

Pressure Injuries A to Z

Adaah Sayyed, MD PGY-2

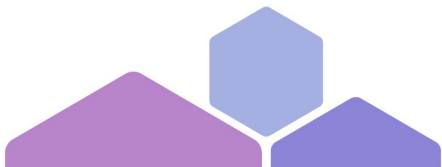
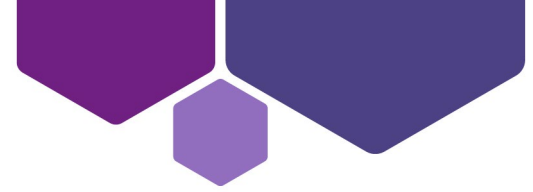
Institute for Plastic Surgery at SIU Medicine

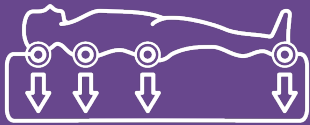


SIU MEDICINE
FORWARD. FOR YOU.

DISCLOSURES

None

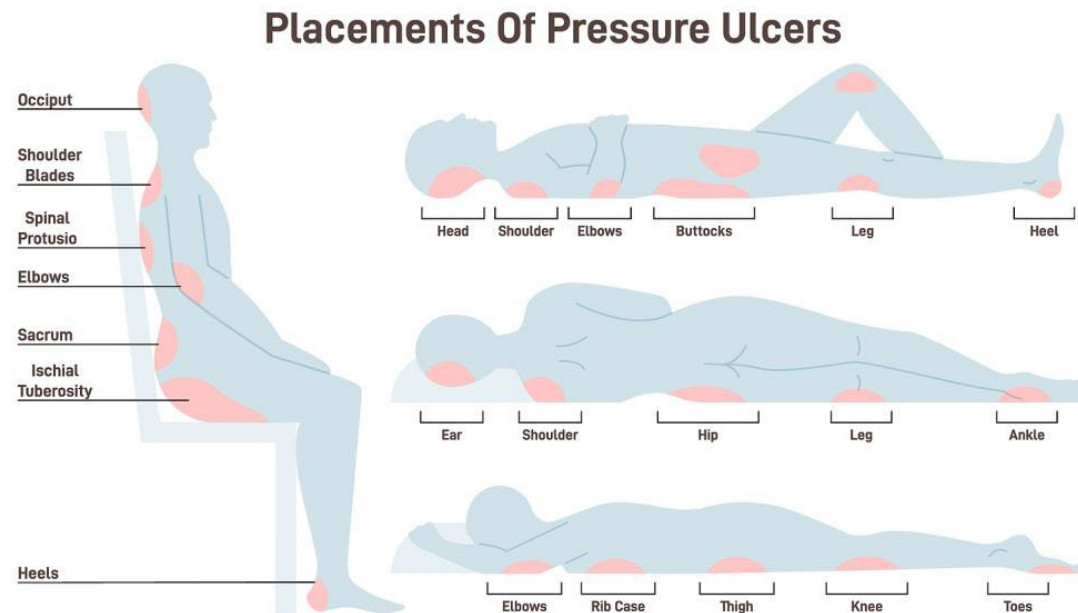




Objective: To provide an overview of pressure injuries, including their causes, staging, prevention, and treatment.

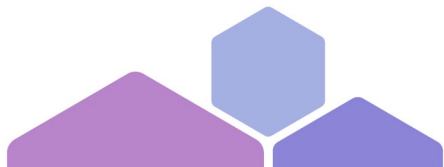
OVERVIEW

- **Pressure sores (PS):** unrelieved prolonged pressure, typically over a bony prominence, resulting in localized soft tissue injury
 - *Bed sores, decubitus ulcers*
- Can occur anywhere on the body due to increased pressure, friction, shearing, or limb spasticity



