vulnerable to eye injury and infection due to inadequate lid closure and epithelial exposure [13, 36]. This may lead to drying of the conjunctiva and corneal epithelium, infection, permanent corneal scarring and visual loss [15, 24]. In the ICU environment, other risks for eye infection and corneal disruption arise from respiratory pathogens [6, 14, 19], high gas flow, CPAP, the use of tracheal or oropharyngeal open suction [12], copious secretions, patient positioning (for example proning) [36] and cross infection from other body infective surface wounds. [12, 14]

Table 4: Risk factors for ocular surface disorders

Risk factor	Level of risk	Overview of evidence	References
Lagopthalmos	Probably highly significant	2 x RCT 1 x Prospective cohort 1 x Observational 1 x Retrospective case control 1 x Narrative review	(5, 7) (40) (6) (41) (36)
Length of sedation/use of neuromuscular blockade	Probably significant	1 x RCT 2 x Observational 2 x Clinical practice guideline 1 x Narrative review	(36) (6, 21) (11, 24) (36)
Length of stay	Probably a function of critical illness	2 x RCT 1 x Observational	(4, 7) (21)
Length of ventilation	Probably a function of critical illness	2 x Observational 1 x Narrative review and meta-analysis	(6, 21) (12)
Medical conditions	Possibly a risk	1 x RCT 2 x Observational 1 x Narrative review	(5) (6, 21) (36)
Respiratory pathogens	Possibly a risk	1 x Narrative review and Meta-analysis 1 x Narrative review	(12) (36)

Clinical practice highlights that early recognition of signs and symptoms of ocular surface disease and early treatment improves resolution of these conditions [8]. Initially on admission, and routinely regularly thereafter, such as at shift handover, recommendation is made that all patients should be assessed for risk factors, the ability to maintain eyelid closure, in addition to assessment for signs and symptoms of eye infection and disease [13, 14]. A bright light (using a pen torch) should be used for eye examination, looking for signs of infection or disease, conjunctival swelling, dullness, cloudiness, whiteness or spotting of the cornea. New findings should initiate the administration of additional lubricant in the short term and trigger a medical alert for ophthalmologic review [8]. Where red eyes are found, with or without exudate, a swab and culture of both eyes should routinely be conducted, and a medical review completed. Development of a red eye in a septic patient should be addressed as an ocular emergency, as the patient's visual capacity may deteriorate within hours, and may be dependent on the need for rapid intervention [8]. Frequency of ocular assessment and eye care interventions used should routinely be documented in a care plan that is regularly reviewed and updated. Results of patient assessment and evaluation of the effectiveness of interventions should also be documented at least each nursing shift.

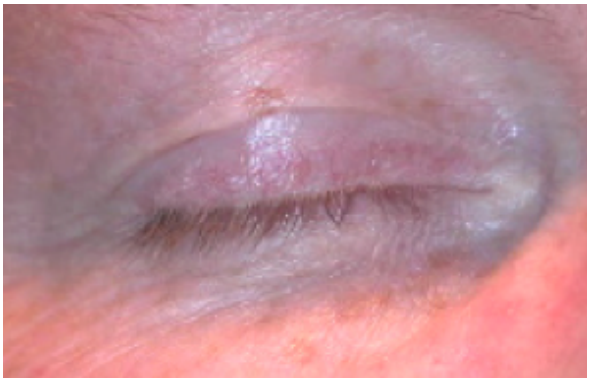
Figure 4: Method of eyelid taping

It is important to ensure that the eye lids are opposed correctly so that the eye lashes are not able to scratch the eye.

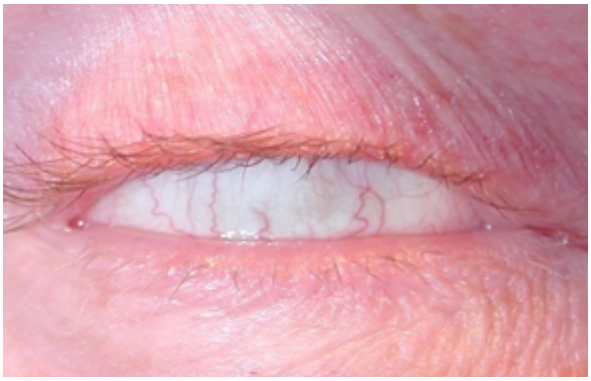
Source [8]

