Prevention and Treatment of Pressure Ulcers: *Pediatric Individuals* – an extract from the Clinical Practice Guideline
INTRODUCTION

Foreword

This document presents an extract of the full Clinical Practice Guideline. The methodology used to appraise research and develop the recommendations is presented in the Clinical Practice Guideline, the abridged Quick Reference Guide, and in the methodology report, all available on the International Pressure Ulcer Guideline website (www.internationalguideline.com).

The full Clinical Practice Guideline presents recommendations and summarizes the supporting evidence for pressure ulcer prevention and treatment. The first edition was developed as a four year collaboration between the National Pressure Ulcer Advisory Panel (NPUAP) and the European Pressure Ulcer Advisory Panel (EPUAP). In the second edition of the guideline, the Pan Pacific Pressure Injury Alliance (PPPIA) has joined the NPUAP and EPUAP.

The goal of this international collaboration was to develop evidence-based recommendations for the prevention and treatment of pressure ulcers that could be used by health professionals throughout the world. An explicit scientific methodology was used to identify and critically appraise all available research. In the absence of definitive evidence, expert opinion (often supported by indirect evidence and other guidelines) was used to make recommendations. Drafts of the recommendations and supporting evidence were made available to 986 invited stakeholders (individuals and organizations) around the world. The final guideline is based on available research and the accumulated wisdom of the NPUAP, EPUAP, PPPIA and international stakeholders. In this edition of the guideline, a consensus voting process (GRADE) was used to assign a strength to each recommendation. The strength of recommendation identifies the importance of the recommendation statement based on potential to improve patient outcomes. It provides an indication to the health professional of the confidence one can have that the recommendation will do more good than harm, and can be used to assist in prioritizing pressure ulcer related interventions. Printed copies of the English version of the full Clinical Practice Guideline are available through links provided on the following websites:

NPUAP website: www.npuap.org
EPUAP website: www.epuap.org
Wounds Australia (previously Australian Wound Management Association) website: www.woundsaustralia.com.au
New Zealand Wound Care Society (NZWCS) website: www.nzwcs.org.nz
International Pressure Ulcer Guideline website: www.internationalguideline.com

Suggested Citation

The NPUAP, EPUAP and PPPIA welcome the use and adaptation of this guideline at an international, national and local level. We request citation as the source, using the following format for this extract:

Limitations and Appropriate Use of This Guideline

- Guidelines are systematically developed statements to assist health professional and patient consumer decisions about appropriate health care for specific clinical conditions. The recommendations may not be appropriate for use in all circumstances.
- The decision to adopt any particular recommendation must be made by the health professional with consideration to available resources and circumstances of the individual patient. Nothing contained in this guideline is to be considered medical advice for specific cases.
- Because of the rigorous methodology used to develop this guideline, the Guideline Development Group members believe that the research supporting these recommendations is reliable and accurate. Every effort has been made to critically appraise the research contained within this document. However, we do not guarantee the reliability and accuracy of individual studies referenced in this document.
- This guideline is intended for education and information purposes only.
- This guideline contains information that was accurate at the time of publication. Research and technology change rapidly and the recommendations contained in this guideline may be inconsistent with future advances. The health professional is responsible for maintaining a working knowledge of research and technology advances that may affect his or her clinical decision making.
- Generic names of products have been used. Nothing in this guideline is intended as endorsement of a specific product.
- Nothing in this guideline is intended as advice regarding coding standards or reimbursement regulations.
- The guideline does not seek to provide full safety and usage information for products and devices; however commonly available safety and usage tips have been included. Adverse events reported in the included research have been reported in the evidence summaries and caution statements. All products should be used according to manufacturer’s directions.

Abstract

The guideline is the result of a collaborative effort among the National Pressure Ulcer Advisory Panel (NPUAP), European Pressure Ulcer Advisory Panel (EPUAP) and Pan Pacific Pressure Injury Alliance (PPPIA). A comprehensive literature review was conducted on pressure ulcer prevention and treatment. A rigorous scientific methodology was used to appraise available research and make evidence-based recommendations for the prevention and treatment of pressure ulcers. Draft guidelines were made available to 986 invited stakeholder individuals and organizations/societies and stakeholder feedback was considered by the guideline developers. In the final development process, the guideline development team used a consensus voting process (GRADE) to assign strengths of recommendation. Strength of recommendations indicate the extent to which one can be confident that adherence to a recommendation will do more good than harm, and are intended to assist the health professional to prioritize interventions.

The full Clinical Practice Guideline includes 575 explicit recommendations and/or research summaries.

This extract focuses on the evidence presented on pediatric individuals.
Strengths of Evidence and Strengths of Recommendations

Full explanation of the methodology is available in Appendix 1: Guideline Methodology. Individual studies were assigned a ‘level of evidence’ based on study design and quality. The body of evidence supporting each recommendation was given a ‘strength of evidence’. A consensus voting process (GRADE) involving all the experts formally engaged in the guideline development was used to assign a ‘strength of recommendation’ that indicates the confidence the health professional can have that the recommended practice will improve patient outcomes (i.e., do more good than harm). The overall aim of the ‘strength of recommendation’ is to help health professionals to prioritize interventions.