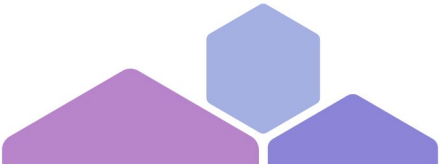


WHY IT MATTERS

- **2.5 million** pressure injuries treated annually in the US
 - Patients with PS have **2-6x greater mortality risk** than those with intact skin
 - ~60,000 patients die annually as a direct result of a PS
 - Chronic skin ulcers rank as the **4th most common diagnosis** for hospital readmission
 - Average hospital stay for PS treatment is 13 days, or 3x longer than the average LOS
 - Hospital incidence rates range from 0.4-38%
 - **Considered a preventable *never event*** by CMS – Medicare may deny reimbursement for treatments
 - **\$11 billion** spent annually in treating PS
 - >\$100,000 spent in managing a single hospital-acquired PS
 - Cost of treating PS is 2.5x the cost of preventing one
- 



RISK ASSESSMENT MODELS

- Tools developed to stratify patient risk and help guide prevention interventions
 - Examples: Braden, Waterlow, and Norton scales
 - Included patient characteristics:
 - Mobility
 - Nutrition
 - Incontinence
 - Mental status
 - Fair predictive value, but no significant effect of scale implementation on reducing PS incidence
- 

BRADEN SCALE FOR PREDICTING PRESSURE SORE RISK

Patient's Name _____	Evaluator's Name _____				Date of Assessment _____			
SENSORY PERCEPTION ability to respond meaningfully to pressure-related discomfort	1. Completely Limited Unresponsive (does not moan, flinch, or grasp) to painful stimuli, due to diminished level of consciousness or sedation. OR limited ability to feel pain over most of body	2. Very Limited Responds only to painful stimuli. Cannot communicate discomfort except by moaning or restlessness OR has a sensory impairment which limits the ability to feel pain or discomfort over 1/2 of body.	3. Slightly Limited Responds to verbal commands, but cannot always communicate discomfort or the need to be turned. OR has some sensory impairment which limits ability to feel pain or discomfort in 1 or 2 extremities.	4. No Impairment Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.				
MOISTURE degree to which skin is exposed to moisture	1. Constantly Moist Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved or turned.	2. Very Moist Skin is often, but not always moist. Linen must be changed at least once a shift.	3. Occasionally Moist: Skin is occasionally moist, requiring an extra linen change approximately once a day.	4. Rarely Moist Skin is usually dry, linen only requires changing at routine intervals.				
ACTIVITY degree of physical activity	1. Bedfast Confined to bed.	2. Chairfast Ability to walk severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.	3. Walks Occasionally Walks occasionally during day, but for very short distances, with or without assistance. Spends majority of each shift in bed or chair	4. Walks Frequently Walks outside room at least twice a day and inside room at least once every two hours during waking hours				
MOBILITY ability to change and control body position	1. Completely Immobile Does not make even slight changes in body or extremity position without assistance	2. Very Limited Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.	3. Slightly Limited Makes frequent though slight changes in body or extremity position independently.	4. No Limitation Makes major and frequent changes in position without assistance.				
NUTRITION <u>usual</u> food intake pattern	1. Very Poor Never eats a complete meal. Rarely eats more than 1/2 of any food offered. Eats 2 servings or less of protein (meat or dairy products) per day. Takes fluids poorly. Does not take a liquid dietary supplement OR is NPO and/or maintained on clear liquids or IV's for more than 5 days.	2. Probably Inadequate Rarely eats a complete meal and generally eats only about 1/2 of any food offered. Protein intake includes only 3 servings of meat or dairy products per day. Occasionally will take a dietary supplement. OR receives less than optimum amount of liquid diet or tube feeding	3. Adequate Eats over half of most meals. Eats a total of 4 servings of protein (meat, dairy products per day. Occasionally will refuse a meal, but will usually take a supplement when offered. OR is on a tube feeding or TPN regimen which probably meets most of nutritional needs	4. Excellent Eats most of every meal. Never refuses a meal. Usually eats a total of 4 or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.				
FRICTION & SHEAR	1. Problem Requires moderate to maximum assistance in moving. Complete lifting without sliding against sheets is impossible. Frequently slides down in bed or chair, requiring frequent repositioning with maximum assistance. Spasticity, contractures or agitation leads to almost constant friction	2. Potential Problem Moves feebly or requires minimum assistance. During a move skin probably slides to some extent against sheets, chair, restraints or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.	3. No Apparent Problem Moves in bed and in chair independently and has sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair.					