Figure 5: Grading lagaopthalmos

Grade 1: Eyes completely closed



Grade 2: Eyes open: Sclera or conjunctiva visible



Grade 3: Eyes open: Cornea visible

Table 5: Opthalmology abnormalities

Figure 6: Chemosis

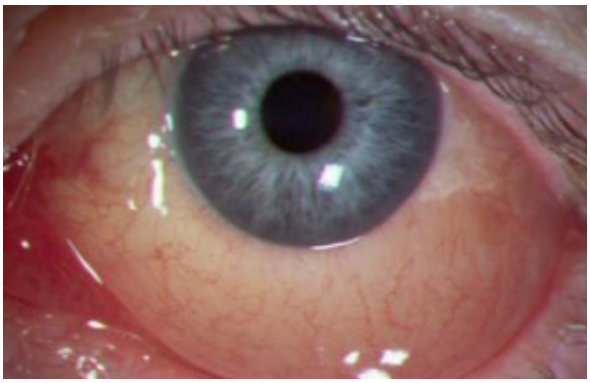


Figure 7: Corneal abrasion

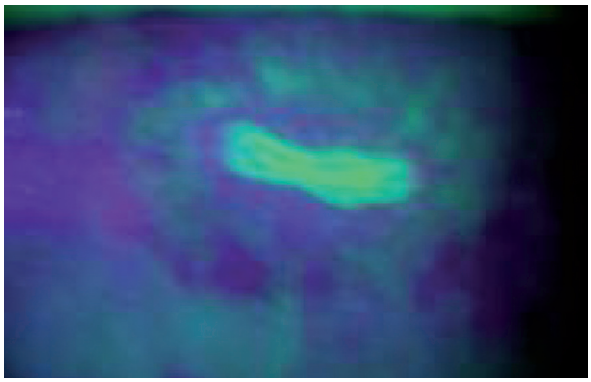


Figure 8: Allergic conjunctivitis

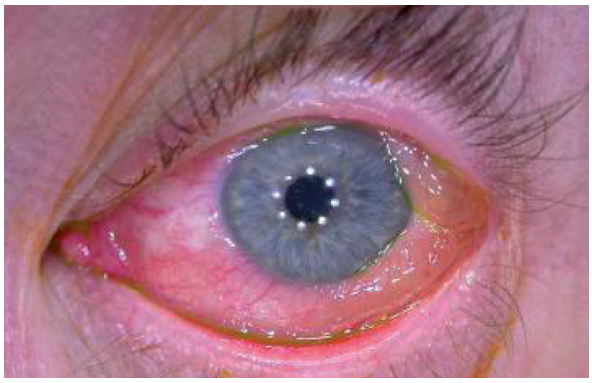


Figure 9: Marginal keratitis

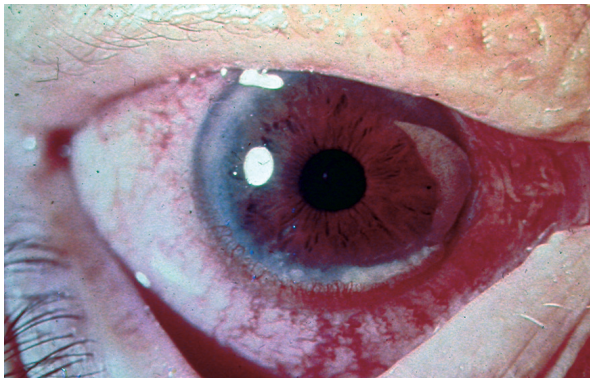


Figure 10: Viral conjunctivitis

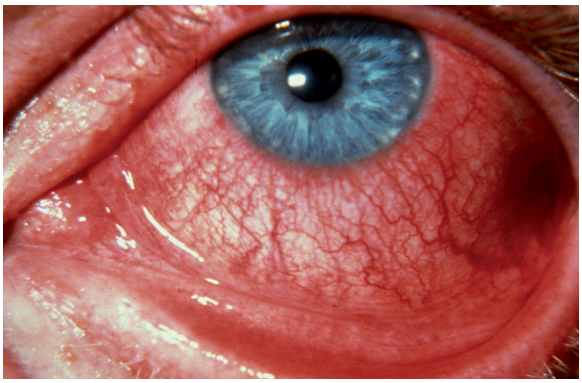


Figure 11: Bacterial ulcer

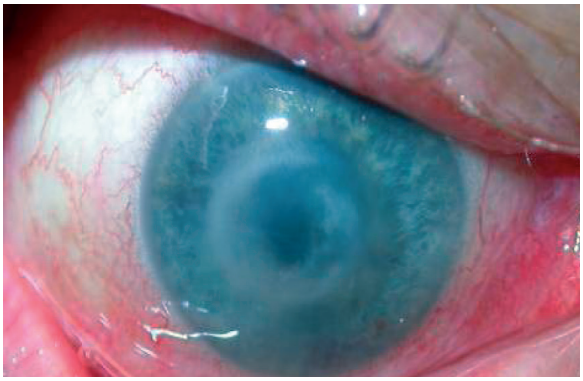


Figure 12: Bacterial conjunctivitis

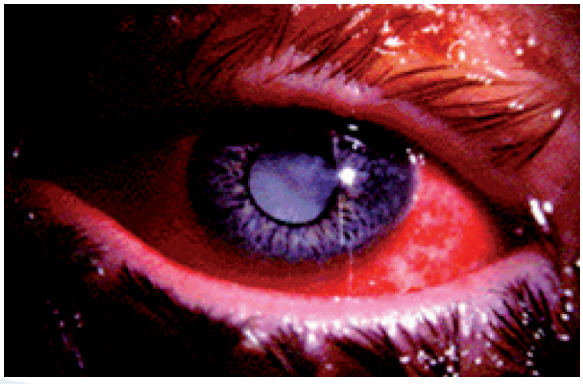
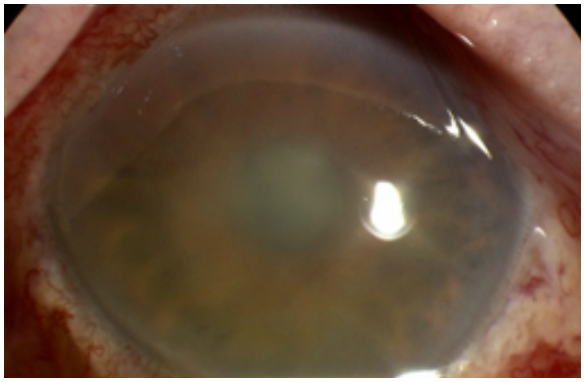


Figure 13: Red eye in septic patient



Figures 6-13 sourced from Eye Emergency Manual [22].

Interventions

SECTION	RECOMMENDATION	GOR
5.	Eyelid closure should be maintained to protect the eyes of intensive care patients who are unable to independently maintain complete lid closure.	B
6.	All patients should receive regular eye cleaning to remove debris, secretions, dried ointment and/or other ocular medications.	D
7.	For all patients with, or at risk of lagopthalmos, second hourly eye care must be undertaken to prevent drying of ocular epithelial surfaces, and reduce the risk of infection. Interventions include: • cleaning of the eye (with saline soaked gauze) • closure of the eyelid by use of either • ocular lubricant, or • creation of a moisture chamber by use of polyethylene wrap The frequency of eye cleansing should vary with the frequency of eye intervention required.	C Consensus
8.	If eyelid closure cannot be maintained passively then mechanical taping methods should be used to close the eye.	C Consensus
9.	If eye infection is suspected, consideration should be given to commencing broad-spectrum topical antibiotic treatment until the result of swabs are available.	D
10.	Clinicians should take care to ensure that patient eyes are not exposed to aspirates during tracheal or oropharyngeal suction procedures.	D
11.	Medical Officers should assess the patient for iatrogenic ophthalmologic complications (at the micro epithelial level) at least weekly in intensive care patients with a length of stay greater than seven days using readily available practical methods.	D
12.	Patients should be referred for specialist ophthalmological consultation where • clinical practices fail to achieve sustained eyelid closure within 24 hours and/or • when iatrogenic ophthalmologic complications are identified, or • patient response to treatment is limited.	C Consensus

Incomplete eye closure (lagopthalmos) has been identified as strongly contributing to the development of iatrogenic ocular surface disorders (OSD) [5-7, 13, 24, 36, 41]. The vulnerability of ICU patients to lagopthalmos has been attributed to a number of factors including reduced level of consciousness, tracheal intubation, prolonged sedation, paralysis, prolonged mechanical ventilation and PEEP. Medical conditions with significant metabolic derangement and positive fluid balances also contribute [1, 5-7, 12, 14, 19, 21, 26, 27, 42]. Exposure of the eye due to inadequate lid closure may lead to drying of the conjunctival and corneal epithelium, and trigger a cascade of infection and corneal erosion resulting in permanent corneal scarring and visual loss[8]. Early identification of incomplete eyelid closure by regular assessment of eyelid position (Figure 5), provides a strategy for early intervention to close and protect the eyes. However, while the underlying principle of the eye care CPG is to ensure eye lid closure, this strategy is based on consensus opinion that treatable causes for lagopthalmos have first been identified and addressed.

Various methods have been used to provide protective barriers and moisture to the corneal surface. Evidence supporting practice however has been inconsistent, due to variations in definitions and methodologies used.

Study outcomes on the effectiveness of interventions used should therefore be viewed with caution. Regardless, support exists for the use of lubricants in all unconscious or heavily sedated patients [13] as lubricants have been found to decrease the risk of corneal dehydration and infection [26]. The literature also supports the use of lubricants over eye drops, as ointment has been shown to provide longer lasting eye moisture, and require less frequent installation [33]. Lubricants have been found to be better than passive eyelid closure in reducing the incidence of corneal erosion [32, 33], less effective than mechanical eye covers (except Geliperm) to reduce corneal breakdown [2, 5, 15], and less effective than polyethylene cover moisture chamber to reduce the incidence of exposure keratopathy [4, 30, 32]. Other studies have found efficiency with the use of either polyethylene covers or lubricants to decrease the incidence of corneal breakdown [4]. Combination use of 1.27cm Duratears ointment with polyethylene covers has been shown to result in a low incidence of OSD (5.3% - 6.8%)[4, 33], and Micropore edging has additionally been used with polyethylene covers in order to create a better seal [4, 30]. Research using swimming goggles as a moisture chamber and changed 12/24 has proved inconclusive in reducing the incidence of OSD [5]. While a meta-analysis [12] supports the use of moisture chambers over the use of lubricants, these findings have been based on studies with a moderate to high risk of bias.

For patients unable to maintain eyelid closure independently, interventions to cover the eye and to maintain corneal moisture (Appendix 7 Clinical practice effective in preventing iatrogenic opthalmological complications) appear to reduce the incidence of eye complications [2, 4, 5, 12, 30, 33, 34, 43]. These interventions include the use of either passive or mechanical means to obtain complete lid closure [13, 32, 33]. Mechanical eye covers have been advocated as a strategy to minimise the risk of eye infection in cases of respiratory infection and wherein open tracheal suction techniques may be in use [26-28]. These covers have been advocated for use in combination with eye ointment [4, 29, 30, 32], paraffin gauze, dressing and tape [15]. All interventions include the use of regular eye hygiene. Eye cleaning with saline soaked gauze 2/24 – 4/24 to remove exudate, debris or dried ocular medications [13, 15, 29, 34] has evidence-based support. However, while the use of normal saline over sterile water remains debatable [4, 13, 15, 30], agreement exists on the need to promote patient comfort and healing by frequently cleaning the eyes with eye care interventions utilised.

Given the limited success at protecting and supporting ocular epithelial integrity associated with moisture chambers, mechanical covers, and passive eye closure, additional mechanical means of eye closure by taping with Micropore has also been suggested [5, 15]. The proviso with

Figure 14: Moisture chamber

Image courtesy RNSH ICU Eye Care Guideline

this recommendation is that extreme care should be taken to prevent injury because the tissues surrounding the eyes are delicate and inadvertent application of tape to the cornea may cause damage [20, 21].

To summarise, available evidence lends support to routine eye hygiene for all patients, and eyelid cleansing if lids are unclean [34, 44]. Eye lubricants, eye covers and eye taping have been found to either decrease the incidence or the severity of OSD once apparent [5, 34, 44]. Furthermore, that incomplete eyelid closure is indicative of a need for eye hygiene, eye lubricant and eye covers, with the exception of the use of Geliperm [15, 24, 34].

Eliminating lagopthalmos and ocular surface exposure has been shown to be essential for the prevention of microbial colonisation and infection [23]. Signs of infection may include redness, pain or discharge [15], lid and conjunctival swelling with hyperaemia, lid margin crusting or corneal clouding [14, 24]. Suspicion of infection, medical review and subsequent to obtaining bilateral eye swabs for culture [15], and medical consideration for ophthalmologic referral, consideration should also be given to the use of a broad-spectrum antibiotic until the result of eye swabs become available. Two antibiotics have been cited in the literature for interim use in this situation: gentamycin, for use when respiratory pathogen involvement is suspected [14], or otherwise, a chloramphenicol prescription [6].