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<td>A</td>
<td>The recommendation is supported by direct scientific evidence from properly designed and implemented controlled trials on pressure ulcers in humans (or humans at risk for pressure ulcers), providing statistical results that consistently support the recommendation (Level 1 studies required).</td>
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<td>B</td>
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<td>C</td>
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Guideline Website

http://www.internationalguideline.com

The guideline website will remain accessible during the interim period until the next guideline revision. The Quick Reference Guideline, sponsor acknowledgement, and supportive documents to the guideline (e.g. data extraction tables) are available from the website.
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INTRODUCTION

GUIDELINE DEVELOPERS

Guideline Development Group (GDG)

NPUAP

Diane Langemo, PhD, RN, FAAN (NPUAP Chair)
Professor Emeritus, University of North Dakota College of Nursing, Grand Forks, ND, USA

Janet Cuddigan, PhD, RN, CWCN, FAAN
Associate Professor, University of Nebraska Medical Center College of Nursing, Omaha, NE, USA

Laurie McNichol, MSN, RN, GNP, CWOCN, CWON-AP
Clinical Nurse Specialist/WOC Nurse, Cone Health, Greensboro, North Carolina, USA

Joyce Stechmiller, PhD, ACNP-BC, FAAN
Associate Professor and Chair, Adult and Elderly Nursing, University of Florida, College of Nursing, Gainsville, FL, USA

EPUAP

Lisette Schoonhoven, PhD (EPUAP Chair)
Senior Researcher Nursing Science, Radboud University Medical Center, Scientific Institute for Quality of Healthcare, Nijmegen, The Netherlands
Associate Professor, University of Southampton, Faculty of Health Sciences, UK

Michael Clark, PhD
Professor in Tissue Viability, Birmingham City University, Birmingham, UK
Director, Welsh Wound Network, Welsh Wound Innovation Centre, Pontyclun, Wales, UK

Jan Kottner, PhD
Scientific Director Clinical Research, Clinical Research Center for Hair and Skin Science, Department of Dermatology and Allergy, Charité-Universitätsmedizin Berlin, Germany

Cees Oomens, PhD, Ir
Associate Professor, Biomedical Engineering Department, Eindhoven University of Technology, Eindhoven, The Netherlands

PPPIA

Keryln Carville, PhD, RN (PPPIA Chair)
Professor, Primary Health Care and Community Nursing, Silver Chain Group and Curtin University, Western Australia, Australia

Pamela Mitchell, MN, RN, PGDipWHTR (Wales)
Clinical Nurse Consultant, Wound Management, Christchurch Hospital, Christchurch, New Zealand.

Siu Ming Susan Law, BScN, MScN, RN, RM, ET
Nurse Consultant (Wound Management), Princess Margaret Hospital, Lai Chi Kok, Kowloon, Hong Kong.

Ai Choo Tay, BN, Oncology Nursing, CWS
Senior Nurse Clinician, Singapore General Hospital, Singapore, Republic of Singapore.

Japanese Society of Pressure Ulcers Observer

Takafumi Kadono, MD, PhD
Associate Professor, Department of Surgical Science, University of Tokyo, Tokyo, Japan

Methodologist and Editor-in-Chief

Emily Haesler, BN, PGDipAdvNursing
Honorary Associate, Department of Nursing and Midwifery, La Trobe University, Victoria, Australia
Visiting Fellow, Academic Unit of General Practice, Australian National University, Canberra, Australia

Small Working Group (SWG) Members

Background

Etiology: Cees Oomens (Leader), David Brienza, Laura Edsberg, Amit Gefen & Pang Chak Hau
Prevalence and Incidence of Pressure Ulcers: Catherine Ratliff (Leader), Yufitriana Amir, Margaret Birdsong, Chang Yee Yee, Emily Haesler, Zena Moore & Lin Perry
Prevention of Pressure Ulcers

Risk Factors and Risk Assessment: Jane Nixon (Leader), Katrin Balzer, Virginia Capasso, Janet Cuddigan, Ann Marie Dunk, Claudia Gorecki, Nancy Stotts & Aamir Siddiqui
Skin and Tissue Assessment: Emily Haesler (Leader), Carina Báath, Margaret Edmondson, Emil Schmidt & Ai Choo Tay
Preventive Skin Care: Emily Haesler
Emerging Therapies for Prevention: Kerrie Coleman (Leader), Teresa Conner-Kerr, Susan Law, Anna Polak, Pamela Scarborough & Jakub Taradaj
Interventions for Prevention and Treatment of Pressure Ulcers

Nutrition in Pressure Ulcer Prevention and Treatment: Jos Schols (Leader), Mary Ellen Posthauer, Merrilyn Banks, Judith Meijers, Nancy Munoz & Susan Nelan • Repositioning and Early Mobilization: Zena Moore (Leader), Barbara Braden, Jill Trelease & Tracey Yap • Repositioning to Prevent and Treat Heel Pressure Ulcers: Zena Moore (Leader), Barbara Braden, Jill Trelease & Tracey Yap • Support Surfaces: Clarissa Young (Leader), David Brienza, Joyce Black, Sandra Dean, Liesbet Demarré, Lena Gunningberg & Cathy Young • Medical Device Related Pressure Ulcers: Jill Cox (Leader), Liesbet Demarré, Tracy Nowicki & Ray Samuriwo