© Copyright Barbara Braden and Nancy Bergstrom, 1988 All rights reserved

Total Score _____

WATERLOW PRESSURE ULCER PREVENTION/TREATMENT POLICY

RING SCORES IN TABLE, ADD TOTAL. MORE THAN 1 SCORE/CATEGORY CAN BE USED

BUILD/WEIGHT FOR HEIGHT		SKIN TYPE VISUAL RISK AREAS	SEX	AGE	MALNUTRITION SCREENING TOOL (MST) (Nutrition Vol.15, No.6 1999 - Australia)	
AVERAGE BMI = 20-24.9	0	HEALTHY	MALE	1	A - HAS PATIENT LOST WEIGHT RECENTLY YES - GO TO B NO - GO TO C UNSURE - GO TO C AND SCORE 2	B - WEIGHT LOSS SCORE 0.5 - 5kg = 1 5 - 10kg = 2 10 - 15kg = 3 > 15kg = 4 unsure = 2
ABOVE AVERAGE BMI = 25-29.9	1	TISSUE PAPER	FEMALE	2		
OBESE BMI > 30	2	DRY	14 - 49	1		
BELOW AVERAGE BMI < 20	3	OEDEMATOUS	50 - 64	2		
BMI = W(kg)/Ht (m) ²		CLAMMY, PYREXIA	65 - 74	3		
		DISCOLOURED	75 - 80	4		
		GRADE 1	81 +	5		
		BROKEN/SPOTS	C - PATIENT EATING POORLY OR LACK OF APPETITE 'NO' = 0, 'YES' SCORE = 1			
		GRADE 2-4	NUTRITION SCORE If > 2 refer for nutrition assessment / intervention			
SPECIAL RISKS						
CONTINENCE		MOBILITY	TISSUE MALNUTRITION			
COMPLETE/ CATHETERISED		FULLY	NEUROLOGICAL DEFICIT			
URINE INCONT.		RESTLESS/FIDGETY	DIABETES, MS, CVA			
FAECAL INCONT.		APATHETIC	MOTOR/SENSORY			
URINARY + FAECAL INCONTINENCE		RESTRICTED	PARAPLEGIA (MAX OF 6)			
		BEDBOUND e.g. TRACTION	MAJOR SURGERY or TRAUMA			
		CHAIRBOUND	ORTHOPAEDIC/SPINAL			
		e.g. WHEELCHAIR	ON TABLE > 2 HR#			
			ON TABLE > 6 HR#			
MEDICATION - CYTOTOXICS, LONG TERM/HIGH DOSE STEROIDS, ANTI-INFLAMMATORY MAX OF 4						

* Scores can be discounted after 48 hours provided patient is recovering normally

© J Waterlow 1985 Revised 2005*

Obtainable from the Nook, Stoke Road, Henlade TAUNTON TA3 5LX

* The 2005 revision incorporates the research undertaken by Queensland Health.