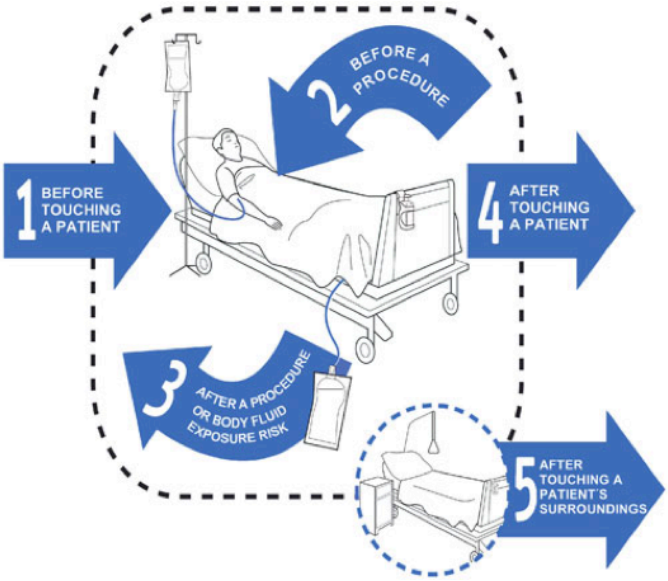
The frequency for medical assessment of iatrogenic ocular surface disease in ICU patients cited in the literature varies. This has ranged from weekly [13] to more frequent examination especially with symptomatic patients [15, 24]. Regardless, timely specialist referral is recommended for symptomatic patients, or for patients in whom treatment response is limited, or the adopted interventions do not achieve the goal of eyelid closure [13-15].

Infection prevention

SECTION	RECOMMENDATION	GOR
13.	Clinicians are to undertake a risk assessment to identity the risk of contamination and mucosal or conjunctival splash injuries when caring for patients PPE (including goggles/face shield/gloves and gown/apron) as per NSW 2007 Infection Prevention control policy should be worn according to the risk assessment.	PD2007_036 Australian Guidelines for Prevention & Control of Infection in Healthcare.
14	Clinicians are to adhere to the Five Moments of Hand Hygiene [10].	PD2010_058
15.	Equipment for eye care must be kept in its own container separate from other patient hygiene equipment. These containers should be passed through ward cleaning procedures on a regular basis.	D

Hand hygiene

The NSW Health Hand Hygiene Policy (PD2010_058) states that all staff must perform hand hygiene as per the Five Moments for Hand Hygiene (http://www.hha.org.au/). Hand hygiene must occur before touching the patient; prior to a procedure; after a procedure or body fluid exposure risk; after touching a patient; after touching a patient's surroundings. Hand hygiene can be performed using appropriate soap solutions and water or ABHR (alcohol-based hand rub). Soap and water must be used when hands are visibly soiled.



Based on the 'My 5 moments for Hand Hygiene', URL: http://www.who.int/gpsc/5may/background/5moments/en/index.html © World Health Organization 2009. All rights reserved.

NSW Ministry of Health policies

Prevention of infection is an important aspect of any clinical practice guideline. Users are directed to the following policy directives covering infection control. Local policy must also be consulted.

1. Infection Control Policy - http://www0.health.nsw.gov.au/policies/pd/2007/PD2007_036.html
2. Infection Control Policy: Prevention & Management of Multi-Resistant Organisms (MRO) http://www0.health.nsw.gov.au/policies/pd/2007/PD2007_084.html
3. Hand Hygiene Policy http://www0.health.nsw.gov.au/policies/pd/2010/pdf/PD2010_058.pdf
4. Australian Guidelines for the Prevention and Control of Infection in Health Care http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/cd33_complete.pdf

Other relevant policies and standards

1. Australian Guidelines for the Prevention and Control of Infection in Health Care http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/cd33_complete.pdf

Personal protective equipment

The Australian Guidelines for the Prevention and Control of Infection in Health Care and the NSW Infection Control Policy (PD2007_036) state that all procedures that generate or have the potential to generate secretions or excretions require that either a face shield or a mask with protective goggles be worn.

Therefore, the use of personal protective equipment (PPE) to prevent mucosal or conjunctival splash injury is

mandatory while suctioning the patient (both open and closed suction). This must include mask and goggles or face shield; gloves and gown/apron.

Critically ill patients are at increased risk of eye infections due to impaired mechanisms such as eyelid closure and reduced tear film [13, 20, 23, 24]. Regular eye hygiene is an integral component of eye care interventions provided for critically ill patients and should routinely pre-empt eye treatment.

Eye care equipment should be kept in containers separate from other hygiene equipment. Additionally, medications including eye lubricants must be for single patient use only, and must be kept in locations and disposed of as indicated by the manufacturer. Critically ill patients are also at risk of ocular infections due to exposure to respiratory pathogens during suction procedures [12, 24, 27, 36]. Accordingly, clinicians should consider interventions to limit this exposure including:

- use of eye covers
- methods of limiting aerolisation of secretions (such as closed tracheal suction systems)
- ensuring suction catheters are not passed over or near patient's eyes.

Workplace health and safety

SECTION	RECOMMENDATION	GOR
16.	Occupational health and safety principles must be followed including: • use of personal protective equipment, and • ergonomic use of equipment, such as appropriate bed height for staff when treating patients.	Consensus

Prevention of work injury is an important aspect of any clinical practice guideline. Users are directed to the following policy directives covering work health and safety. Local policy must also be consulted.

NSW Work Health and Safety Act 2011 www.legislation.nsw.gov.au/maintop/view/inforce/act+10+2011+cd+0+N

The NSW Work Health and Safety Act 2011 states that organisations must eliminate risks to the health and safety of workers where at all possible. When it is not possible to eliminate risks, the risk must be minimised as far as reasonably practicable. Organisations must provide appropriate PPE for use by staff. Staff have a responsibility to use that PPE according to policy.

The worker has an obligation under the NSW Work Health and Safety Act 2011 to;

i) take all reasonable care for their own safety

ii) take care that their acts or omissions do not adversely affect the health and safety of other persons

iii) comply with any reasonable instruction they are given.

Governance

SECTION	RECOMMENDATION	GOR
17.	Eye care interventions should be included as part of a comprehensive patient care plan.	Consensus
18.	All ICUs must ensure clinical staff are competent in the delivery of appropriate eye care.	Consensus
19.	All clinical staff must maintain contemporaneous documentation of eye health and interventions. A flowchart, checklist or check box tool is suggested, which should be completed on shift handover for this purpose.	D
20.	All ICUs should monitor the effectiveness of eye care delivered by monitoring for iatrogenic ophthalmological complications. This could include: • review of adverse events as reported • audit of practice • review of ICU eye consults • review of health of donated corneas • point prevalence studies	D

Governance mechanisms are essential if the eye health of critically ill patients is to be maintained and incidence of iatrogenic ophthalmological complications minimised. These mechanisms include:

- contemporaneous documentation
- inclusion of ophthalmological problems of critical illness in clinician education
- evaluation of practices and patient outcomes.

Eye care interventions should be included in a comprehensive patient care plan, which is regularly reviewed and updated. This approach facilitates awareness of changes to the patient's condition, eye care treatment requirements and a record of treatment outcomes [13]. Standing orders may be useful in ensuring timely intervention such as the initiation of ocular antibiotics where infection is suspected. Contemporaneous documentation of patient eye status (and treatment), recorded each nursing shift as a minimum, may be aided by the use of a tick box checklist tool for attachment to either paper flow chart, or CIS entry.

Staff training in eye care practice has been identified as being essential to addressing the incidence of OSD in ICU [34]. For this reason, staff education on the essentials of eye care practice, including hand hygiene and infection control for eye care management, has been recommended. A comprehensive education program is also suggested, including content covering ocular physiology and pathophysiology, treatment options, eye care guidelines and care plan development.

Currently, Australasian data on the epidemiology of iatrogenic ophthalmological complications in ICU is limited. To date, limited data has been obtained in NSW through the use of the IIMS incidence reporting mechanism. Ongoing monitoring OSD rates and the effectiveness of eye care practices does have support in the literature [13]. The use of existing auditing tools and outcome assessment measures, such as IIMS and practice audit reporting, should be considered in order to identify both individual and system issues negatively affecting patient quality of care. Consensus among GDN members also supports the usefulness of auditing processes to track the rate and need for ophthalmologic intervention, to review the health of donated corneal tissue, and for use as a point prevalence study to identify the incidence of OSD for patients in the ICU unit at any time point.. In conclusion, it has also been recommended that the use of data and information gathered through auditing processes, iteratively inform eye care practice and policy development at a local ICU level.

