# PRESSURE ULCER PREVENTION DURING SURGERY


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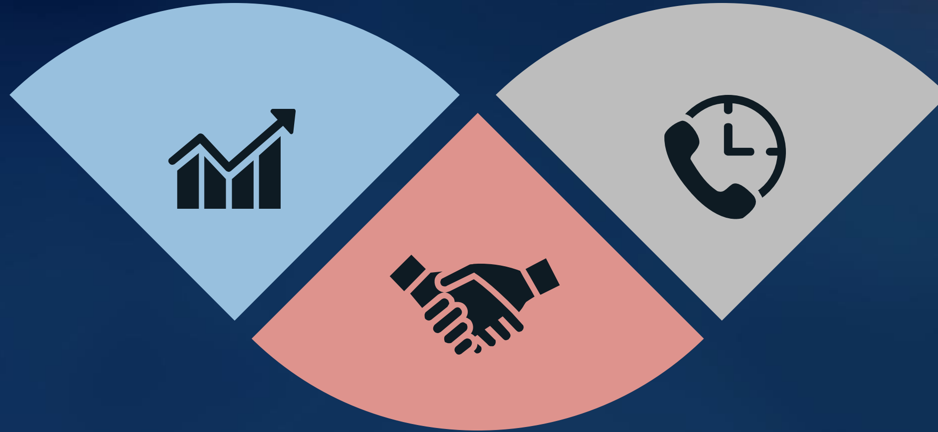
# A pressure ulcer detected within 3 days post-surgery should be considered *intraoperatively acquired*

Primiano, M., Friend, M., McClure, C., Nardi, S., Fix, L., Schafer, M., Savochka, K., & McNett, M. (2011). Pressure ulcer prevalence and risk factors during prolonged surgical procedures. AORN journal, 94(6), 555–566. https://doi.org/10.1016/j.aorn.2011.03.014

Etiology

Risk Factors



Preventative Strategies

# Variable Prevalence and Incidence Data

- Prevalence of Pressure Ulcers in the Operating Room
- Incidence of Pressure Ulcers in the Operating Room
- Key Risk Factors

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# Prevalence of Pressure Ulcers in the Operating Room

- Systematic Review and Meta-analysis
- Articles included: 19
- N = 9527

Shafipour, V., Ramezanpour, E., Gorji, M. A., & Moosazadeh, M. (2016). Prevalence of postoperative pressure ulcer: A systematic review and meta-analysis. *Electronic physician*, *8*(11), 3170–3176. https://doi.org/10.19082/3170

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Prevalence of pressure ulcer (%) by articles entering the meta-analysis

| First author | *n* | | Total P[3] | MP[4] | FP[5] | p-stage 1 | p-stage2 | p-stage 3 | p-stage 4 |
|---|---|---|---|---|---|---|---|---|---|
| | M[1] | F[2] | | | | | | | |
| Schoonhoven | 136 | 72 | 21.1 | | | 11 | 10.1 | | |
| Pokorny | 222 | 129 | 7 | 4.5 | 10.8 | 4.3 | 1.99 | 0.28 | 0.28 |
| Lindgren | 157 | 129 | 14.3 | 7.6 | 22.5 | 9.79 | 3.5 | 1 | |
| Nixon | 38 | 59 | 15.5 | | | | 13.4 | | 1.7 |
| Karadag | | | 54.8 | | | 54.8 | | | |
| Sewchuk | 100 | 50 | 11.3 | | | 3.33 | 5.3 | 2 | 1.3 |
| Feuchtinger | 31 | 22 | 64.1 | | | 62.2 | 1.8 | | |
| Rademarkers | 171 | 551 | 30 | | | | 27.5 | 2.07 | |
| Scarlatti | 101 | 98 | 20.6 | | | 13 | 7 | 0.28 | 0.28 |
| KAMpbell | 28 | 44 | 17 | | | 3 | 7 | | |
| Tschanen | 1681 | 1161 | 12 | 13.6 | 13.2 | | | | |
| Shen | | | 16.4 | | | 16.08 | 0.35 | | |
| Primiano | 108 | 147 | 8.1 | 12.03 | 4.8 | | | | |
| Esoppi | 1025 | 604 | 11.1 | 12.2 | 9.3 | | | | |
| Lumbley | | | 27.3 | 18.5 | 8.7 | | | | |
| Shadedi | 115 | 100 | 27.9 | 17.3 | 40 | | | | |
| Honglinchen | 160 | 126 | 16.4 | | | 16 | 0.35 | | |
| Shaw | 162 | 135 | 9.8 | 9.8 | 9.6 | | | | |
| Shaw | 162 | 135 | 5.1 | 6.1 | 3.7 | | | | |

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A randomised effect model was used to report the general prevalence of the ulcer, which is estimated as **18.96%** [CI 95%: 15.3–22.6]

# Prevalence of Pressure Ulcers in the Operating Room (OR)

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- These PUs are caused by **intense or prolonged pressure** that is unrelieved for a long period of time, resulting in skin and underlying tissue damage
- Pressure ulcer formation related to positioning in the OR is a leading cause of **increased length of hospital stay** among surgical patients, costing between $14,000 and $40,000 per patient

Primiano, M., Friend, M., McClure, C., Nardi, S., Fix, L., Schafer, M., Savochka, K., & McNett, M. (2011). Pressure ulcer prevalence and risk factors during prolonged surgical procedures. *AORN journal*, *94*(6), 555–566. https://doi.org/10.1016/j.aorn.2011.03.014

# Incidence of Pressure Ulcers in the Operating Room

- Systematic Review
- Articles included: 135
- N = 970,193

Kurian, S., Moore, Z., Patton, D., & George, S. (2025). The Incidence of Pressure Ulcers in Surgical Patients: A Systematic Review. International wound journal, 22(8), e70738. https://doi.org/10.1111/iwj.70738

# Incidence of Pressure Ulcers in the Operating Room

- The rate substantially varied across the studies, from **0.05% to 74.2%**
- The mean (SD) PU incidence was **17.22% (±19%)**

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Kurian, S., Moore, Z., Patton, D., & George, S. (2025). The Incidence of Pressure Ulcers in Surgical Patients: A Systematic Review. International wound journal, 22(8), e70738. https://doi.org/10.1111/iwj.70738

Type of surgery and PU incidence.