www.judy-waterlow.co.uk

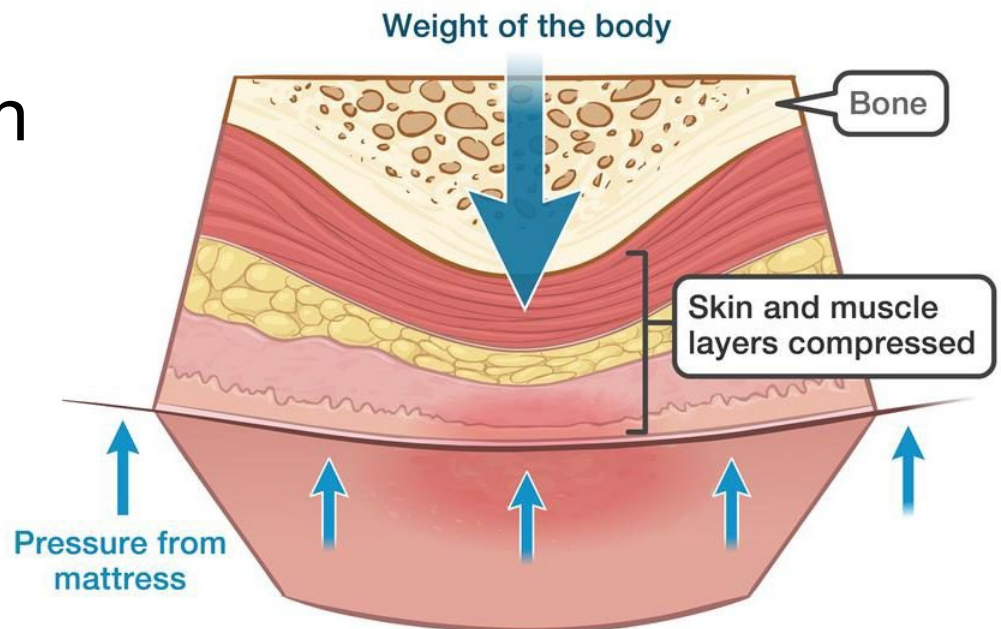
Table 1. Norton Scale for Assessing Risk of Pressure Ulcers.

Physical condition	Mental condition	Activity	Mobility	Incontinent
4 = Good	4 = Alert	4 = Ambulant	4 = Full	4 = Not
3 = Fair	3 = Apathetic	3 = Walk/help	3 = Slightly limited	3 = Occasional
2 = Poor	2 = Confused	2 = Chair bound	2 = Very limited	2 = Usually/urine
1 = Very bad	1 = Stupor	1 = Bed	1 = Immobile	1 = Doubly

Note. Calculated as the sum of the scores in all five areas. A score of less than 14 indicates a high risk for pressure ulcer development.