5. GUIDELINE DEVELOPMENT HISTORY

1. November 2011 – New guideline development network formed; new systematic review and guideline scope development
2. November-February 2012 – Literature review (Table 7)
3. March 2012 – Consensus development meeting – recommendation development
4. April 2012 – GDN consensus (Table 7)
5. August 2013 – Network consultation

Table 6: External validation members

NAME	ROLE	HOSPITAL
EXTERNAL VALIDATION		
Jeff Breeding, CNC	Intensive care	SVH – Sydney
Leanne Schubert, CNE	Intensive care	Manning
Mark McLennan, CNC	Intensive care	Lismore
Philip Marshall, NUM	Intensive care	Sutherland
Skye Vagg, CNE	Intensive care	Griffith
Sue Lamb, CNC	Intensive care	Gosford

Table 7: Consensus results

RECOMMENDATION	1	2	3	4	5	6	7	8	9	10
GDN	9 (8.25-9)	9 (8-9)	8.5 (8-9)	8 (8-8.75)	9 (8-9)	9 (8-9)	9 (7.25-9)	7.5 (7-8)	9 (8-9)	9 (8.25-9)
EVP	8 (7-9)	8 (7-8)	8.5 (8-9)	8 (8-8.75)	9 (8-9)	9 (8-9)	9 (7.25-9)	7.5 (7-8)	9 (8-9)	9 (8.25-9)

RECOMMENDATION	11	12	13	14	15	16	17	18	19
GDN	7.5 (7-8.75)	8 (7.25-8.75)	9 (8.5-9)	9 (8.5-9)	9 (8-9)	9 (8.25-9)	8.5 (8-9)	9 (8-9)	8 (8-8.75)
EVP	7.5 (7-8.75)	8 (7.25-8.75)	9 (8.5-9)	9 (8.5-9)	9 (8-9)	9 (8.25-9)	8.5 (8-9)	9 (8-9)	8 (8-8.75)
Median (IQR)									

6. APPENDICES

Appendix 1: 2012 literature review

Introduction

The search for literature to inform this guideline update and review was undertaken within the context of the 2007 Eye Care CPG. Initially a bibliography citation search was conducted using keywords: eyes and adult intensive care patients. Animal, paediatric, burns and trauma studies were excluded. Following this, a structured search of databases was conducted and outlined below.

Results of search strategies

Structured research questions:

1. What is the incidence of iatrogenic ophthalmological complications in the adult ICU population?
2. What risk factors have been identified for iatrogenic ophthalmological complications in adult ICU patients?
3. What clinical practices are effective in preventing ophthalmological complications?

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

Databases:	Pubmed, OvidSP		
Key words:	Eye + intensive care/critical care (+ guidelines/clinical practice/eye assessment/ eye exam/eye risk factors/iatrogenic ophthalmic complications/prone positioning/ nursing/corneal/epithelial damage/infection)		
Publication years:	2006 - 2012		
Other search filters:	Meshing of terms, and combined searches included in strategy. Adults (plus 13 -18 yrs and older), humans: male and female.		
English language only			
Adult	45		3 paediatric

How many articles first hit? 19 bibliography citation search, 20 PubMed, 9 OVID SP.

Studies reviewed for the 2012 Eye Care Clinical Practice Guidelines development have been organised according to the above three research questions.

Literature review process

The primary authors (KJ and KR) reviewed each article independently using the data extraction tool. Disagreements were resolved through discussion

Description of literature identified

Only 17 papers were found with only seven suitable for grading according to NHMRC guidelines (see Table 8 for details). Appendix 4 are the summary tables for the literature used to inform the development of recommendations. Appendix 10 contains papers that were reviewed but not used to develop practice recommendations.

Literature synthesis process

The primary authors developed four summary tables using the data extraction tools.

Strengths and limitations of the review

For this systematic review of ocular surface disorders in intensive care patients most studies identified as relevant had a moderate to high risk of bias. Substantial variability in definitions used within studies made it difficult to compare study outcomes, and to assess relevance for clinical practice. As a result of this heterogeneity, outcome findings should be critically interpreted.

Process of guideline development

GDN members received the literature review. A single day meeting was held where the recommendations were developed by discussion. Following this meeting, a draft guideline was developed by the primary authors.. Infection prevention clinicians were consulted to address these issues. Recommendation agreement was achieved by sending the draft guideline document to GDN members 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 7 Consensus results sets out the results of the EVP process for this guideline.

Appendix 2: NHMRC levels of evidence

LEVEL	INTERVENTION
I	A systematic review of level II studies
II	A randomised controlled trial
III-1	A pseudo-randomised controlled trial
III-2	A comparative study with concurrent controls: • non-randomised, experimental trial • cohort study • case-control study • interrupted time series with a control group
III-3	A comparative study without concurrent controls: • historical control study • two or more single arm study • interrupted time series without a parallel control group
IV	Case series with either post-test or pre-test/post-test outcomes
GPG	Guidelines from international organisation
NHMRC grades [45]	

Appendix 3: NHMRC grading of recommendations

Component	A Excellent	B Good	C Satisfactory	D Poor
Evidence base [2]	One or more level I studies with low risk of bias or several level II studies with a low risk of bias	One or two level II studies with a low risk of bias or an SR/ several level III studies with a low risk of bias	One or two level III studies with a low risk of bias, or level I or II studies with a moderate risk of bias	Level IV studies, or level I to III studies/ SRs with a high risk of bias
Consistency [3]	All studies consistent	Most studies consistent and inconsistency may be explained	Some inconsistency reflecting genuine uncertainty around clinical question	Evidence is inconsistent
Clinical impact	Very large	Substantial	Moderate	Slight or restricted
Generalisability	Population/s studied in body of evidence are the same as the target population for the guideline	Population/s studied in the body of evidence are similar to the target population for the guideline	Population/s studied in body of evidence differ to target population for guideline but it is clinically sensible to apply this evidence to target population [3]	Population/s studied in body of evidence differ to target population and hard to judge whether it is sensible to generalise to target population
Applicability	Directly applicable to Australian healthcare context	Applicable to Australian healthcare context with few caveats	Probably applicable to Australian healthcare context with some caveats	Not applicable to Australian healthcare context
NHMRC grades (45)				

[2] Level of evidence determined from the NHMRC evidence hierarchy – **Table 3**, Part B.

[3] If there is only one study, rank this component as 'not applicable'.

[4] For example, results in adults that are clinically sensible to apply to children or psychosocial outcomes for one cancer that may be applicable to patients with another cancer.

Appendix 4: Summary of 2012 eye studies

STUDY	METHOD	LOE	SAMPLE SIZE	INTERVENTION	OUTCOMES/ RECOMMENDATIONS	COUNTRY	BIAS RISK
Desalu I 2008 [6]	Observational	IV	56	Daily eye exam	55.4% developed OSD	Sub Saharan	High
Mehta S 2007 [3]	Retrospective Case Series	IV -D	12	Medical record review for evidence of eye exam on admission.	50% ocular lesions secondary to candida	India	High
Mela E 2010 [21]	Cohort	III - 2	70	Daily eye exam, weekly cultures until sedation ceased.	77% microbial keratitis, 10% non-ulcerative keratitis secondary to corneal exposure	Greece	High
Oh E 2008 [41]	Retrospective Case Control	Iv -D	216	Retrospective chart review	Low incidence of OSD = 8.6%. Of which: corneal dryness (72.2%), redness (41.2%), lagopthalmos (13.4%), eye discharge (13%) and Increased intraocular pressure (1.9%).	Korea	Moderate
Rosenberg J 2008[12]	Narrative review and meta -Analysis	III-3	264	Use of open and closed chambers: lubricating ointment vs. moisture chamber (MC).	MC more effective than lubricating ointment in preventing exposure keratopathy.	US	Moderate
So H 2008 [4]	RCT	II - C-D	116	Lanolin vs. polyethylene cover (PC) moisture chamber.	Low incidence of corneal abrasions from study. No difference between groups, both equally effective.	Hong Kong (China)	Moderate
Ezra D 2009 [34]	RCT	III-2	40	Lacrilube vs. Geliperm	No difference between groups for exposure keratitis provided that staff are trained in eye care.	UK	Moderate
Guler E 2011[7]	RCT	III-1	18	PC vs. carbomer drops	PC better than carbomer drops for dry eye syndrome and corneal abrasion.	Turkey	High
Ramirez R 2008 [36]	Narrative review	IV		Review of eye conditions often encountered in ICU	Lagopthalmos most important risk factor for eye complications in ICU. Sedated patients at greater risk than those able to blink. Adequate eye care should include frequent assessment from both physicians and nursing personnel, and should be considered the standard of care in ICU.	Mexico	Moderate to high:

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STUDY	METHOD	LOE	SAMPLE SIZE	INTERVENTION	OUTCOMES/ RECOMMENDATIONS	COUNTRY	BIAS RISK
McHugh J 2008 (46)	Prospective cohort	III-2-D	18	Whether junior ICU doctors are comparable with opthalmologists for detecting exposure keratopathy.	No difference between groups for exposure keratitis. Significant difference in detecting microscopic punctuate lesions attributable to variation of examination tools used.	UK	Moderate to high
Konno R 2011 (11)	Clinical practice guideline (CPG)	Guideline	SR x 5 RCT, M-A of x 3 RCT, Quasi experimental & Observational studies, Prospective RCT	Question: What is the best available evidence for the effectiveness of eye care in ICU?	Eye care is very important to maintain the integrity of the ocular surface throughout illness and to prevent eye complications. Findings: PC cover better than drops to decrease corneal abrasion (II), Duratears better than passive eyelid closure, Moisture chamber better than lubricant for exposure keratopathy (I), No difference between Lacrilube ointment and polyethylene film (gladwrap) (II), Assessment should include risk factors for iatrogenic eye complications (III), rates of iatrogenic eye complications should be monitored, Regular assessment of eye care should be performed, If eyelids can't be closed - use of mechanical methods such as tape +/- Lacrilube should be considered (IV), Prompt referral for suspected iatrogenic eye complications, especially if white/yellow spots found on surface of cornea, or conjunctival discharge or redness (IV), Geliperm as effective as Lacrilube, in preventing exposure keratopathy (EK) in the critically ill (II), Ointment as effective as gladwrap to prevent EK, Timely referral and monitoring of rates of iatrogenic eye complications should be done.	Australia	Moderate

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Table continued from page 26

STUDY	METHOD	LOE	SAMPLE SIZE	INTERVENTION	OUTCOMES/ RECOMMENDATIONS	COUNTRY	BIAS RISK
Marshall A 2008 (13)	CPG		RCT x 5, Retrospective Chart review x 2, pre-post Observational study x 1	Question: 1) Risk factors for developing OSD in ICU. 2) Incidence of iatrogenic opthalmological complications. 3) What clinical practices are effective in preventing iatrogenic opthalmological complications?	Pt assessment for ability to maintain eyelid closure for iatrogenic opthalmic complications. Rates of OSD should be monitored. Timely referral should be made for suspect iatrogenic complications. Eyelid closure should be maintained if closure not obtained passively. All patients who cannot achieve eyelid closure independently should receive eye care 2/24.	Australia	Low
Yi Y 2009 (24)	Masters Thesis: SR and Eye Care CPG for ICU patients with altered level of consciousness.		Meta -analysis x 1, SR	Question: is evidence-based eye care protocol more effective than routine care in decrease the incidence +/or severity of OSD in ICU patients with altered level of consciousness?	Recommendations made with: Assessment, Intervention, use of eye covers, use of eye lubricant, eye covers for suction, and the prevention and management of conjunctival oedema.	Hong Kong (China)	Low

Appendix 5: Incidence summary for iatrogenic opthalmological complications

SHORT REFERENCE	DESIGN/METHOD	SAMPLE DESCRIPTION	OUTCOMES/FINDINGS	LEVEL OF BIAS
Desalu, I. et al 2008. *Internet J of Emerg & Intensive Care Med* [6]	• Prospective observational adult and paediatric study over 4/12. • Daily eye exam by nurse. Fluorescein staining post +ve result. • Pt's divided into 2 gps for analysis: OSD =+ve:-ve. • No routine eye care given	• N=56. • Variability of age, (mean 36.55, SD 16.68, Ra 5-78) sex. (male: female 3:1) and disease: (trauma 32% n=18, post-op 21.4% n=12)	N=31/56 (55.4%) developed OSD: (conjunctival changes/oedema, exudate,corneal disorder / haziness/ulcer, dryness identified.).	High
Mehta, S et al 2007 *JAPI* [3]	• Retrospective Case Series/ chart Rv of pt records.. • Eye exam as part of admission record. • Indirect ophthalmoscopy.	• N = 12Adult pts Dx with candida sepsis. • Male:fem = 9:3 • Mean age = 52.7 (Ra 26-97) • 8/12 > x 2 sites candida • 7/12 NIDDM, 7/12 Survival	• N = 6/12 (50%) with ocular lesions, attributable to candidemia. Lesion U/L in 5/6, & B/L in 1/6. • Follow up made for 2 cases, which resolved in 48/48 with antifungal.	HIgh
Mela E. et al. 2010 *Anaesthetics and Intensive Care* [21] (See also S.3 of Summary)	• Prospective observational 12/12 study. • Standardised eye care protocol in use. • Corneal exam O/adm, and daily. • Conjunctival cultures BE taken O/adm and every 7/365 till sedn ceased. • Standardlab analysis of cultures • Ab Rx for prophylaxis administered according to lab results	N=134 Adult gen ICU pts in a large univ hospital in S Greece. N=64 Excluded (n=59<7/365, n=5 dur to pre-existing condition). N=70 analysed.	• N=70 Analysed • N=54 (77%) colonised by @ least x 1 exogenous bacterial species within Ra: 7-42 days: 26/54 (48% x 1 species), 28/54 (51% x 2 or >spec) • N=16 (No change from admission of normal flora). 7/16 non-ulcerative sterile keratitis due to corneal exposure (10%) • Time to +ve culture: n=46 @ 7d(85%), n=2 @ 14d, n=2 @ 21d, n=2 @ 28d, n=2 @ 42d.	High
Oh E et al 2008 *J of Clin Nurs* [41]	Retrospective case control study.	• Adult ICU pts ,> 17 yrs age. • N = 2500 • N= 216 eye disorders documented. • N = 522 controls. Matched for age and gender.	Incidence for eye disorders = 8.6% Types:	Moderate

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<table>
<tr><th>SHORT REFERENCE</th><th>DESIGN/METHOD</th><th>SAMPLE DESCRIPTION</th><th>OUTCOMES/FINDINGS</th><th>LEVEL OF BIAS</th></tr>
<tr><td>Oh E et al 2008
J of Clin Nurs (41)</td><td>Retrospective case control study.</td><td>• Adult ICU pts ,> 17 yrs age.
• N = 2500
• N= 216 eye disorders documented.
• N = 522 controls. Matched for age and gender.</td><td>Incidence for eye disorders = 8.6%
Types:<table><tr><td>Corneal dryness</td><td>156/216</td><td>72.2%</td></tr><tr><td>Redness</td><td>89/216</td><td>41.2%</td></tr><tr><td>Lagopthalmos</td><td>29/216</td><td>13.4%</td></tr><tr><td>Discharge</td><td>28/216</td><td>13.0%</td></tr><tr><td>Incr IOP</td><td>4/216</td><td>1.9%</td></tr></table></td><td>Moderate</td></tr>
<tr><td>Rosenberg Jet al 2008
Crit Care Med (See also S.3 of Summary) (12)</td><td>• Narrative review and meta-analysis. M-A
• On the use of open and closed chambers. lubricating ointment (LO) vs. moisture chamber (MC)
• QUORUM guideline, Cochrane Q statistic for heterogeneity and random effects model used.</td><td colspan="2">• Exposure keratopathy incidence:
• MC8/113 (7.1%)
• LO32/151(21.2%)
• OR 0.208 (95% CI 0.090-0.479, p<0.001)
• Heterogeneity p 0.666
• Conclusion: MC more effective</td><td>Moderate</td></tr>
<tr><td>So H et al 2008 Int J of Nursing Stud (4)
(See also S.3 of Summary)</td><td>• RCT over 20/12 In 2004-2005.
• Legitimate eye care team used.
• Initial bedside eye exam to assess: blink reflex, eye lid position, conjunctival status, and corneal changes.
• -ve Fluorescein tested Pt were randomised into either polyethylene covers or lanolin eye ointment.
• Fluorescein test done 1/7 for 1 week by eye care team, then 1/52 until study completion/end point.</td><td>• N = 116 adult patients.
• N = 59 moisture chamber
• N = 57 lanolin
• Fairly homogenous groups.</td><td>• Low incidence of corneal abrasions in this study= 7/116. (6%)
• 4/59 (6.8%) = PC
• 3/57 (5.3%) = Lanolin ointment:
• No difference between groups.
• NB: 15/314 (4.7%) Patients tested +ve Fluorescein on admission.</td><td>Moderate</td></tr>
</table>