| Type of surgery | Sum of (PU incidence) number | % (of PU) each surgical category (%) |
|---|---|---|
| Ortho surgery | 3414 | 80 |
| Cardiac surgery | 349 | 8 |
| Vascular surgery | 162 | 4 |
| Spinal surgery | 95 | 2 |
| Neuro surgery | 70 | 1.64 |
| Other surgeries | 55 | 1.29 |
| Bowel or laparotomy/abdominal | 35 | 0.82 |
| General surgery | 34 | 0.79 |
| Urological surgery | 28 | 0.65 |
| Limb amputation | 18 | 0.42 |
| Trauma surgery | 7 | 0.16 |
| ENT | 5 | 0.12 |
| Obstetrics gynaecology | 3 | 0.07 |
| Inflammatory surgeries | 2 | 0.05 |
| Tumour surgery | 2 | 0.05 |
| Bleeding surgeries | 1 | 0.02 |

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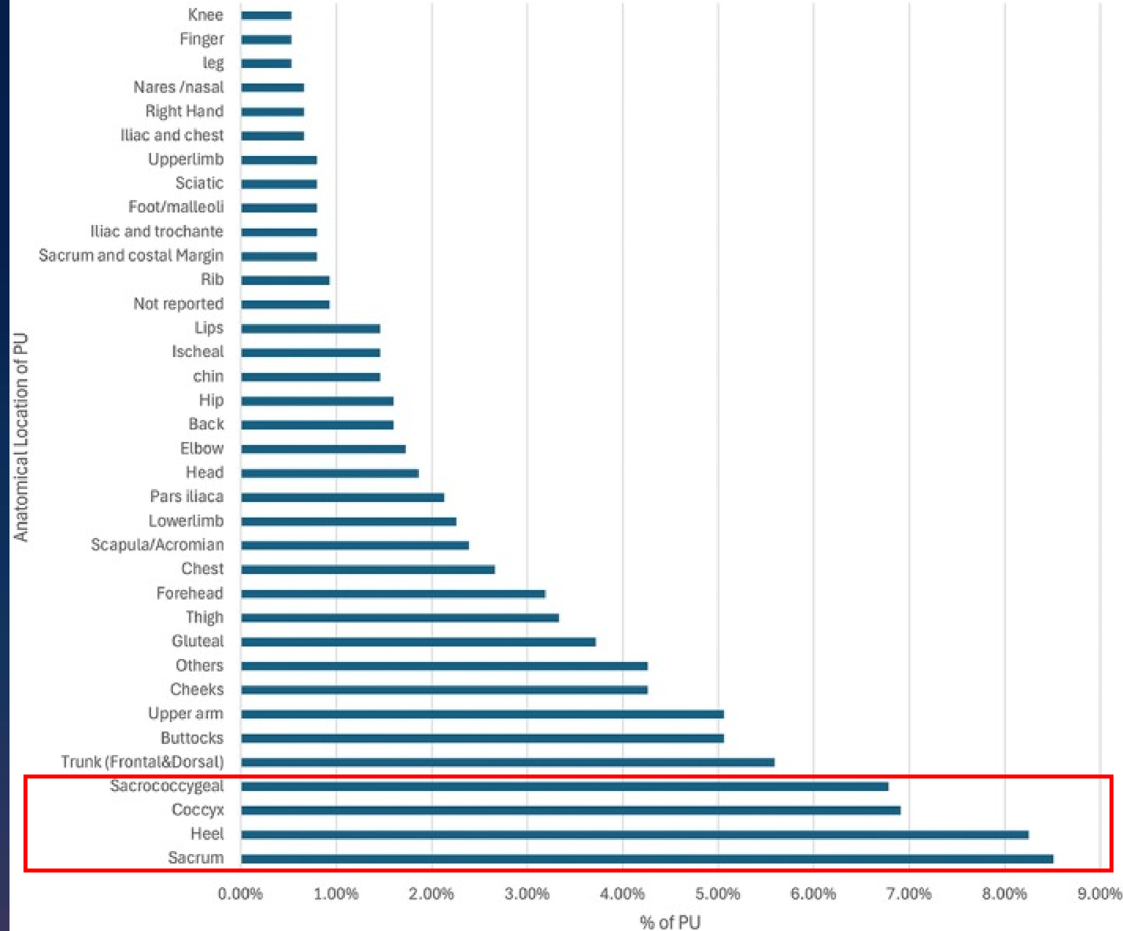
Anatomical Location and Percentage of PU
Knee
Finger
leg
Nares /nasal
Right Hand
Iliac and chest
Upperlimb
Sciatic
Foot/malleoli
Iliac and trochante
Sacrum and costal Margin
Rib
Not reported
Lips
Ischeal
chin
Hip
Back
Elbow
Head
Pars iliaca
Lowerlimb
Scapula/Acromian
Chest
Forehead
Thigh
Gluteal
Others
Cheeks
Upper arm
Buttocks
Trunk (Frontal&Dorsal)
Sacrococcygeal
Coccyx
Heel
Sacrum
Anatomical Location of PU
0.00%
1.00%
2.00%
3.00%
4.00%
5.00%
6.00%
7.00%
8.00%
9.00%
% of PU
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# Why the OR Is High-Risk

- The risk and incidence increase notably with **prolonged surgeries**:
  - ~ 9% for procedures lasting 4–5 hours,
  - 10% for 5–7 hours, and
  - over 13% for longer surgeries

Gefen, A. (2020). *Minimising the risk for pressure ulcers in the operating room using a specialised low-profile alternating pressure overlay*. Wounds International, 11(2). https://woundsinternational.com/wp-content/uploads/2023/02/668f9f34716cf9cbc22137b51135307f.pdf

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# Why the Operating Room Is High-Risk

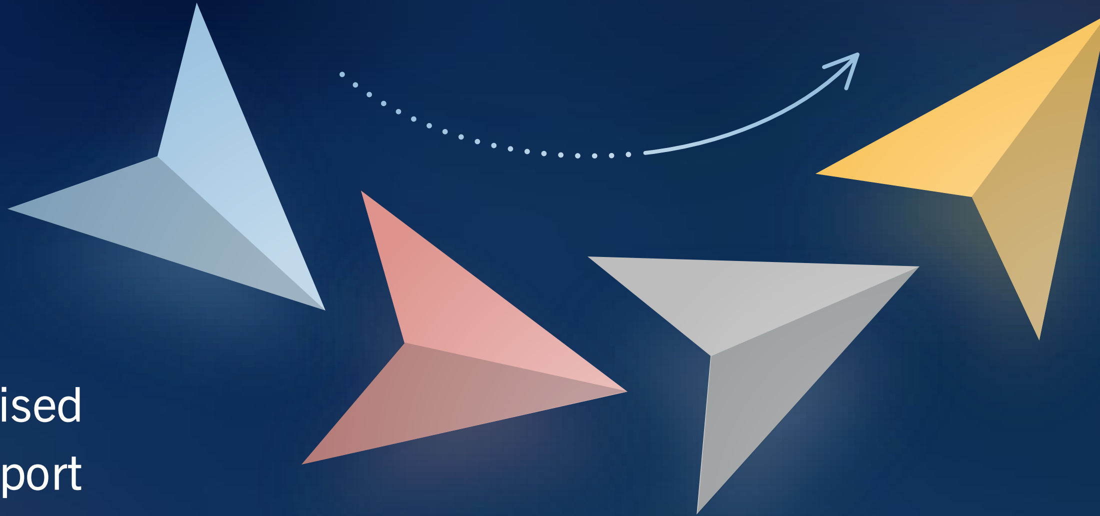
- Thin pads must be stiff → **high interface pressures**
- Poor immersion and envelopment
- Surgical positions (Trendelenburg, park-bench, etc.) **increase shear and friction**
- Hypothermia, blood loss, and vasopressors **reduce tissue perfusion** → higher injury risk
- Additional equipment (retractors, tubing, warming devices) **adds local pressure points**