Treatment of Pressure Ulcers

Classification of Pressure Ulcers: Emily Haesler (Leader), Carina Bååth, Margaret Edmondson, Emil Schmidt & Ai Choo Tay • Assessment of Pressure Ulcers and Monitoring of Healing: Kerrie Coleman (Leader), Elizabeth Ong Choo Eng, Michelle Lee, Amir Siddiqui, Mary Sieggreen • Pain: Assessment and Treatment: Carrie Sussman (Leader), Jane Nixon & Jan Wright • Wound Care: Cleansing: Nicoletta Frescos (Leader), Mona Baharestani, Catherine Ratliff, Sue Templeton, Martin van Leen & David Voegeli • Wound Care: Debridement: Sue Templeton (Leader), Mona Baharestani, Nicoletta Frescos, Catherine Ratliff, Martin van Leen & David Voegeli • Assessment and Treatment of Infection and Biofilms: Judith Barker (Leader), Virginia Capasso, Erik de Laat & Wan Yin Ping • Wound Dressings for Treatment of Pressure Ulcers: Erik de Laat (Leader), Michelle Deppisch, Margaret Goldberg, Yanting Quek, Jan Rice & Quek Yan Ting • Biological Dressings: Laura Edsberg (Leader), Kumal Rajpaul & Colin Song • Growth Factors: Laura Edsberg (Leader), Kumal Rajpaul & Colin Song • Biophysical Agents for Treatment: Kerrie Coleman (Leader), Teresa Conner-Kerr, Anna Polak, Pamela Scarborough, Maria ten Hove & Jakub Taradaj • Surgery for Pressure Ulcers: Aamir Siddiqui (Leader), Emily Haesler & Kok Yee Onn

Special Populations

Bariatric Individuals: Mary Ellen Posthauer (Leader), Jeannie Donnelly & Tracy Nowicki • Critically Ill Individuals: Jill Cox (Co-leader), Ang Shin Yuh (Co-leader), Maarit Ahtiala, Paulo Alves, & Alison Stockley • Older adults: Tracey Yap (Leader), Jill Campbell, Emily Haesler & Susan Kennerly • Individuals in the Operating Room: David Huber (Leader), Steven Black, Ray Samuriwo, Susie Scott-Williams & Geert Vanwalleghem • Individuals in Palliative Care: Trudie Young (Leader), Wayne Naylor & Aletha Tippett • Pediatric Individuals: Emily Haesler, Mona Baharestani, Carmel Boylan, Holly Kirkland-Walsh & Wong Ka Wai • Individuals with Spinal Cord Injury: Emily Haesler (Leader), Amy Darvall, Bernadette McNally & Gillian Pedley

Implementing the Guideline

Facilitators, Barriers and Implementation Strategy: Dimitri Beeckman (Leader), Nancy Estocado, Morris Magnan, Joan Webster, Doris Wilborn & Daniel Young • Health Professional Education: Dimitri Beeckman (Leader), Nancy Estocado, Morris Magnan, Joan Webster, Doris Wilborn & Daniel Young • Patient Consumers and Their Caregivers: Nancy Stotts (Leader), Winnie Siu Wah Cheng, Michael Clark, Liesbet Demarré, Rebekah Grigsby & Emil Schmidt • Quality Indicators: Ruud Halfens (Leader), Anne Gardner, Heidi Huddleston Cross, Edel Murray, Lorna Semple & Mary Sieggreen

Further Research Needs

Keryln Carville, Michael Clark, Janet Cuddigan, Emily Haesler, Jan Kottner, Diane Langemo, Susan Law, Laurie McNichol, Pamela Mitchell, Cees Oomens, Lisette Schoonhoven, Joyce Stechmiller, Ai Choo Tay
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Janet Cuddigan, PhD, RN, CWCN, FAAN, Interim Methodologist (literature update, review and analysis during the interim between formal guideline development activities [2009 to 2012])

Lisette Schoonhoven, PhD (lead organizer and convener of the Guideline Development Group)

Kandis McCafferty, PhD, RNC-OB (preliminary evidence tables)

Paul Haesler, BSc(Hons) (web development and IT support)

College of Nursing, University of Nebraska Medical Center, Omaha, NE, USA (professional, organizational and IT support)

McGoogan Library, University of Nebraska Medical Center, Omaha, NE, USA (consultation on database searches, journal access and interlibrary loan services)

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Translation

The following experts from the Clinical Research Center for Hair and Skin Science, Department of Dermatology and Allergy, Charité-Universitätsmedizin Berlin, Germany completed translation and data extraction for papers in languages other than English:

Claudia Richter, MA
Vera Kanti, MD
Eva Katharina Barbosa Pfannes, PhD
Jan Kottner, PhD

Stakeholders

Special thanks to the many stakeholders who reviewed the guideline processes and drafts. All stakeholder comments were reviewed by the Guideline Development Group and revisions were made based on the comments received. We appreciate the investment of health professionals, researchers, educators and manufacturers from all over the world who took time to share their expertise and thoughtful critique.
SPONSOR ACKNOWLEDGEMENTS

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SPECIAL POPULATIONS

Introduction

Pressure ulcers are a significant concern for the pediatric population. As discussed in the *Prevalence and Incidence of Pressure Ulcers* section of the full Clinical Practice Guideline in more detail, pediatric pressure ulcer prevalence rates reported in the international literature since 2000 range from 0.47% to 75%, with the highest prevalence reported in children with chronic illness and those with medical devices. Pressure ulcer incidence rates of 0.29% to 27% have been reported in the recent literature.\(^1\) Recognition of the risk of pressure ulcers in children is important, as lack of awareness on behalf of the health professional, and a perception that pressure ulcers are not a concern for this special population leads, caregivers to overlook the importance of assessment and prevention.\(^2\)

The recommendations outlined in other sections of this guideline are generally appropriate for the prevention and treatment of pressure ulcers in pediatric populations. Of particular relevance to children is the full Clinical Practice Guideline section, *Medical Device related Pressure Ulcers*. An exception is the chapter *Nutrition in Prevention and Treatment*, which provides recommendations for nutritional intake for adult populations, based on research conducted in adults.

As part of this guideline update, a comprehensive search was conducted for pressure ulcer literature in pediatric populations published since January 2008. Literature published prior to this date may also support the recommendations in this section.