Appendix 6: Risk factors for iatrogenic opthalmologic complications

SHORT REFERENCE	DESIGN/METHOD	SAMPLE DESCRIPTION	OUTCOMES/FINDINGS	LEVEL OF BIAS
Desalu, I.et al 2008. *Internet J of Emerg & Intensive Care Med* [6] (See also S.2 of Summary)	• Prospective observational. • Adult and paediatric population, 4/12. Study. • Daily eye exam by? nurse. Fluorescein staining post +ve result. • Pt's divided into 2 gps for analysis: OSD =+ve:-ve. • No routine eye care given	• N=56. • Variability of age, (mean 36.55, SD 16.68, Ra 5-78) sex. (male:female 3:1) & Disease: (trauma 32% n=18, post op 21.4% n=12)	**Risk factors:** • Duration of sedation (p 0.008) Ventilation length (p 0.001), MOF.(0.043), • Saline irrign (p0.020). Lagopthalmos (p 0.07).	High
Ezra D et al 2008 *Intensive Care Med* (2009) [47] (See also S.3 of Summary)	• Prospective RCT Contralateral eye study, over 6/12. • Study end pts: A corneal exposure score > 3, discharged from ITU, extubated, blink reflex recovery, if nursed prone, died. • Pt randomisation and staff training.	• N = 40 adult pts = 80 eyes. • 16 female/24 male. • Mean age = 53.5 (SD 20.5) • Median length of eye care = 7 (2-15 days) • Mean Apache = 16 (Ra 5-40)	Provided that staff are given training, No signif diff Bw either Lacrilube or Geliperm gps on outcome measures of: eye opening, palpable aperture, conjunctival oedema (McNamus p=0.69), or corneal exposure (Wilcoxon matched pairs rank test p=0.38)	
Guler, E et al 2011 *JCN* [7]	• Prospective RCT. /Subjects used as own control: C/Lat eye study. • 1/24 eye exam for dryness and ocular lesion. randomisation into Intervention and Control. • Study end pt = 5/7 or if corneal lesion detected.	• N = 18 pts = 36 eyes. Over 5/7. • Mixed adult and paediatric population.	• Polyethylene Cover (PC) better than Carbomer Drops(CD) for dry eyes syndrome (DES) and corneal abrasion. • Predictive factors included incomplete lid closure. **Lid closure & +ve fluoro stain** Gd 1 / 1/3 pos / Lids closed 2 / 1/1 pos / Conjunctiva only 3 / 10/11 / 1/3 Cornea 4 / 3/3 pos / ½ or > exposed	Moderate

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SHORT REFERENCE	DESIGN/METHOD	SAMPLE DESCRIPTION	OUTCOMES/FINDINGS	LEVEL OF BIAS
Mehta, S et al 2007 *JAPI* [3] (See also S.2 of Summary	• Retrospective Case Series/ chart Rv of pt records. • Eye exam as part of admission record. • Indirect ophthalmoscopy.	• N = 12Adult pts Dx with candida sepsis. • Male:fem = 9:3 • Mean age = 52.7 (Ra 26-97) • 8/12 > x 2 sites candida • 7/12 NIDDM, 7/12 Survival	• N = 6/12 (50%) with ocular lesions, attributable to candidemia. Diagnostic conditions increasing risk :3/6 pts immunosuppressed • 3/6 pts were NIDDM • 1/12 Diab retinopathy.	Moderate to high
Mela E. et al. 2010 *Anaesthetics and Intensive Care* [21] (See also S.2 of Summary)	• Prospective observational 12/12 study. • Standardised eye care protocol in use. • Corneal exam O/adm, and daily. • Conjunctival cultures BE taken O/adm and every 7/365 till sedn ceased. • Std lab analysis of cultures • Ab Rx for prophylaxis administered according to lab results	• N=134 Adult gen ICU pts in a large univ hospital in S Greece. • N=64 Excluded • N=70 analysed.	• N=70 Analysed • N=54 (77%) colonised by @ least x 1 exogenous bacterial species within Ra: 7-42 days: • This study observed that microbial colonisation was time dependent. The longer the time in ICU, sedated and MV, the greater the colonisation. 85% of pts showed microbial changes within the ist 7 days. 100% colonisation by day 42.	High
Oh E et al 2008 *J of Clin Nurs* (41) (See also S.2 of Summary)	• Retrospective Case control study	• Adult ICU pts ,> 17 yrs age. • N = 2500 • N= 216 eye disorders documented. • N = 522 controls. Matched for age and gender.		Moderate
So H et al 2008 *Int J of Nursing Stud.* [4] (See also S.2&3 of Summary)	• RCT over 20/12 In 2004-2005. • Legitimate Eye care team used. • Initial bedside eye exam to assess: blink reflex, eye lid posn, conjunctival status, and corneal changes. • -ve Fluorescein tested Pt were randomized into either polyethylene covers or Lanolin eye ointment. • Fluorescein test done 1/7 for 1 week by eye care team, then 1/52 tillstudy completion/ end point.	• N = 116 adult pts. • N = 59 moisture chamber • N = 57 lanolin • Fairly homogenous groups.		Moderate

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SHORT REFERENCE	DESIGN/METHOD	SAMPLE DESCRIPTION	OUTCOMES/FINDINGS	LEVEL OF BIAS
Ramirez R et al 2008 *Crit Care & Shock* [36]	• Narrative review (Not SR)	• Eye complications are common in ICU • Lagopthalmos is the most important risk factor. • Patients sedated and unconscious are at greater risk for corneal insults than those able to blink. Other risk factors include: open respiratory and oro-pharyngeal suction, medications used, diseased states (diabetes, arterial hypertension), sedatives, neuro muscular blockage, dec LOC, lagopthalmos, mechanical and prone ventilation.		moderate
Rosenberg. J et al 2008 *Crit Care Med.*[12]	• Narrative review and meta-analysis.M-A) • On the use of open and closed chambers, lubricating ointment (LO) vs. moisture chamber (MC). QUORUM guideline, Cochrane Q statistic for heterogeneity and random effects modelused.	• Risks for exposure keratopathy: • Mech Ventilation, Paralysis and Sedn, O2 therapy, open suction and dec Rapid Eye Mvt.		moderate
Jammal [40]	• Prospective cohort • patients without blink reflex and ventilated > 24 hrs • Tertiary ICU • 6 months	• 74	• 31% lagothamos • Lagopthalmos score • 2- OR 14.4 (CI 2.67-77.2; o =.002) • 3 - OR 136 (CI14.97-1242; p<0.000) • 54% chemosis	low

Appendix 7: Clinical practice effective in preventing iatrogenic opthalmological complications

<table>
<tr><th>SHORT REFERENCE</th><th>DESIGN/METHOD</th><th>SAMPLE DESCRIPTION</th><th>OUTCOMES/FINDINGS</th><th>LEVEL OF BIAS</th></tr>
<tr><td>Ezra D et al 2008
Intensive Care Med
(2009)</td><td>• Prospective RCT contralateral eye study, over 6/12.
• Study end pts: A corneal exposure score > 3, discharged from ITU, extubated, blink reflex recovery, if nursed prone, died.
• Pt randomisation and staff training</td><td>• N = 40 adult pts = 80 eyes.
• 16 female/24 male.
• Mean age = 53.5 (SD 20.5)
• Median length of eye care = 7 (2-15 days)
• Mean Apache = 16 (Ra 5-40)</td><td>• Provided that staff are given training,
• No signif diff Bw either Lacrilube or Geliperm gps on outcome measures of: eye opening, palpable aperture, conjunctival oedema (McNamus p=0.69), or corneal exposure (Wilcoxon matched pairs rank test p=0.38)</td><td>moderate</td></tr>
<tr><td>Guler, E et al 2011 JCN</td><td>• Prospective RCT. /Subjects used as own control: C/Lat eye study.
• 1/24 eye exam for dryness and ocular lesion. Randomisation into Intervention and Control.
• Study end pt = 5/7 or if corneal lesion detected.</td><td>• N = 18 pts = 36 eyes. Over 5/7.
• Mixed adult and paediatric population.</td><td>• PC better than Carbomer drops for dry eye syndrome (SD= 0.38, Z=-3.87, p<0.001). Testing for corneal abrasion (@ day 5: 18/18 PC gp –ve Vs CD gp 15/18 +ve.
• PC /CD cover effective for longer 5/5days Vs2.94/5days.
• Predictive factors included incomplete lid closure
Lid closure & +ve fluoro stain
<table><tr><td>Gd 1</td><td>1/3 pos</td><td>Lids closed</td></tr><tr><td>2</td><td>1/1 pos</td><td>Conjunctiva only</td></tr><tr><td>3</td><td>10/11</td><td>1/3 Cornea</td></tr><tr><td>4</td><td>3/3 pos</td><td>½ or > exposed</td></tr></table></td><td>high</td></tr>
</table>