Gefen, A. (2020). *Minimising the risk for pressure ulcers in the operating room using a specialised low-profile alternating pressure overlay*. Wounds International, 11(2). https://woundsinternational.com/wp-content/uploads/2023/02/668f9f34716cf9cbc22137b51135307f.pdf

# Risk Factors

Vasselli, B., Spazzapan, L., Sartorato, P., Makuc, E., Grezar, L., Ramella, V., & Papa, G. (2022). Pressure ulcers incidence in a perioperative neurosurgical setting. *Plastic Reconstructive and Regenerative Surgery*, 114-120.

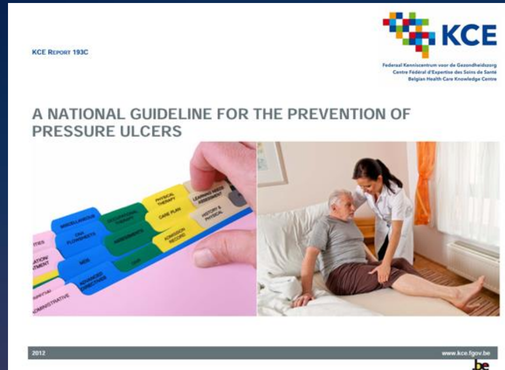
# Intraoperative Prevention Strategies

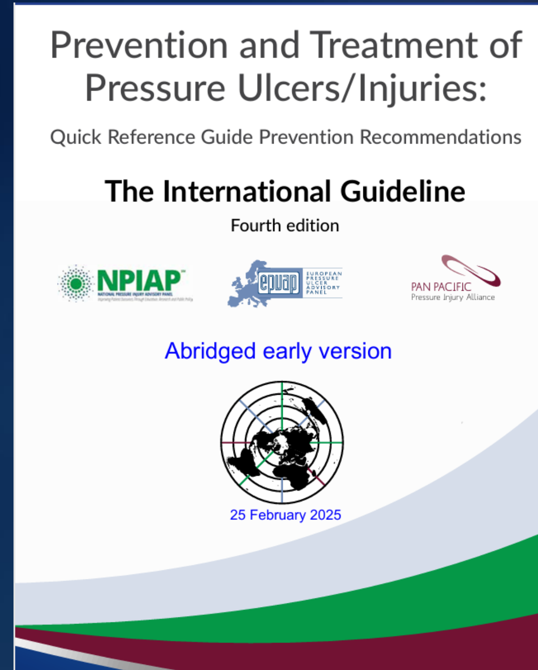


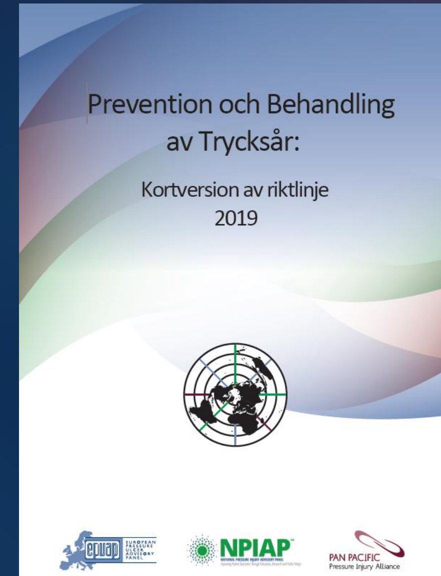
Specialised Support Surfaces

# Guidelines

NATIONAL PRESSURE INJURY ADVISORY PANEL




*NPIAP, EP{UAP, PPPIA: Prevention and Treatment of Pressure Ulcers/Injuries*: Clinical Practice Guideline https://internationalguideline.com/the-international-guideline

**Full body support surfaces are specialized mattresses, overlays and integrated systems that are designed to redistribute pressure, reduce friction and shear, and aid microclimate management, all factors that play a role in pressure injury development. *(1)***

**Clinical question: What are considerations in ensuring availability and safe use of full body support surfaces for individuals at risk of pressure injuries?**

## SS1: Good Practice Statement

**It is good practice for organizations to maintain an inventory of, or access to, a range of full body support surfaces appropriate to the clinical context. The inventory should be maintained, stored and used in accordance with manufacturer recommendations.**

## SS3: Recommendation

**We recommend using a pressure redistribution foam (reactive) full body support surface for individuals at risk of pressure injuries.**

**Strong recommendation; low certainty of evidence**

Table 1: Extract of S3I terminology *(1)*

| Support surface category | Component/material | Design features | Performance characteristics |
|---|---|---|---|
| • Active support surface<br>• Reactive support surface | • Air<br>• Cell/bladder<br>• Foam<br>• Gel | • Alternating pressure<br>• Constant/continuous low pressure<br>• Convertible/adaptable<br>• Hybrid<br>• Integrated bed system<br>• Lateral rotation<br>• low air loss<br>• Multi-zoned surface<br>• Non-powered<br>• Powered<br>• Pulsation<br>• Turn assist<br>• Zone | • Envelopment<br>• Immersion<br>• Microclimate<br>• Pressure Redistribution |

Terminology:

- **Immersion** reduces pressure by increasing the body–surface contact area,
- **Envelopment** reduces pressure by conforming to the body's shape—both working together to protect tissue and prevent pressure injuries.

# Need for Innovative Prevention

- Need alternatives that reduce tissue deformation.
- Prevention should reduce tissue deformation and provide **cyclic relief**.
- Must maintain patient stability for precision procedures.