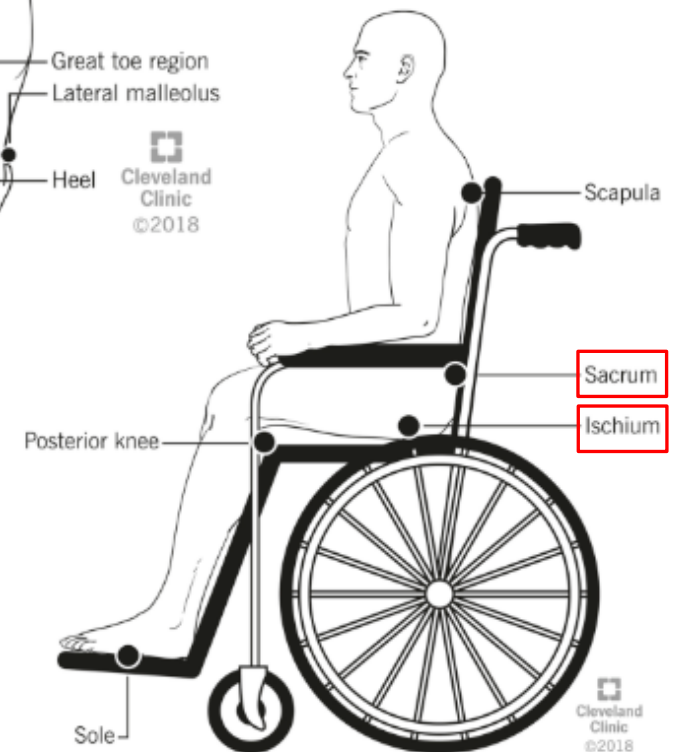
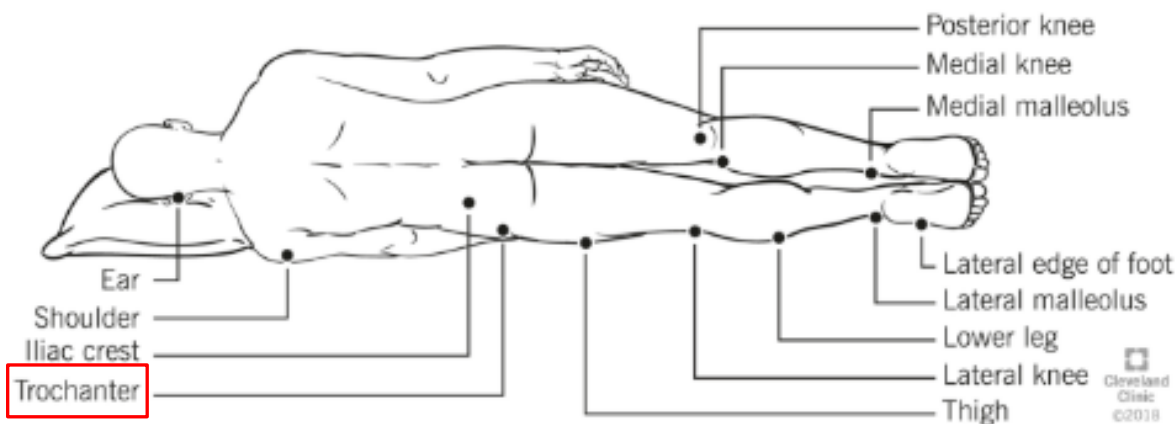
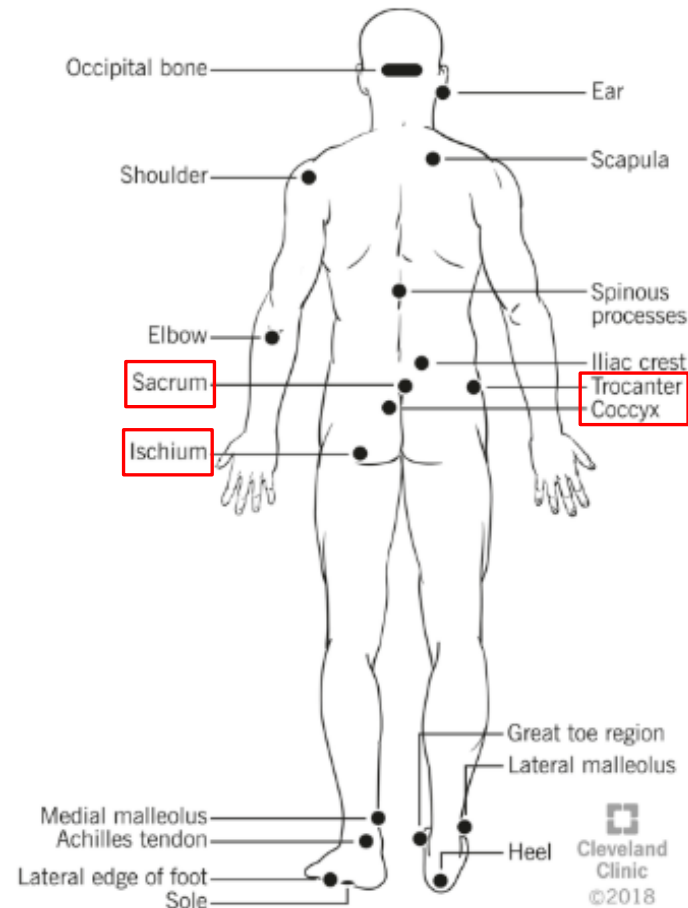
PATHOPHYSIOLOGY

- Occurs due to unrelieved mechanical pressure to soft tissue
 - External pressure > capillary bed pressure (32mmHg), perfusion is impaired → ischemic and pressure-related tissue injury
 - Pressure greater than supplying vessels → edema/ischemia, accumulation of metabolic waste products and free radicals, and permanent tissue destruction
- 5min pressure relief q2h allows adequate perfusion and reduces risk of breakdown