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<table>
<tr><th>SHORT REFERENCE</th><th>DESIGN/METHOD</th><th>SAMPLE DESCRIPTION</th><th>OUTCOMES/FINDINGS</th><th>LEVEL OF BIAS</th></tr>
<tr><td>McHugh J et al 2008. Eye (2008)</td><td>• Prospective cohort study.
• 48 ocular assessments performed on 18 pts.
• Pts examined twice weekly by ½ Jnr ICU Drs, followed within 4/24 by an ophthalmologist Rv.
• Record made of Pt age, sex, ventil settings, CVP and Apache II score.
• No standard eye care given</td><td>• N=18 adult ICU pts = 48 Exams</td><td>• Junior ICU Dr comparable with Opthalmologist for detecting exposure keratopathy.
<table>
<tr><th></th><th>Sens</th><th>Spec</th><th>X(p)</th></tr>
<tr><td>Incomplete lid</td><td>90%</td><td>94%</td><td>0.06 (<1)</td></tr>
<tr><td>chemosis</td><td>75%</td><td>70%</td><td>5.2 (<.025)</td></tr>
<tr><td>discharge</td><td>100%</td><td>87.5%</td><td>2.22 (<.2)</td></tr>
<tr><td>C Abrasions</td><td>77.8%</td><td>96.7%</td><td>0.41 (<1)</td></tr>
</table></td><td>moderate</td></tr>
<tr><td>Mela E. et al. 2010 Anaesthetics and Intensive Care</td><td>• Prospective observational 12/12 study.
• Standardised eye care protocol in use.
• Corneal exam O/adm, and daily.
• Conjunctival cultures BE taken O/adm and every 7/365 till sedn ceased.
• Std lab analysis of cultures
• Ab Rx for prophylaxis administered according to lab results</td><td>• N=134 Adult gen ICU pts in a large univ hospital in S Greece.
• N=64 Excluded (n=59<7/365, n=5 dur to pre-existing condition).
• N=70 analysed.</td><td>• N=70 Analysed
• N=54 (77%) colonised by @ least x 1 exogenous bacterial species within Ra: 7-42 days:
• This study observed that microbial colonization was time dependent. The longer the time in ICU, sedated and MV, the greater the colonisation. 85% of pts showed microbial changes within the ist 7 days. 100% colonisation by day 42.</td><td>high</td></tr>
<tr><td>Rosenberg, J et al 2008. Crit Care Med</td><td>• Meta-analysis. Of 3RCT'sidentified. Medline & Embase Db, and Google Scholar, searches conducted1996-2006.
• Random effects model, QUORUM guidelines, Biostat M-A program, Cochrane Q statistic (for homogeneity), summary odds ratio, & Mantel-Haenzel(95% CI for the study end pt) used.</td><td>• N = 294 patients.
• N = 113 Moisture chamber
• N = 151 Lubricating ointment</td><td>• Moisture chambers 8/113 (7.1%) more effective than lubricating ointment 32/151 (21.2%) for preventing exposure keratopathy.
• OR = 0.208 (95% CI: 0.090-0.479, p<0.001)</td><td>moderate</td></tr>
</table>

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SHORT REFERENCE	DESIGN/METHOD	SAMPLE DESCRIPTION	OUTCOMES/FINDINGS	LEVEL OF BIAS
So H et al 2008 *Int J of Nursing Stud.*	• RCT over 20/12 In 2004-2005. • Legitimate eye care team used. • Initial bedside eye exam to assess: blink reflex, eye lid posn, conjunctival status and corneal changes. • -ve fluorescein tested Pt were randomised into either polyethylene covers or lanolin eye ointment. • Fluorescein test done 1/7 for 1 week by eye care team, then 1/52 until study completion/end point.	• N = 116 adult pts. • N = 59 moisture chamber • N = 57 lanolin • Fairly homogenous group.	• No stat signif: p=.519 Bw the use of polyethylene covers 4/59 (6.8%) vs. lanolin ointment 3/57 (5.3%) for exposure keratopathy.	moderate

Appendix 8: Clinical practice guidelines (AGREE tool used for assessment)

SHORT REFERENCE	DESIGN/ METHOD	RECOMMENDATIONS FOR PRACTICE	METHODOLOGICAL QUALITY
Konno R et al 2011 *JBI*	• Eye CareCPG Follows the AGREE Appraisal Tool.	1. Regular assessment of eyes and care needed. 2. Assessment to be inclusive of risk factors for iatrogenic eye complications: patients' ability to maintain eyelids closed, and signs of suspected eye complications. 3. Use of tape or / and Lacrilube is recommended if eyelids cannot be closed. 4. Use of polyethylene films is recommended over regular eye installations and/or drops for reducing the incidence of corneal abrasions. 5. Application of artificial tear ointment (Duratears) is recommended over passive eyelid closure alone, for reducing the incidence of corneal abrasions. 6. Hydromellose lubricating ointment (Lacrilube) and Polyethylene film (Gladwrap) are equally effective in preventing corneal damage. 7. Referral for any suspected iatrogenic eye complications such as white or yellow spots on the surface of the cornea, or conjunctival discharge and redness. 8. To monitor the rate of iatrogenic eye complications in all ICUs. 9. Ocular lubricant (Lacrilube) and polyacrylamide hydrogel dressings (Geliperm) may be used for the prevention of exposure keratopathy in the critically ill.	high
Marshall A et al 2008 *Aust Crit Care*	• Eye Care CPG • Adult patients	1. For ICU nurses to assess each patient for the risk factors of iatrogenic ophthalmologic complications. 2. Assessment of the ability of the patient to maintain eyelid closure should be performed daily in intensive care patients. 3. Observation for iatrogenic ophthalmologic complications (at the micro epithelial level) should be performed at least weekly in intensive care patients using practical methods readily available to busy clinicians (for example, the instillation of fluorescein and use of a cobalt blue pen torch). 4. It is recommended that all intensive care units monitor the rates of iatrogenic ophthalmologic complications. 5. Referral must be made in a timely manner for any suspected iatrogenic ophthalmologic complications in intensive care patients. 6. Eyelid closure should be maintained in intensive care patients who cannot maintain complete eyelid closure. 7. If eyelid closure cannot be maintained passively then mechanical methods should be used. 8. All patients who cannot achieve eyelid closure independently and unconscious or heavily sedated patients should receive eye care every 2 hours (cleaning with saline soaked gauze and the administration of an eye specific lubricant).	High

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SHORT REFERENCE	DESIGN/ METHOD	RECOMMENDATIONS FOR PRACTICE	METHODOLOGICAL QUALITY
Yi Y 2009 Univ of Hong Kong Masters Thesis http://hub.hku.hk/bitstream/10722/56966/1/FullText.pdf?accept=1	• SR and Eye Care CPG • ICU Pts with dec LOC • Uses SIGN method	**Assessment** 1. Assess risk factors for OSD regularly on all newly admitted ICU patients regardless of their levels of consciousness. Patients who are at risk will receive the corresponding eye care interventions (GOR D) a. Assess the risk factors for incomplete lid closure at least daily. Patients who are at risk will receive the following eye assessments. The risk factors include: reduced conscious level, protective eye reflexes, use of sedatives or neuromuscular relaxants, tracheal intubation, use of PEEP of 5 or above, ventilation in prone position, conjunctival oedema, and significant metabolic derangement (cardiac or renal failure) (GOR B) 2. Assess the incomplete lid closure at least every 8 hours, using a bright hand-held torch in line with eye lashes (GOR B) a. Patients who are unable to maintain complete lid closure will receive eye hygiene, eye cover or eye lubricant (GOR A) 3. Assess the ocular surface dryness (dullness and absence of sparkles at least every 4 hours using a hand-held torch (GOR D) a. Dry ocular surface indicates a need of having eye cover or eye lubricant (See 7.0-9.1) (GOR D) 4. Assess the lid cleanliness at least every 4 hours. More frequent assessment is required for patients with signs of eye infection or copious eye discharge, or respiratory infection with copious sputum production (that requires frequent suctioning at least 2-hourly), especially PAER infection. Unclean lids indicate a need for eye hygiene (see 6.0 and 6.1) (GOR D) 5. Assess the signs of OSDs at least daily, using readily available tools such as fluorescein stain and cobalt blue hand-held torch. Other signs of OSD include lid swelling, conjunctival swelling with hyperaemia, lid margin crusting, corneal clouding, epithelial loss, redness or discharge (GOR C) a. Assess the signs of OSD more frequently for patients with respiratory infection especially those with PAER infection or copious sputum production (that requires at least 2hourly suctioning (GOR D) b. Signs of OSDs indicate a prompt medical and ophthalmic consultation for early treatment and complications prevention (GOR C) c. Signs of eye infection indicate an eye swab for culture and more frequent eye hygiene (GOR D)	Moderate

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Table continued from page 37