Gefen, A. (2020). *Minimising the risk for pressure ulcers in the operating room using a specialised low-profile alternating pressure overlay*. Wounds International, 11(2). https://woundsinternational.com/wp-content/uploads/2023/02/668f9f34716cf9cbc22137b51135307f.pdf

# Types of Support Surfaces in OR (example)

- **Low-Tech Surfaces**
- Not powered; static materials such as **foam, gel, viscoelastic polymer**.
- Aim to increase body area contact and distribute weight.
- Examples:
  - Dry viscoelastic polymer overlay
  - High-specification foam
  - Gel pads, egg-crate foam, "foam donuts"

Prado, C. B. C., Machado, E. A. S., Mendes, K. D. S., Silveira, R. C. C. P., & Galvão, C. M. (2021). Support surfaces for intraoperative pressure injury prevention: systematic review with meta-analysis. Revista latino-americana de enfermagem, 29, e3493. https://doi.org/10.1590/1518-8345.5279.3493

# Types of Support Surfaces in OR (example)

- High-Tech Surfaces
- Powered devices that **actively alternate pressure.**
- Dynamic redistribution through inflation/deflation cycles.
- Examples:
  - Alternating pressure overlays (AP overlays)
  - Pulsatile dynamic mattresses

Prado, C. B. C., Machado, E. A. S., Mendes, K. D. S., Silveira, R. C. C. P., & Galvão, C. M. (2021). Support surfaces for intraoperative pressure injury prevention: systematic review with meta-analysis. Revista latino-americana de enfermagem, 29, e3493. https://doi.org/10.1590/1518-8345.5279.3493

# Comparison of Support Surfaces – Meta-analysis Data

| Comparison | Relative Risk (RR) | 95% CI | Evidence Certainty |
|---|---|---|---|
| Low-Tech vs Standard Mattress | 0.88 | 0.30–2.39 | Very Low |
| High-Tech vs Low-Tech | 0.17 | 0.05–0.53 | Moderate |

Prado, C. B. C., Machado, E. A. S., Mendes, K. D. S., Silveira, R. C. C. P., & Galvão, C. M. (2021). Support surfaces for intraoperative pressure injury prevention: systematic review with meta-analysis. Revista latino-americana de enfermagem, 29, e3493. https://doi.org/10.1590/1518-8345.5279.3493

# Mechanisms: Why High-Tech Surfaces Perform Better

- Provide cyclic pressure offloading, mimicking mini-repositioning
- Reduce **sustained tissue deformation**, a major cause of PUs
- Improve **tissue perfusion** during long procedures.
- Work within OR constraints where **repositioning is impossible**.

Prado, C. B. C., Machado, E. A. S., Mendes, K. D. S., Silveira, R. C. C. P., & Galvão, C. M. (2021). Support surfaces for intraoperative pressure injury prevention: systematic review with meta-analysis. Revista latino-americana de enfermagem, 29, e3493. https://doi.org/10.1590/1518-8345.5279.3493

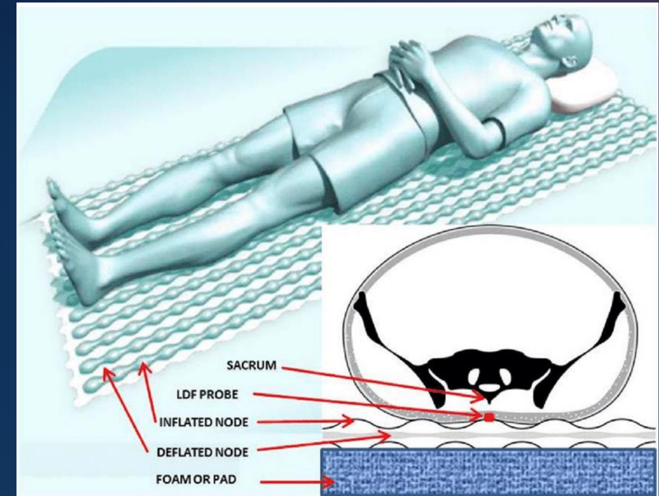
# Key Takeaways for Practice

- Priority should go to **alternating pressure overlays** when feasible.
- **Low-tech surfaces**: inconsistent evidence; cannot reliably outperform standard OR mattresses
- Selection must consider:
  - Procedure length
  - Patient risk profile (BMI, comorbidities, microclimate)
  - OR positioning
  - Budget and availability

Prado, C. B. C., Machado, E. A. S., Mendes, K. D. S., Silveira, R. C. C. P., & Galvão, C. M. (2021). Support surfaces for intraoperative pressure injury prevention: systematic review with meta-analysis. Revista latino-americana de enfermagem, 29, e3493. https://doi.org/10.1590/1518-8345.5279.3493

# Low-Profile Alternating Pressure Overlay (example)

- Thin overlay with inflatable nodules
- Provides cyclic micro-repositioning
- Does not disturb surgery
- Maintains patient stability




Gefen, A. (2020). *Minimising the risk for pressure ulcers in the operating room using a specialised low-profile alternating pressure overlay*. Wounds International, 11(2). https://woundsinternational.com/wp-content/uploads/2023/02/668f9f34716cf9cbc22137b511135307f.pdf

# Intraoperative Prevention Strategies

# Patient Positioning

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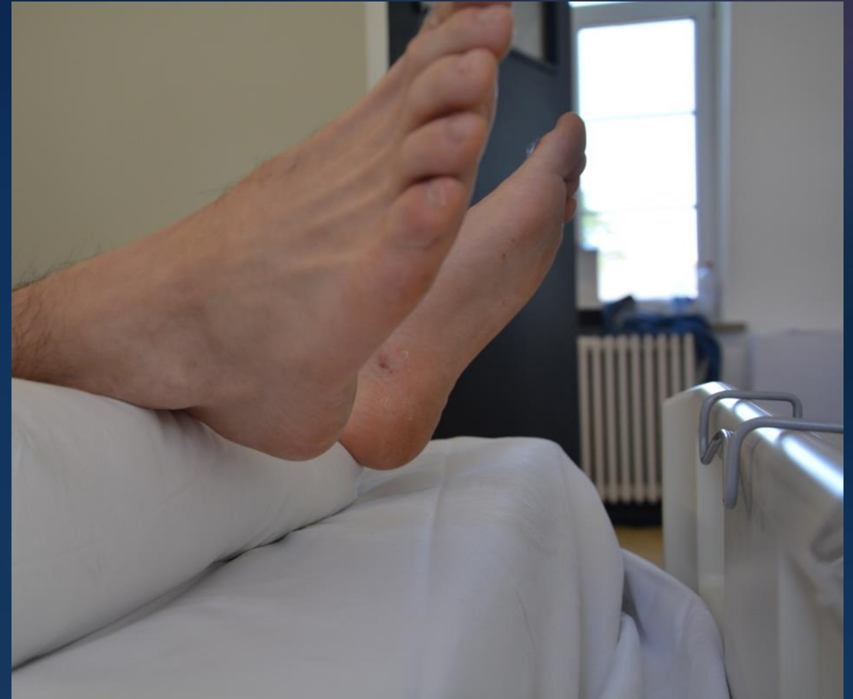
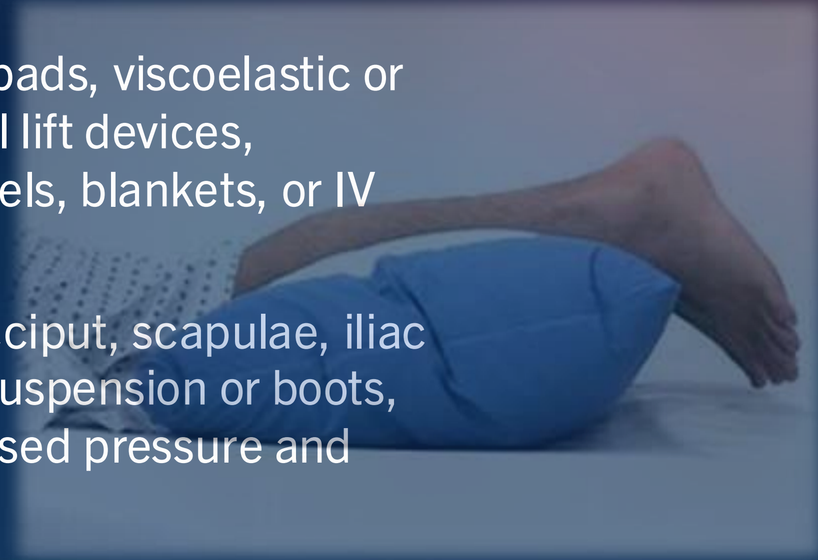
- "Position the individual in such a way as to reduce the risk of PU development, especially by avoiding shear forces.
- **Elevate the heels completely** (offload them) in such a way to redistribute the weight of the leg along the calf without putting all the pressure on the Achilles tendon. The knee should be in flexion and supported" (KCE report, 2013)