PATHOPHYSIOLOGY

- >70% develop over:
 - Sacrum
 - Coccyx
 - Ischium
 - Trochanter



RISK FACTORS

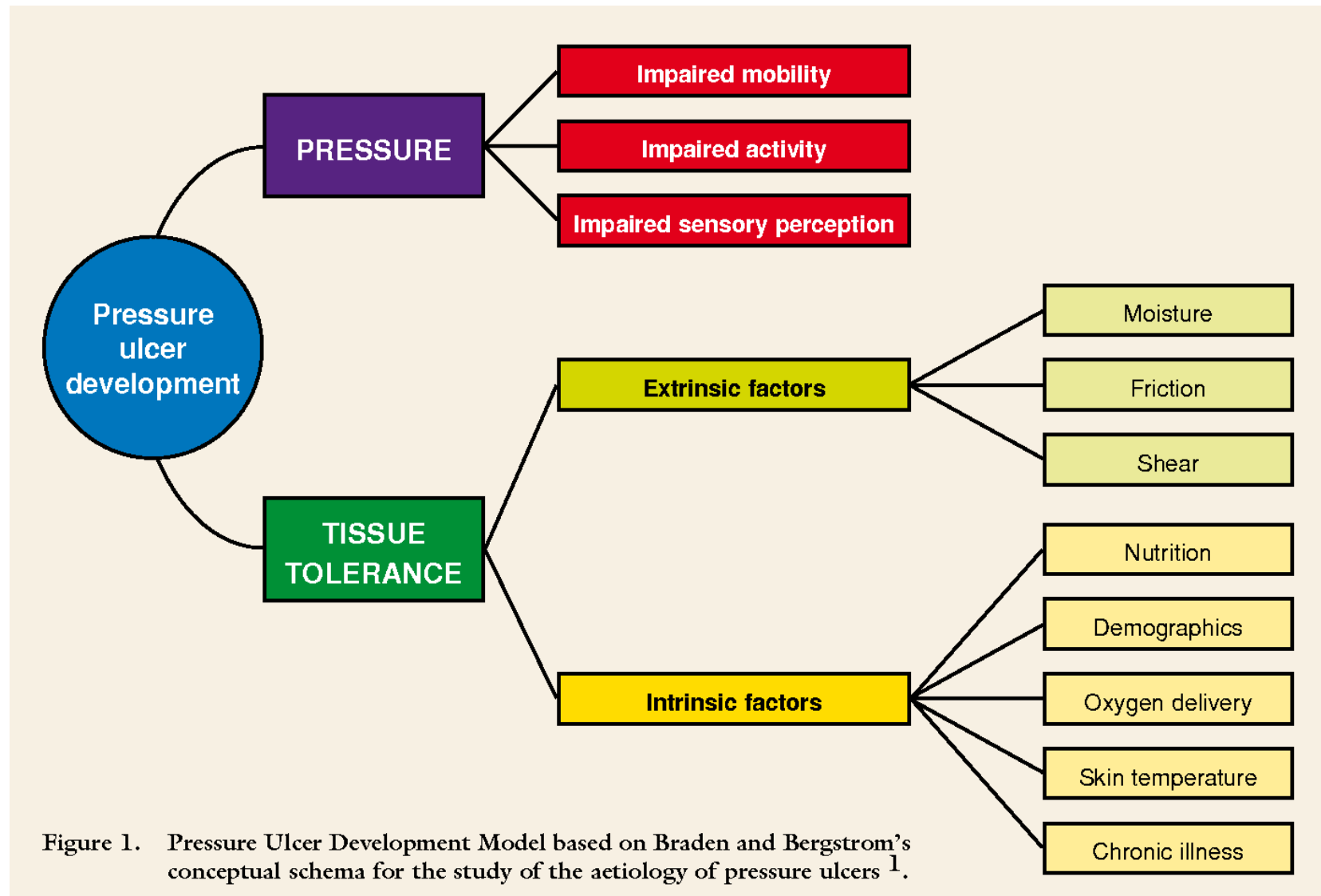
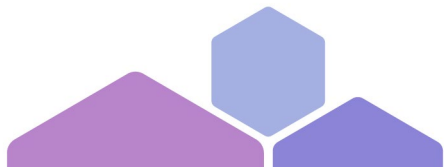