Pressure Ulcer Risk Assessment

An assessment of risk factors for pressure ulcers, followed by planning and implementation of early preventive interventions, is an integral component of patient care. Pressure ulcers in children cannot be underestimated nor presumed to be uncommon. Pressure ulcer risk assessment is an essential component of the admission process, not only to identify risk but also to ensure that effective preventive strategies are planned and implemented. Early recognition of risk factors is the precursor to planning preventive care.

1. **Perform an age appropriate risk assessment that considers risk factors of specific concern for pediatric and neonate populations, including:**
   - activity and mobility levels,
   - body mass index and/or birth weight,
   - skin maturity,
   - ambient temperature and humidity,
   - nutritional indicators,
   - perfusion and oxygenation,
   - presence of an external device, and
   - duration of hospital stay. (Strength of Evidence = B; Strength of Recommendation = \(\star\star\))

The pediatric population is at risk of pressure ulcers due to inherent differences in their anatomical characteristics compared to adults. Children’s body surface area proportions differ from those of adults, for instance they have a disproportionally larger head size as compared to the head-body proportions of an adult.\(^2,3\) Not only does this influence their risk of pressure ulcers, but it also contributes to a difference in the anatomical sites most susceptible to skin and tissue breakdown.\(^2,3\)

Fujii et al. (2010)\(^4\) conducted a prospective cohort study in seven neonatal intensive care units (NICUs) in Japan. Neonates (n = 81) included in the survey had a mean age of 32.5 weeks gestation and a mean birth weight of 1,745 grams. Daily clinical skin assessment identified that the cumulative pressure ulcer...
incidence was 16%, with 62% of pressure ulcers occurring in neonates of less than 33 weeks gestation. Approximately 78% of the pressure ulcers were classified as Category/Stage II and the remainder were Category/Stage I.

In univariate analysis, factors found to be significantly associated with development of a pressure ulcer ($p < 0.05$) were low birth weight, skin texture, incubator temperature and humidity, the support surface, limited position changes and endotracheal (ET) intubation. The multivariate analysis found two significant factors that increased risk of pressure ulcers in neonates. Skin texture immaturity measured using the Dubowitz Neonatal Maturity Assessment Scale had an odds ratio (OR) of 7.6 (95% confidence interval [CI] 1.58 to 36.71, $p = 0.012$) and ET intubation had an OR of 4.0 (95% CI 1.04 to 15.42, $p = 0.047$) (Level 2 study).

Skin maturity is directly related to the neonate’s age. At 23 to 24 weeks gestation, the stratum corneum is not developed, and by 30 weeks gestation it has only two to three cell layers. The skin appears as transparent, and is particularly fragile. Thus, the skin of younger infants provides an inadequate barrier and, as indicated in risk studies, is highly susceptible to breakdown.

Schindler et al. (2011)\(^5\) conducted a large retrospective database review in nine pediatric intensive care units (PICUs) in the US over a 22 month period ($n = 5,346$). The aggregate incidence of pressure ulcers was 10.2%, with 63% reported as Category/Stage I pressure ulcers, 32% Category/Stage II pressure ulcers and the remainder were Category/Stage III or IV pressure ulcers. A multivariate analysis identified a hospital stay of greater than three days ($OR = 5.88$, 95% CI 4.481 to 7.21, $p < 0.001$) and score on the Pediatric Index of Mortality scale ($OR = 1.132$, 95% CI 1.055 to 1.215, $p < 0.001$) to be significantly associated with an increased risk of pressure ulcers. In addition, four factors associated with an increased risk of pressure ulcers were related to the use of ventilation devices:

- bi-level positive airway pressure (BPAP) or continuous positive airway pressure (CPAP) ($OR = 2.004$, 95% CI 1.509 to 2.661, $p < 0.001$);
- mechanical ventilation ($OR = 1.334$, 95% CI 1.031 to 1.726, $p = 0.03$);
- high frequency oscillatory ventilation ($OR = 2.057$, 95% CI 1.208 to 5.134, $p = 0.01$); and
- extracorporeal membrane oxygenation OR 2.490 (95% CI 1.208 to 5.134, $p=0.01$) (Level 4 study).

In this study there was a wide pressure ulcer incidence range (0.8% to 17.5%) between different PICUs, suggesting that pressure ulcer management protocols in different units may have influenced the findings; however, this was not investigated in the study.

Anthony et al. (2010)\(^6\) conducted a cross-sectional study investigating validity of various pediatric risk assessment tools. The researchers recruited children with pressure ulcers ($n = 61$) and children without pressure ulcers ($n = 175$). Three pediatric risk assessment tools were administered to all the pediatric participants by nurses trained in the use of the scales. The logistic regression analysis for all three risk assessment tools identified that decreased mobility, and incontinence and/or moisture were significantly associated with presence of a pressure ulcer. Tissue perfusion, presence of pyrexia and low serum albumin were found to be significant for two of the risk assessment tools. The age of the pediatric population in this study was not reported. The risk assessment tools were applied after the development of the pressure ulcer for the 26% of the study participants with pressure ulcers (Level 3 study).

In a prevalence study conducted through retrospective review of records from 1,314 pediatric admissions to one US PICU over a three year period, Rana et al. (2009)\(^7\) established an increased rate of pressure ulcers in obese (body mass index [BMI] ≥ the 95th percentile for their age) children compared to children of normal BMI (1% versus 0.2%, $p = 0.04$). The children’s height and weight from which the BMI was calculated was documented on admission, prior to the development of pressure ulcers. Comorbidities and other factors that may influence pressure ulcer risk were not reported in the study.