# Patient Positioning



- Use **evidence-based positioning devices** (gel pads, viscoelastic or pressure-redistributing overlays, foam/gel heel lift devices, headrests, arm supports) instead of rolled towels, blankets, or IV bags
- Off-load bony prominences (sacrum, heels, occiput, scapulae, iliac crests, trochanters, malleoli) with pads, heel suspension or boots, and neutral joint positioning to minimise localised pressure and shear.

Garrubba, M., & Joseph, C. (2016). *Pressure injury prevention in the operating theatre: Rapid review*. Monash Health. https://monashhealth.org/wp-content/uploads/2019/01/Pressure-injuries-in-the-OT-2.pdf
McBride, J. E. (2018, May 8). *Prevent pressure ulcers — 7 practical pearls to protect your patients' skin*. Outpatient Surgery Magazine. https://www.aorn.org/outpatient-surgery/article/2018-May-prevent-pressure-ulcers

# Patient Positioning

- For very long cases, use **micro-relief strategies** that do not compromise sterility
  - subtle tilt changes,
  - table flex adjustments,
  - decompression of heels or occiput and,

  where available, consider body-pressure monitoring to detect high-pressure zones.

Anesthesia Services of Kansas. (n.d.). *Avoiding pressure injuries in the operating room (2024).* https://www.anesthesiaservicesks.com/avoiding-pressure-injuries-in-the-operating-room/

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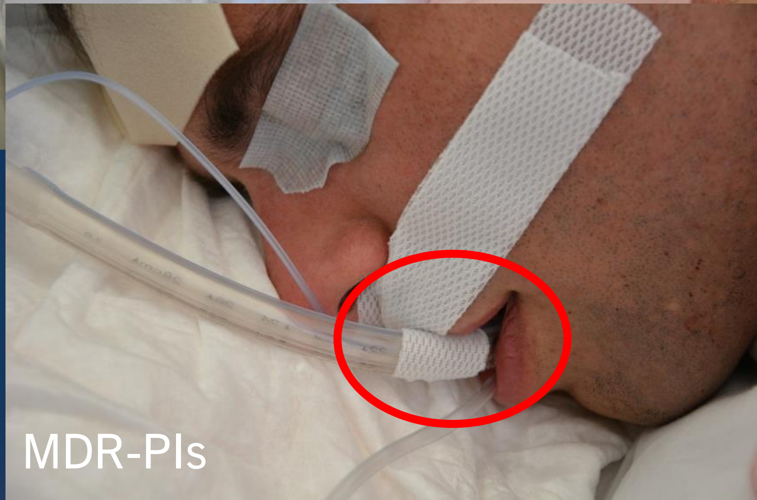
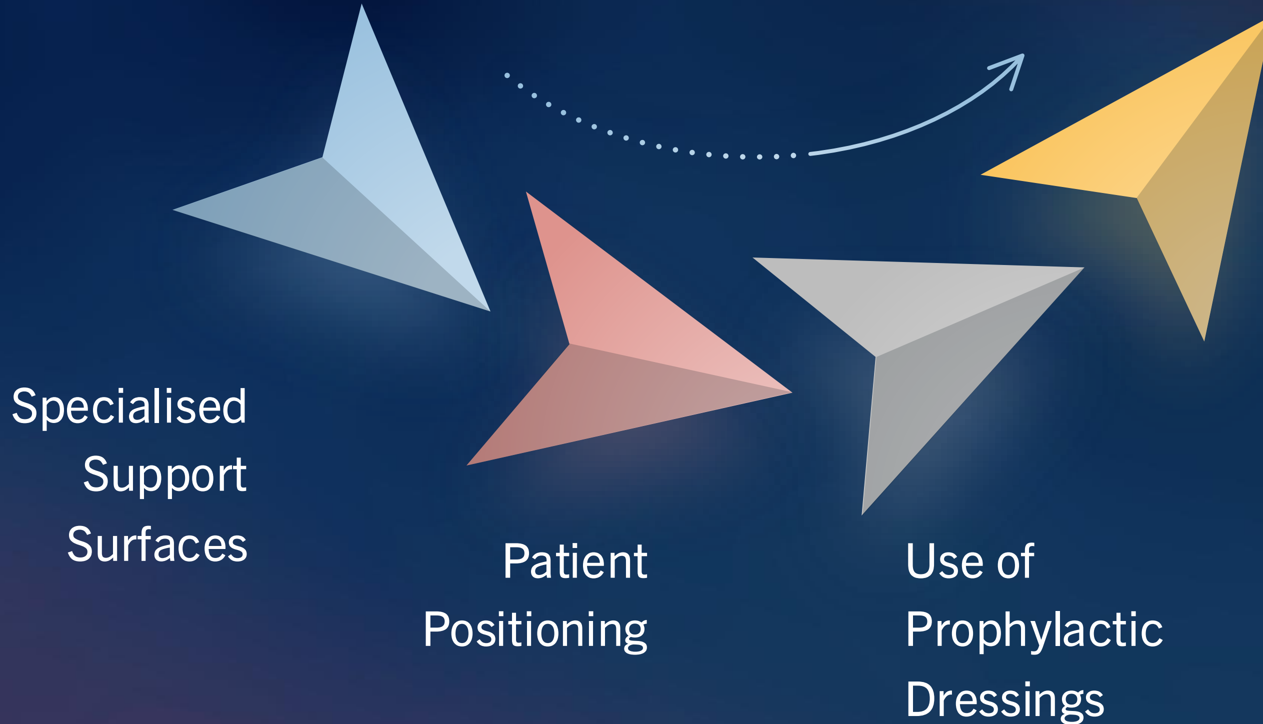
PRONETECT
EDUCATION
Protocol
Check-List
Literature
Teaching Aids
Simulation Videos
www.PRONEtection.com
Education Hub
Skin/Tissue Damage Prevention for the critically ill patient in the Prone Position