SHORT REFERENCE	DESIGN/ METHOD	RECOMMENDATIONS FOR PRACTICE	METHODOLOGICAL QUALITY
Yi Y 2009 Univ of Hong Kong Masters Thesis http://hub.hku.hk/bitstream/10722/56966/1/FullText.pdf?accept=1	• SR and Eye Care CPG • ICU Pts with dec LOC • Uses SIGN method	**Interventions** 6. Perform lid cleansing at least 4-hourly for patients with incomplete lid closure and unclean lids. More frequent lid cleansing is indicated for eye infection or copious eye discharge, or respiratory infection with copious sputum (that requires frequent suctioning at least 2-hourly), especially PAER infection. (GOR C) 7. Lid cleansing with sterile water or normal saline soaked sterile gauze, in once-swab-once manner, is recommended over eye. However, the use of normal saline is still controversial until further evidence is available. Nurses' hand hygiene is emphasised. (GOR C) **Eye covers** 8. For patients with incomplete lid closure and dry ocular surface, eyes should be kept closed by mechanical eye covers. Mechanical eye cover is preferred over eye lubricant. (GOR A) a. Transparent polyethylene covers (Gladwrap) is suggested to apply on clean eyes from eyebrows to cheekbones, with Micropore sealing edge if necessary. Change the polyethylene covers daily or whenever necessary (such as soiled or torn). (GOR A) b. Micropore taping is NOT recommended until further evidence is available. (GOR D) c. Geliperm and Cornea Care covers are NOT recommended. (GOR B) **Eye lubricant** 9. Eye lubricant is recommended when eye cover is not applicable, such as the patients with eye infection or copious eye secretion, or occasional spontaneous blink reflex. a. Duratears is suggested to apply to the "V" pocket between eyeball and lower lid every 4 hours (GOR A) b Hypromellose, Lacrilube and HL combination are NOT recommended. (GOR A) **Eyecovers during suctioning** 10. Apply eye covers during open tracheal ororopharyngeal suctioning (for patients with respiratory infection) and copious sputum production (that requires suctioning at least 2-hourly). (GOR C) a. Should not withdraw the suction catheter across patient's face after suctioning. (GOR D) **Prevention or management of conjunctival oedema** 11. To reduce or prevent conjunctival oedema, elevate the head of bed, and check for appropriate tightness of airway securing taping. (GOR D) 12. Prevention of Ventilator associated pneumonia reduces the risk of eye infection. For example, use aseptic technique during open tracheal suctioning, and follow the VAP bundle care protocol as implemented in the target ICU.	Moderate

Appendix 9: Research papers not included in 2012 Eye Care CPG

FULL NAME OF PAPER	REASONS FOR NON-INCLUSION
Carstens, J.(2009)Eye Care: (ICU): Clinical InformationEvidence Summaries (July 30 2009) The Joanna Briggs Institute for Evidence Based Nursing and Midwifery, Systematic Review. Adelaide, SA.	• Reference source only • X 4 recommendations based on Joyce N 2002 and Marshall A 2008
Coyer, F. Wheeler, M. Wetzig, S. Couchman, B. (2007)Nursing Care of the mechanically ventilated patient: What does the evidence say? Part Two Intensive and Critical Care Nursing Vol 23, Issue 2, April 2007. pp 71-80	• SR but only ltd cover of eye care in ICU popn • (x 3 references previously cited in other studies) • Eye care not central to this study
Dawson D(2005)Development of a new eye care guideline for critically ill patients. Intensive and Critical Care Nursing. Vol 21, Issue 2, April 2005, pp 119-122	• Reference source only • Incidence only useful +/- algorithm
Dingwall, L. (2010)Care of the eyes (Chpt3) in Personal Hygiene Care, Wiley-Blackwell, Oxford, UK.	• Reference source only • Non ICU population
Ervin, AM.Wojciechowski, R. Schein, O. (2010) Punctal occlusion for dry eye syndrome. A Cochrane Review in the Cochrane Library 2010, Issue 9. John Wiley & Sons Publication.	• Reference source only • Treatment review for eye condition • Non ICU population
Ewald, M. Hammersmith, K.(2009) Review and diagnosis and management of recurrent erosion syndrome. Current Opinion in Opthalmology, 2009, 20:287-291	• Reference source only • Not acute iatrogenic ophthalmic complication • Non ICU population
Federici, L. proust, H. Conrath, J. Ridings, B (2006) Bilateral corneal endothelial decompensation after post septicaemia coma. J Fr Opthalmology, 2006 May; 29(5):556-8	• Abstract English, text in French
Fullbrook, P. (2006) Eye Care in ACCCN: Crit Care Nursing. P.190-191	• Reference source only • Book pages on Eye Care for Critical Care Patients • Nil author reference
Germano, E. Mello, M. Sena, D. Correia, J. Amorim, M. (2009) Incidence and risk factors of corneal epithelial defects in mechanically ventilated children. Crit Care Med 2009 Vol.37, No.3	• Brazilian paediatric study in 2001
Jackson W (2008) Blepharitis: current strategies for diagnosis and management. Can J Opthalmology. Vol 43, No.2, 2008	• Reference source only • Non ICU population
Kam, R. Hayes, M. Joshi, N.(2011) Ocular care and complications in the critically ill. Trends in Anaesthesia and critical Care 1 (2011) 257-262	• Narrative review only • Reference source only
Kocacal, E. Eser, I. (2008) Significant problems in ICU patients eye complications, medical education. Turkiye Klinikleri J med Sci 2008, 28:193-7	• Abstract in English, text in Turkish
Konno, R. (2011) Eye Care: (ICU) Clinicain Information. The Joanna Briggs Institute for Evidence Based Nursing and Midwifery, Systematic Review. Adelaide, SA. 03/03/2011	• Reference source only. • Annotated CPG for ICU pts • Insufficient information to assess quality
Maxeiner, H. Jekat, R. (2010) Resuscitation and conjunctival petechial hemorrhages. J Forensic Leg Med. 2010 Feb; 17(2):87-91. Epub 2009 Oct 6.	• Non ICU population: out of hospital cardiac arrest • Majority of pts examined were deceased

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FULL NAME OF PAPER	REASONS FOR NON-INCLUSION
Oh, E. Lee, W. Yoo, J. Kim, S. Ko, I. Chu, S. Song, E. Kang, S. (2009) Factors related to the incidence of eye disorders in Korean patients at intensive care units. J. of Clinical Nursing, 18, 29-35.	• Ref source for incidence data only. Cases studied, not matched for confounding variables.
Pazzaolini, A. Pantaleo, F. (2006) Hygiene & eye care in critically ill patient. Prof Inferm. 2006 Oct-Dec; 59(4):246-8	• Article in Italian
Schutz, J. Mavrakanas, N.(2009)The value of opthalmic independent medical examination: analysis of 344 cases. Br J Opthalmology. 2009 Oct;93(10): 1371-5. Epub 2009 Jun 30.	• Non ICU population
Sorce, L. (2009)Preventing corneal abrasions in critically ill children receiving neuromuscular blockade: a RCT. Pediatr Crit Care Med. 2009 Vol. 10, No. 2	• Paediatric population
Sundling, V. Gulbrandsen, P. jervekk,J. Straand, J. (2008) Care of vision and ocular health in diabetic members of a national diabetes organization: a cross sectional study. BMC Health Services Research 2008, 8:159	• Non ICU sample
Suwan-apichon, O. Reyes, J. herretes, S. Vedula, S. chuck, R. (2009) Topical corticosteroids as adjunctive therapy for bacterial keratitis. A Cochrane Review in the Cochrane Library 2009, Issue 1. John Wiley & Sons Publication.	• Reference source only
Watson, S.Barker, N. (2009) Interventions for recurrent corneal erosions. A Cochrane Review in the Cochrane Library 2009, Issue 1. John Wiley & Sons Publication.	• Reference source only • Community population
Xue, Y. (2011)Eye Care: ICU. The Joanna Briggs Institute for Evidence Based Nursing and Midwifery, Systematic Review. Adelaide, SA. 03/03/2011	• Reference use only for eye care algorithm • Narrative review

Appendix 10: Updated literature review 2013

A PUBMED and CINAHL search was undertaken using the same criteria as the 2012 search except years covered were 1/1/2012-8/7/2013. No controlled studies were found. No changes were made to the guideline

STUDY NAME	OUTCOME
Azfar et al Protocolized eye care prevents corneal complications in ventilated patients in a medical intensive care unit al Saudi J Anaesth. 2013 Jan-Mar; 7(1): 33–36. doi: 10.4103/1658-354X.109805	• Not included • Limited quality improvement study – significant measurement bias
Ahmadi-Nejad Comparing the Effectiveness of Two Methods of Eye Care in the Prevention of Ocular Surface Disorders in Patients Hospitalized in Intensive Care Unit- journals.ajaums.ac.ir	• Not available
Werli-Avargenga Nursing Interventions for Adult Intensive care patients with risk for corneal injury: a systematic review. International journal of Nursing knowledge, 24(1): 25-29	• Not included because SR identified same studies as this review • Quality limited due to sample bias
Grixti Uncommon ophthalmologic disorders in intensive care unit patients Journal of Critical Care 27(746.e9-e22	• Not included as SR on disorders not treatment
Jammal Exposure keratopathy in sedated and ventilated patients Journal of Critical Care 27: 537-541	• Included

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