1.1. **Consider children with medical devices to be at risk for pressure ulcers.** (Strength of Evidence = B; Strength of Recommendation = )
Medical device related pressure ulcers are also an important consideration in children. In a retrospective review of children (mean age 45 months ± 8.7 months) who underwent a tracheostomy over a 15 month period in a US pediatric medical center (n = 65), Jaryszak et al. (2011) reported the rate of tracheostomy related pressure ulcers as 29.2%. Multivariate analysis found that the type of tracheostomy tube (p = 0.003) and a lower age (under 12 months versus over 12 months) were significant risk factors for a device related pressure ulcer (Level 5 study).

In a prospective cohort study conducted in seven NICUs (n = 81; mean age 32.5 weeks gestation), Fujii et al. (2010) reported that 86% of pressure ulcers were associated with CPAP or directional positive airway pressure (DPAP). A multivariate analysis showed an OR of 4.0 (95% CI 1.04 to 15.42, p = 0.047) for pressure ulcers in children undergoing ET intubation. In this study most of the neonates were extremely underweight, which also a factor associated with increased pressure ulcer risk (Level 2 study).

Schindler et al. (2011) conducted a multivariate analysis of risk factors for pressure ulcers from retrospective data collected in seven PICUs and trauma centers (n = 5,346). A number of medical devices were significantly associated with an increased risk of pressure ulcers including mechanical ventilation (OR = 1.334, 95% CI 1.031 to 1.726, p = 0.03); BPAP or CPAP (OR = 2.004, 95% CI 1.509 to 2.661, p < 0.001); high frequency oscillatory ventilation (OR = 2.057, 95% CI 1.208 to 5.134, p = 0.01) and extracorporeal membrane oxygenation (OR = 2.490, 95% CI 1.208 to 5.134, p = 0.01) (Level 4 study).

In a prospective point prevalence study conducted in children hospitalized for at least 24 hours (n = 412; aged 24 hours to 18 years) Schluer et al. (2012) reported that 40% of children with an external medical device were assessed as having a pressure ulcer related to the device.

2. Consider using a reliable and valid pediatric pressure ulcer risk assessment tool to facilitate a structured assessment. (Strength of Evidence = C; Strength of Recommendation = ▶️)

This recommendation is based on expert opinion. Pressure ulcer risk assessment tools are often used to guide a structured approach to risk assessment. For further discussion on structured risk assessment, see the guideline section Risk Factors and Risk Assessment.

Recent studies have focused on the reliability of various pediatric risk assessment tools. Willock et al. (2008) demonstrated 100% agreement (κ = 1.0) on nine subscales and good agreement for the tenth subscale (κ = 0.63) of the Glamorgan scale when used by 15 nurse raters to assess 15 children with a low pressure ulcer risk (Level 3 study). Kottner et al. (2012) found good agreement (48%) between 27 nurses administering the Glamorgan scale to 30 children, but the scale had poor interrater reliability (intraclass coefficient [ICC] = 0.34, 95% CI 0.12 to 0.57). Findings were similar in a second study by the team. The scale had poor differentiation between children, possible because of the overall low pressure ulcer risk of the sample (Level 2 study).

Assessment and Monitoring

1. Engage the family or legal guardian involved in the individual’s care when establishing goals of care. (Strength of Evidence = C; Strength of Recommendation = ▶️)

2. Conduct and document a skin assessment at least daily and after procedures for changes related to pressure, friction, shear, moisture. (Strength of Evidence = C; Strength of Recommendation = ▶️

These recommendations are based on expert opinion. Assess the skin at the time of admission to the health care facility (or at first visit for community settings) and at regular intervals (i.e., at least every 24 hours). In particular, assess skin over bony prominences. See the Assessment of Pressure Ulcers and Monitoring of Healing section of the full Clinician Practice Guideline for recommendations related to skin
2.1. Assess the skin on occiput for neonate and pediatric individuals. (Strength of Evidence = C; Strength of Recommendation = ★★★)

This recommendation is based on expert opinion. Younger individuals are at higher risk of developing occipital pressure ulcers due to their comparatively larger head circumference compared with older children and adults.2, 3

2.2. Inspect the skin under and around medical devices at least twice daily for the signs of pressure related injury on the surrounding tissue. (Strength of Evidence = C; Strength of Recommendation = ★★★)

This recommendation is based on expert opinion. Younger individuals are at high risk of developing pressure ulcers associated with medical devices.2, 5, 13 The Medical Device Related Pressure Ulcers of the full Clinician Practice Guideline is of particular significance to pediatric individuals.

Nutritional Management

The recommendations in the Nutrition in Pressure Ulcer Prevention and Treatment section of the full Clinician Practice Guideline have been developed based on evidence in adult populations and are generally not appropriate for pediatric individuals. There is a paucity of research on the most appropriate nutritional interventions for neonates and children with or at risk of pressure ulcers.

Neonates and children are at higher risk of nutritional deficiencies due to having an increased nutritional requirement per unit weight to meet normal growth needs, as well as having smaller appetites and dietary intake. Additionally, children at risk of or with a pressure ulcer for the most part have other severe acute or chronic comorbidities that influence both nutritional needs and the ability to meet these needs.14 Nutritional assessment; selection of the appropriate mode of feeding; frequent monitoring; strategies to promote adequate intake in an appealing manner; and, when required, nutritional supplements or nutritional support, are all important considerations in the promotion of wound healing in children.15

1. Conduct an age appropriate nutritional assessment for neonates and children. (Strength of Evidence = C; Strength of Recommendation = ★★★)

1.1. Regularly reassess the nutritional requirements of critically ill neonates and children who have, or are at risk of, a pressure ulcer. (Strength of Evidence = C; Strength of Recommendation = ★★★)