| List of educational resources on the PRONEtect Education Hub | | Duration / length |
|---|---|---|
| Video #00a | **Supine to prone** manoeuvre | 06:51min |
| Video #00b | **Prone to supine** manoeuvre | 03:06min |
| Video #01 | **Incontinence-associated dermatitis** prevention | 02:28min |
| Video #02 | **Nasogastric tube** securement | 02:02min |
| Video #03 | **Endotracheal tube** securement | 04:28min |
| Video #04 | **Eye** protection | 00:45min |
| Video #05 | **Peri-stomal** protection | 01:57min |
| Video #06 | Protection of **high-risk areas** | 02:50min |
| Video #07 | Skin protection **from medical adhesive-related skin injuries** | 02:11min |
| Video #08 | Head, neck and body **repositioning** – Swimmer's position | 03:12min |
| **Protocol** | Skin/tissue damage prevention for the critically ill patient in the prone position | 28 pages |
| **Checklist** | Summary: Prepare the team, Prepare the patient, Reposition | 1 page |
| **Teaching aid** | Comprehensive Powerpoint® slide deck for didactic lecturing | 63 slides |
| **Literature hub** | GLOBIAD-categorisation tool, NPIAP pressure injury classification, PRONEtect practice guidance document | 1-7 pages each |

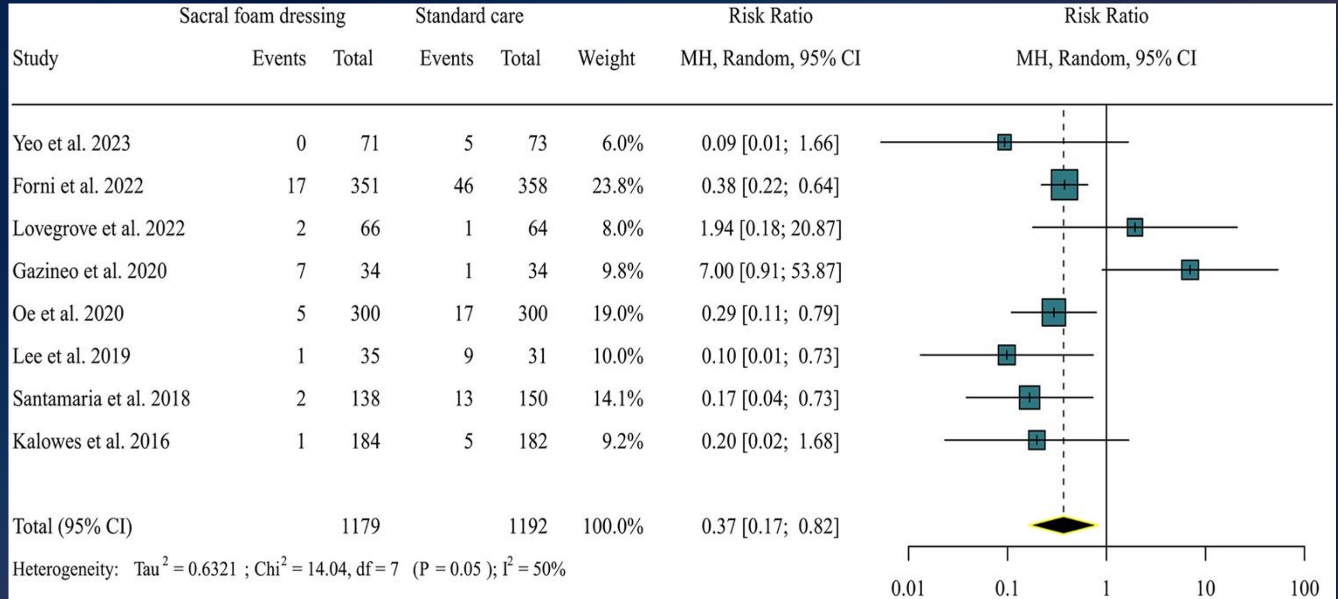
Air-fluidized positioner


MDR-PIs

# Intraoperative Prevention Strategies



The efficacy of sacral foam dressing in preventing sacral pressure injury: A systematic review and meta-analysis



| Study | Sacral foam dressing Events | Sacral foam dressing Total | Standard care Events | Standard care Total | Weight | Risk Ratio MH, Random, 95% CI |
|---|---|---|---|---|---|---|
| Yeo et al. 2023 | 0 | 71 | 5 | 73 | 6.0% | 0.09 [0.01; 1.66] |
| Forni et al. 2022 | 17 | 351 | 46 | 358 | 23.8% | 0.38 [0.22; 0.64] |
| Lovegrove et al. 2022 | 2 | 66 | 1 | 64 | 8.0% | 1.94 [0.18; 20.87] |
| Gazineo et al. 2020 | 7 | 34 | 1 | 34 | 9.8% | 7.00 [0.91; 53.87] |
| Oe et al. 2020 | 5 | 300 | 17 | 300 | 19.0% | 0.29 [0.11; 0.79] |
| Lee et al. 2019 | 1 | 35 | 9 | 31 | 10.0% | 0.10 [0.01; 0.73] |
| Santamaria et al. 2018 | 2 | 138 | 13 | 150 | 14.1% | 0.17 [0.04; 0.73] |
| Kalowes et al. 2016 | 1 | 184 | 5 | 182 | 9.2% | 0.20 [0.02; 1.68] |
| Total (95% CI) | | 1179 | | 1192 | 100.0% | 0.37 [0.17; 0.82] |

Heterogeneity: $Tau^2 = 0.6321$ ; $Chi^2 = 14.04$, df = 7 (P = 0.05 ); $I^2 = 50\%$



International Wound Journal, Volume: 21, Issue: 2, First published: 31 January 2024, DOI: (10.1111/iwj.14673)

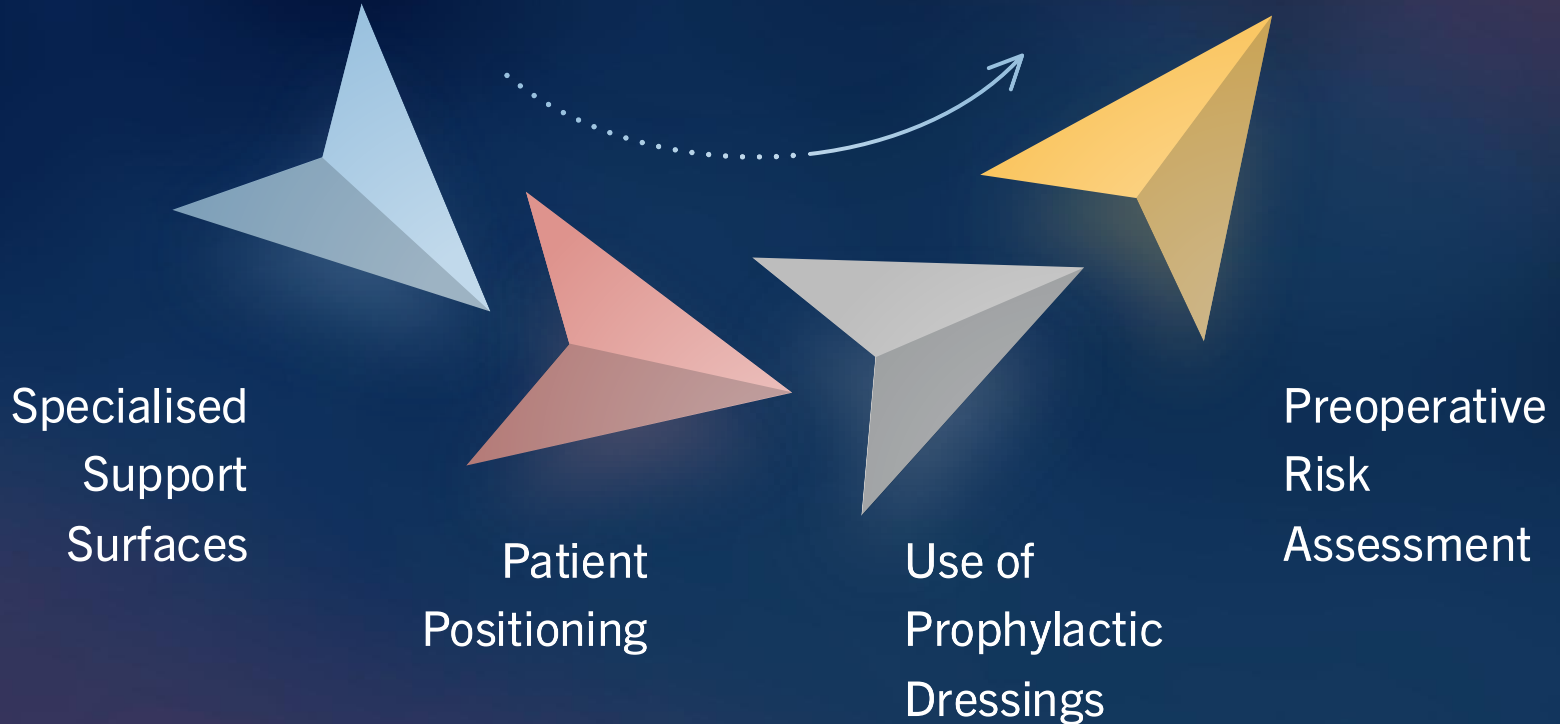
# NPIAP/EPUAP/PPPIA Guideline (2019)

## Prophylactic Dressings

3.5: Use a soft silicone multi-layered foam dressing to protect the skin for individuals at risk of pressure injuries.
(Strength of Evidence = B1; Strength of Recommendation = ↑)

6.4: Use a prophylactic dressing as an adjunct to heel offloading and other strategies to prevent heel pressure injuries.
(Strength of Evidence = B1; Strength of Recommendation = ↑)

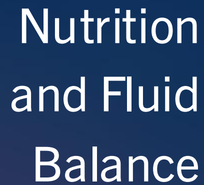
# Intraoperative Prevention Strategies



# Risk Assessment

- **Identifying patients at high risk** for pressure injuries is crucial
- Part of the assessment should also involve reviewing the planned surgery **duration and positioning requirements** (Anesthesia Services of Kansas. (n.d.). *Avoiding pressure injuries in the operating room*. https://www.anesthesiaservicesks.com/avoiding-pressure-injuries-in-the-operating-room/
- Currently, it is unknown which pressure ulcer risk assessment scale is best for patients undergoing surgery. Evidence suggests the use of a validated scale in conjunction with clinical judgement is best (NICE, 2014)

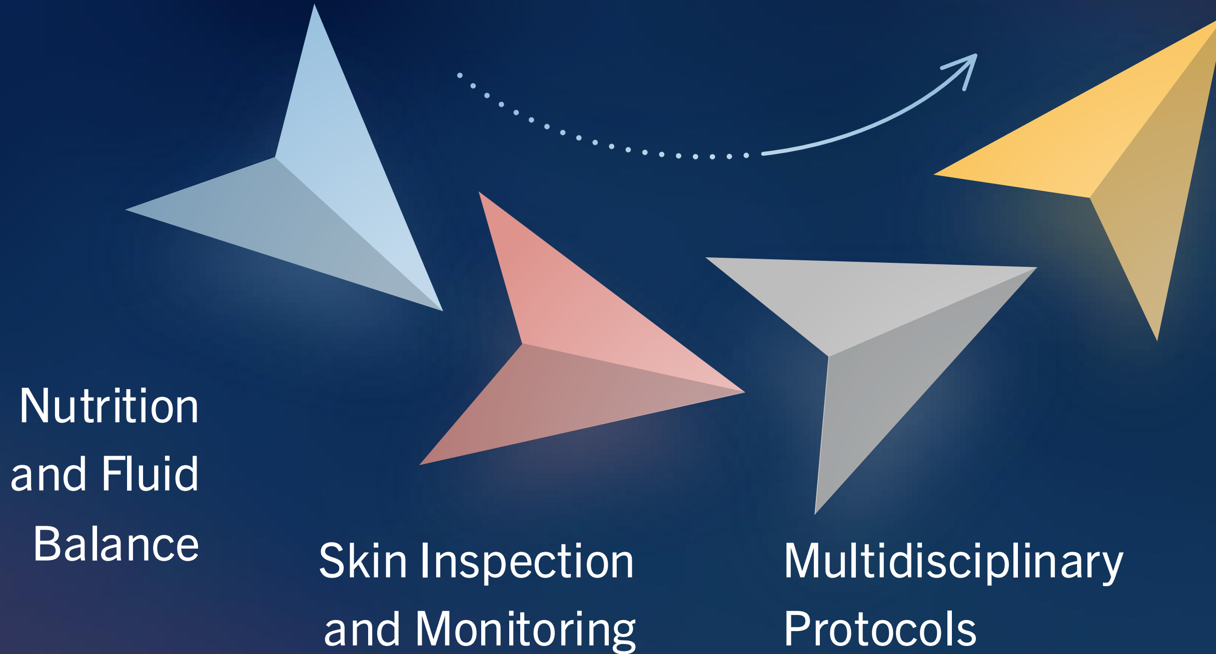
# Intraoperative Prevention Strategies



Nutrition and Fluid Balance

Maintaining **adequate blood pressure, ensuring proper hydration, and regulating body temperature can help preserve skin integrity** and promote blood circulation, thereby reducing the risk of PUs