These recommendations are based on expert opinion. A pediatrician, dietitian or other qualified health professional should conduct an age appropriate nutritional assessment to identify nutritional requirements for neonates and children with or at risk of pressure ulcers. The Braden Q scale (designed for use in pediatric individuals aged from 21 days to 8 years) includes a nutritional screening tool that considers the child’s usual nutritional intake that may supplement the before mentioned assessment. Anthropometric measurements and growth charts can be used to determine if the child is developing within expected growth patterns;14, 15 however, consider the influence of edema and fluid shifts on measures made in critically ill children.14 Critically ill children should have their energy expenditure assessed regularly in order to determine appropriate energy needs. Consider that standard equations are often unreliable in estimating energy expenditure in children14, 16 because they are often derived from measurements in healthy children or adults.16 When direct measurement cannot be made, ensure that any energy expenditure equation that is used to estimate needs is both age and condition appropriate.16
2. Develop an individualized nutrition care plan for neonates and children with, or at risk of, a pressure ulcer. (Strength of Evidence = C; Strength of Recommendation = \( \star \))

3. Ensure all neonates and children maintain adequate hydration. (Strength of Evidence = C; Strength of Recommendation = \( \star \star \))

4. When oral intake is inadequate, consider age appropriate nutritional supplements for neonates and children who are at risk of a pressure ulcer and are identified as being at risk of malnutrition. (Strength of Evidence = C; Strength of Recommendation = \( \star \))

5. When oral intake is inadequate, consider age appropriate nutritional supplements for neonates and children who have an existing pressure ulcer and are identified as being at risk of malnutrition. (Strength of Evidence = C; Strength of Recommendation = \( \star \))

6. When oral intake is inadequate, consider enteral or parenteral nutritional support in neonates and children who are at risk of a pressure ulcer or have an existing pressure ulcer and who are also identified as being at risk of malnutrition. (Strength of Evidence = C; Strength of Recommendation = \( \star \))

These recommendations are based on expert opinion and indirect evidence. Energy and protein intake should be determined in consideration of:

- requirements for normal growth and development;
- any nutritional deficiency;
- altered needs associated with critical illness or comorbidities; and
- needs associated with wound healing.

A pediatrician, pediatric dietitian or other qualified health professional should be involved in planning an appropriate, individualized nutrition plan, and providing caregivers with strategies to promote nutritional intake. Energy needs should be individualized and determined with consideration to energy expenditure in order to avoid overfeeding or underfeeding. In a review of cohort studies conducted in critically ill children, the variability of metabolic state and thus the inappropriate nature of providing recommendations on specific intake goals was highlighted. The American Society for Parenteral and Enteral Nutrition (ASPEN) guidelines for nutritional requirements for children who are critically ill also indicate that there is insufficient evidence to make specific recommendations on the macronutrient requirements for these children (indirect evidence).

### Selection of Support Surfaces

1. Select an age appropriate, high specification support surface for children at high risk of pressure ulcers. (Strength of Evidence = C; Strength of Recommendation = \( \star \))

The efficacy and safety of using a support surface designed for an adult individual for preventing pressure ulcers in the pediatric population has not been investigated thoroughly. When selecting a pressure redistribution support surface for children, consideration should be given to the specific bony prominences most at risk.

García-Molina et al. (2012) compared the incidence of hospital acquired pressure ulcers in a cohort of children in intensive care who were placed on a continuous, reactive low pressure support surface compared with a standard mattress. The support surface consisted of a double air cell construction with three separate compartments for the head, body and trunk. Although the pressure differed between each section, it was consistent within each section (i.e., not an active support surface). The study mattress was available in two sizes, one for children weighing 500 g/1.1 lb to 6 kgs/13.2 lb (n = 4) and one for children above 6 kgs/13.2 lb (n = 26). Due to clinical condition, 63% of the participants did not receive any repositioning during their time on the study mattress. There was a significant decrease in
facility-acquired pressure ulcers (not related to medical devices) associated with the study mattress compared to a retrospective cohort that used a standard hospital mattress (3.3% versus 20%, 95% CI 0.08% to 17.2%, p < 0.021). The severity of the pressure ulcers that did develop was not reported. One third of the children who participated in the study had a pre-existing pressure ulcer on admission to the PICU, and of these, 66.6% had healed prior to their discharge from the PICU (Level 4 study).

1.1. Select a high specification support surface for premature infants and younger children to prevent occipital pressure ulcers. (Strength of Evidence = C; Strength of Recommendation = 
)

Occipital pressure ulcers are a specific concern for younger pediatric individuals. For younger children, the head composes a greater percentage of the body surface area than in adults and the occiput is a primary pressure point for children in the supine position. In a survey of seven NICUs, Fujii et al. (2010) reported that approximately 7% of reported pressure ulcers were in the occipital region. Schindler et al. (2011) supported these findings in their own survey of nine PICUs that reported 6% of pressure ulcers were occipital.

Turnage-Carrier et al. (2008) investigated the interface pressure at the occipital bony prominence in healthy premature (mean age 30.2 gestational weeks) infants who were in an open crib, feeding and gaining weight, had no history of pressure ulcers and were within one to three weeks of discharge (n = 11). Infants with head or neck abnormalities were excluded from the study. The infants were placed on five different support surfaces and interface pressure was measured under the occiput after five minutes. The infants were consecutively placed on a gel mattress, a gel pillow, a water pillow and a standard crib/cot mattress with 2.75 inch (7 cm) thick foam overlay and a standard (undefined) crib/cot mattress. A regular crib/cot blanket was placed over each support surface, except the gel pillow, which was fitted with its own disposable cover. Each of the four high specification support surfaces were associated with significantly lower interface pressure (p < 0.001) compared to a standard crib/cot mattress. The mattress with the foam overlay had the lowest interface pressure (31 mmHg versus 86.8 mmHg for the standard crib/cot mattress, p < 0.001). Development of pressure ulcers was not an outcome measure in this study (indirect evidence).