# Intraoperative Prevention Strategies



# Skin Inspection and Protocols

- Perform and document a structured **skin assessment** immediately before and after surgery,
  - Focus on all pressure points and device contact areas, to
  - Detect early colour or texture changes that may signal deep tissue pressure injury.

# Skin Inspection and Protocols

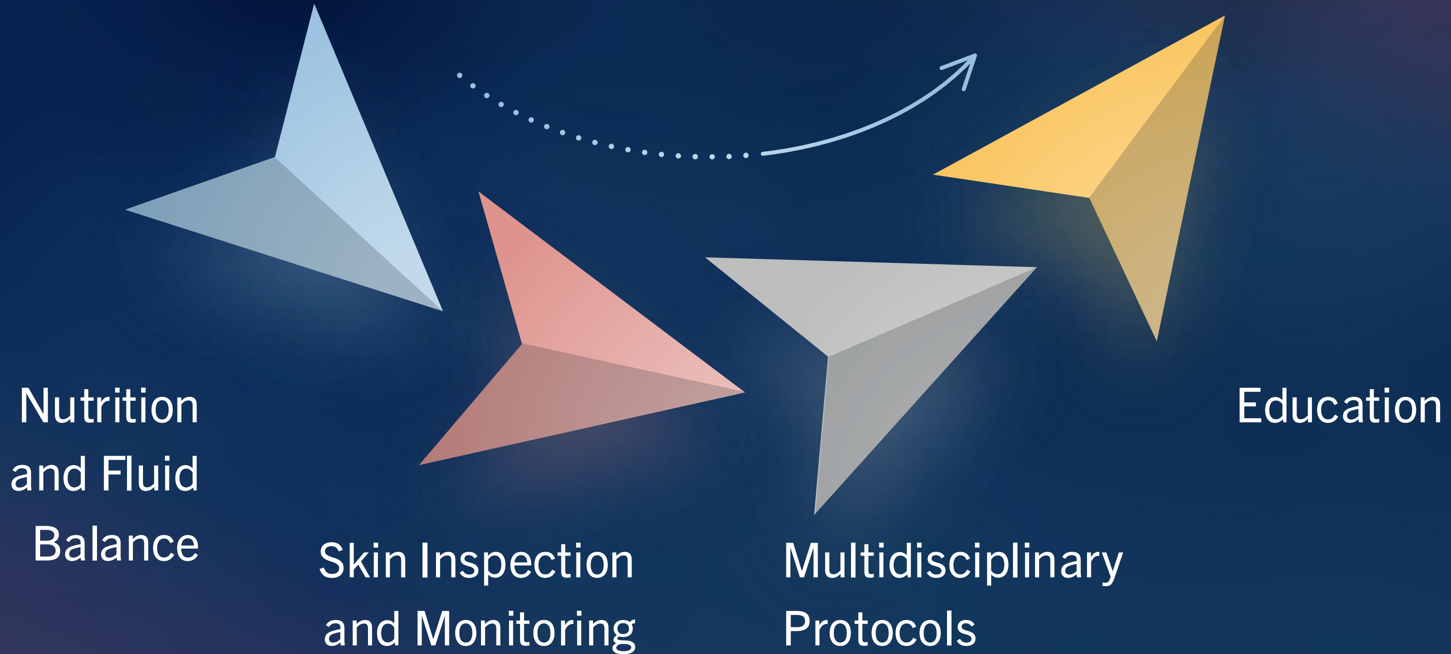
- **Assess the skin, immediately after surgery**
  - particularly over bony areas,
  - to identify any early signs of pressure injury.
  - Prompt intervention can prevent further deterioration of the affected area.

Postoperative care should also involve **continued use of pressure-relieving devices** until the patient can move independently.

# Skin Inspection and Protocols

- Embed these measures into **perioperative checklists** and **multidisciplinary protocols** so that anaesthesia, nursing, and surgery **teams** share responsibility for pressure ulcer prevention across the entire surgical pathway.

# Intraoperative Prevention Strategies



# Education

- **Educating** all OR personnel about the risks and prevention of pressure injuries is vital.

Training should include:

- The importance of using positioning devices correctly,
- Recognising patients at high risk of pressure injuries, and
- The need for timely adjustments in patient positioning.

Regular training sessions can reinforce best practices and encourage vigilance among staff members.

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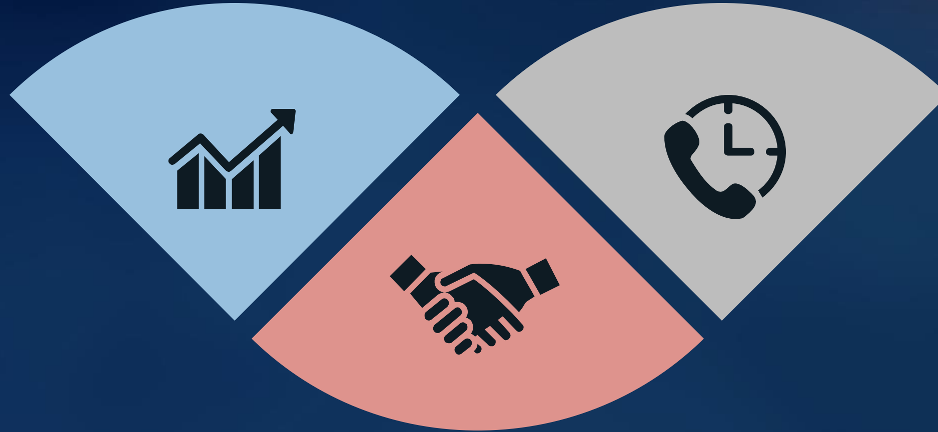
Etiology

Risk Factors



Preventative Strategies

With thoughtful planning, vigilant care, and evidence-based strategies, we can protect our patients and elevate the standard of care in every Operating Room

# Thank You

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http://www.oru.se

https://ewma.org/council/

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