2. Ensure that the individual’s height, weight and age are consistent with the manufacturer’s recommendations when placing a pediatric individual on a low-air-loss bed or alternating pressure support surface. (Strength of Evidence = C; Strength of Recommendation = 
)

This recommendation is based on expert opinion. The manufacturer’s weight recommendations for low-air-loss beds should be followed. Low-air-loss beds have pressure areas designed for adults. When children are placed on an adult bed, their head is frequently positioned in an area with pressures designed for an adult’s trunk.

Alternating pressure support surfaces are designed to support the weight of an adult over a larger number air cells than will be required to support a child’s surface area, resulting in inappropriate pressures. The child’s smaller limbs can lodge between alternating air cells, and the sacrum region can rest between cells in the sitting position. This results in a need to more regularly reposition the child appropriately on the alternating pressure cells.

Repositioning

The Repositioning and Early Mobilization section of the full Clinican Practice Guideline outlines general recommendations on the frequency and principles for repositioning for prevention and treatment of pressure ulcers. In addition, the following recommendations should be considered for pediatric individuals.

1. Ensure that the heels are free of the surface of the bed. (Strength of Evidence = C; Strength of Recommendation = 
)
This recommendation is based on expert opinion. Suspension of heels off the bed is particularly important in neonates and smaller children as it is difficult to redistribute pressure off the smaller surface area of pediatric heels, even with a high specification support surface. In their study measuring interface pressures, McLane et al. (2002) found that mean perpendicular heel interface pressure was significantly higher than coccyx and occiput interface pressure for children aged from six to 16 years. Heel interface pressure was significantly lower when the foot was positioned on its side, due to the increase in surface area (indirect evidence). Floating the heels entirely free of the bed surface further reduces the risk of heel pressure ulcers.

2. Frequently reposition the head of neonates and infants when they are sedated and ventilated. (Strength of Evidence = C; Strength of Recommendation = 2)

Pediatric individuals are at high risk of occipital pressure ulcers. Diligent repositioning of the neonate or infants head is of particular importance when the individual is sedated and is unable to reposition alone.

References

GLOSSARY OF TERMS – PEDIATRIC INDIVIDUALS EXTRACT

**Albumin:** Albumin makes up 60% of total protein in the blood. It decreases with stress, age, and impaired liver function. Albumin serves to maintain colloid osmotic pressure and as a transport protein for certain ions, hormones, medications, enzymes, fatty acids, amino acids, and bilirubin. It decreases with over-hydration, stress, infection, impaired renal function, and liver disease, among other causes. Normal albumin blood level is 3.5 to 5.4 gm/dL. Normal values may vary depending upon the laboratory performing analysis.

**Bony prominence:** A bony elevation or projection on an anatomical structure.¹

**Enteral nutrition:** Nutritional support given via a nasogastric, nasoenteral, or percutaneous tube. Enteral nutrition is used when the gastrointestinal tract is functioning.²

**Float:** A method used to relieve a body part, such as the heel, of pressure.

**Interface pressure:** The force per unit area that acts perpendicularly between the body and a support surface. This parameter is affected by the stiffness of the support surface, the composition of body tissue, and the geometry of the body being supported.¹

**Malnutrition:** Malnutrition defined as any nutritional imbalance³ and is synonymous with the term undernutrition.

**Mobility:** The ability to move oneself from one position to another.

**Nutritional supplement:** A commercial or other prepared food or beverage that supplements energy, protein, carbohydrate, and/or fiber.

**Oral nutritional supplement:** A commercial or other prepared food or beverage that supplements nutrient and caloric intake.

**Overlay:** An additional support surface designed to be placed directly on top of an existing surface.

**Parenteral nutrition:** The provision of macronutrients, vitamins, minerals, electrolytes, and fluids via a central or peripheral vein that is indicated when the gastrointestinal tract cannot be used for nutritional support. Total parenteral nutrition (TPN) provides all essential nutrients and is delivered through of central vein.

**Pressure injury:** see Pressure ulcer.

**Pressure ulcer (pressure injury):** a localized injury to the skin and/or underlying tissue, usually over a bony prominence, as a result of pressure or pressure in combination with shear. A number of contributing or confounding factors are also associated with pressure ulcers; the significance of these factors has yet to be elucidated. (See the Etiology of Pressure Ulcers section of the guideline). Previously referred to as decubitus ulcer, bedsore and pressure sore.

**Prevalence:** The proportion/percentage of individuals in a defined population who have a pressure ulcer at a specified point in time.

  - **Point prevalence:** Measures the proportion of a defined population (e.g., individuals in a hospital) who have a pressure ulcer at a specific moment in time (e.g., on a specific day).³

  - **Period prevalence:** Measures the proportion of a defined population (e.g., individuals in a hospital) who have a pressure ulcer over a period of time (e.g., over a week).

**Protein:** A complex organic compound made up of chains of amino acid molecules. Proteins are responsible for the repair of injured tissue, fluid balance, antibody production, cellular function, and hormonal and enzymatic function. Proteins are a source of building material for muscle and for healing wounds.

**Reposition:** A change in position in the lying or seated individual, with the purpose of relieving or
redistributing pressure and enhancing comfort, undertaken at regular intervals.

**Risk assessment**: An assessment to determine which, if any, risk factors are present that might contribute to the development of a pressure ulcer.¹

**Support surface**: A specialized device for pressure redistribution designed for management of tissue loads, microclimate, and/or other therapeutic functions. Support surfaces include but are not limited to mattresses, integrated bed systems, mattress replacements or overlays, or seat cushions and seat cushion overlays.

**Support surfaces: physical concepts**:

- **Active support surface**: A powered support surface that produces alternating pressure through mechanical means and has the ability to change its load distribution properties with or without an applied load.⁵

- **Coefficient of friction**: A measurement of the amount of friction existing between two surfaces.⁶

- **Envelopment**: The ability of a support surface to conform to irregularities in the body.⁶⁻⁸

- **Fatigue**: The reduced capacity of a surface or its components to perform as specified. This change may be the result of intended or unintended use and/or prolonged exposure to chemical, thermal, or physical forces.⁶

- **Force**: A push/pull vector with magnitude (quantity) and direction (pressure and shear) that is capable of maintaining or altering the position of a body.⁶, ⁹

- **Friction (frictional force)**: The resistance to motion in a parallel direction relative to the common boundary of two surfaces.⁶

- **Immersion**: The depth of penetration (sinking) into a support surface.⁶⁻⁸

- **Life expectancy**: The defined period of time during which a product is expected to effectively fulfill its designated purpose.⁶

- **Mechanical load**: The force distribution acting on a surface.⁶

- **Pressure**: The force per unit area exerted perpendicular to the plane of interest.⁶

- **Pressure redistribution**: The ability of a support surface on which an individual is placed to distribute load over the contact areas of the human body, thereby reducing the load on areas in contact with the support surface. This term replaces prior terminology of pressure reduction and pressure relief surfaces.⁶

- **Pressure relief**: see Pressure redistribution.

- **Reactive support surface**: A powered or non-powered support surface with the ability to change its load distribution properties only in response to applied load.⁶⁻¹⁰, ¹¹

- **Shear (shear stress)**: The force per unit area exerted parallel to the plane of interest.⁶, ⁹

- **Shear strain**: The distortion or deformation of tissue as a result of shear stress.⁶⁻⁹, ¹²

**Support surfaces: components**: The components of any support surface described below may be used alone or in combination.

- **Air**: A low-density fluid with minimal resistance to flow.⁶

- **Cell/bladder**: A means of encapsulating a support medium.⁶

- **Closed-cell foam**: A non-permeable structure in which there is a barrier between cells, preventing
gases or liquids from passing through the foam.  

**Elastic foam:** A type of porous polymer material that conforms in proportion to the applied weight. Air enters and exits the foam cells more rapidly due to greater density (non-memory).  

**Elastomer:** Any material that can be repeatedly stretched to at least twice its original length. Upon release, the stretch will return to approximately its original length.  

**Gel:** A semi-solid system of a network of solid aggregates, colloidal dispersions, or polymers, which may exhibit elastic properties. Gels can range from hard to soft.  

**Open cell foam:** A permeable structure in which there is no barrier between cells, and gases or liquids can pass through the foam.  

**Pad:** A cushion-like mass of soft material used for comfort, protection, or positioning.  

**Solid:** A substance that does not flow perceptibly under stress. Under ordinary conditions, it retains its size and shape.  

**Viscoelastic foam:** A type of porous polymer material that conforms in proportion to the applied weight. The air enters the foam cells slowly, which allows the material to respond more slowly than a standard elastic (memory) foam.  

**Viscous fluid:** A fluid with a relatively high resistance to flow of the fluid.  

**Water:** A moderate density fluid with moderate resistance to flow.  

**Support surface features:** A feature is a functional component of a support surface that can be used alone or in combination with other features.  

**Air fluidized:** A feature that provides pressure redistribution via a fluid-like medium created by forcing air through beads, as characterized by immersion and envelopment.  

**Alternating pressure:** A feature that provides pressure redistribution via cyclic changes in loading and unloading, as characterized by frequency, duration, amplitude, and rate of change parameters.  

**Lateral rotation:** A feature that provides rotation about a longitudinal axis, as characterized by degree of turn, duration, and frequency.  

**Low air loss:** A feature that provides a flow of air to assist in managing the heat and humidity (microclimate) of the skin.  

**Multi-zoned surface:** A surface in which different segments can have different pressure redistribution capabilities.  

**Zone:** A surface with a single pressure redistribution capability.  

**Support surface categories:**  

**Active support surface:** A powered support surface with the capability to change its load distribution properties, with or without applied load.  

**Integrated bed system:** A bed frame and support surface that are combined into a single unit, whereby the surface is unable to function separately.  

**Mattress:** A support surface designed to be placed directly on the existing bed frame.  

**Non-powered:** Any support surface that does not use external sources of energy, either electric or battery, for operation.
**Overlay:** An additional support surface designed to be placed directly on top of an existing surface.\(^6\),\(^10\),\(^11\)

**Powered:** Any support surface requiring or using external sources of energy to operate, either electric or battery.\(^6\)

**Reactive support surface:** A powered or non-powered support surface with the capability to change its load distribution properties only in response to applied load.\(^6\)

**Suspected deep tissue injury:** Purple or maroon localized area of discoloured, intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear. The area may be preceded by tissue that is painful, firm, mushy, boggy, or warmer or cooler than adjacent tissue. Deep tissue injury may be difficult to detect in individuals with dark skin tones. Evolution may include a thin blister over a dark wound bed. The wound may further evolve and become covered by thin eschar. Evolution may be rapid exposing additional layers of tissue even with treatment.

**Undernutrition:** see *Malnutrition*.

**References**