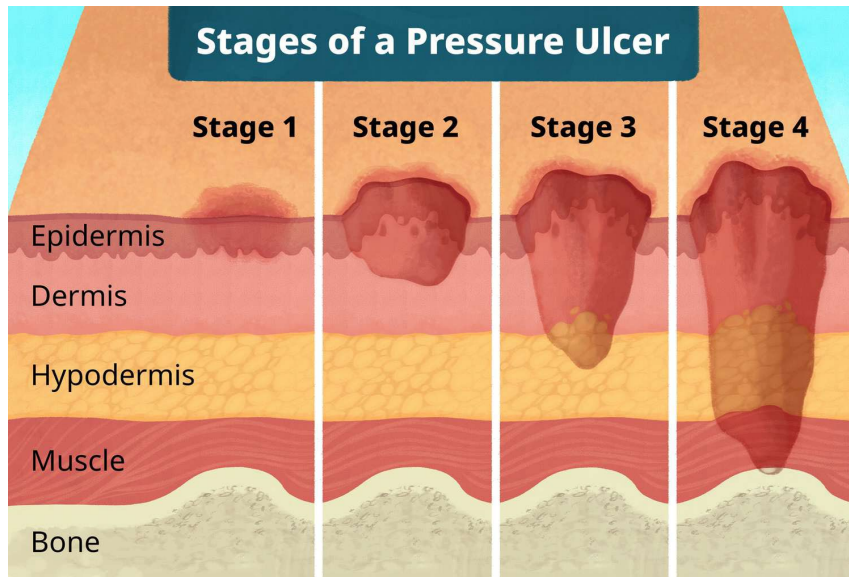
Figure 1. Pressure Ulcer Development Model based on Braden and Bergstrom's conceptual schema for the study of the aetiology of pressure ulcers ¹.



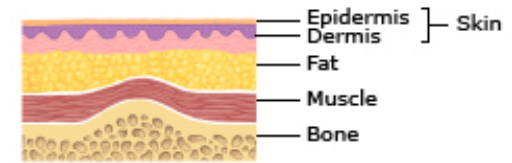
HIGH RISK POPULATIONS

- Spinal cord injury (SCI)
 - 20% to 30% in paraplegic and quadriplegic patients
 - 4.5x increased risk for PS in complete SCI
 - 41% patients develop a PS within 1st year after SCI
 - Lower extremity trauma
 - Bone or soft tissue injury with fixation and casting
 - Elderly patients
 - Immobility, cachexia
 - ICU patients
- 

STAGING SYSTEM



Stage	Treatment
Stage I	Wound protection with transparent film, preventive measures
Stage II	Dressings to maintain a moist wound environment
Stage III	Debridement of necrotic tissue, coverage with appropriate dressings, treatment of infection if present
Stage IV	Debridement of necrotic tissue, coverage with appropriate dressings, treatment of infection if present, surgery if necessary



Normal

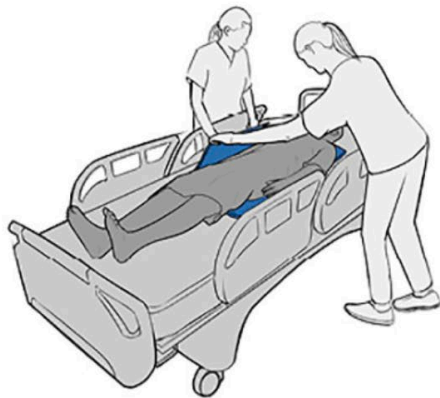
<p>Clinical appearance</p> <p>Depth</p> <p>Stage 1</p> <ul style="list-style-type: none"> ■ Skin intact. ■ Non-blanchable erythema. ■ Remains after relief of pressure. 	<p>Clinical appearance</p> <p>Depth</p> <p>Stage 2</p> <ul style="list-style-type: none"> ■ Blister or other break in dermis with partial thickness skin loss. ■ With or without infection. ■ Subcutaneous fat is not visible. 	<p>Clinical appearance</p> <p>Depth</p> <p>Stage 3</p> <ul style="list-style-type: none"> ■ Full-thickness skin loss. ■ With or without infection. ■ Subcutaneous fat may be visible. ■ Undermining and tunneling may be present.
<p>Clinical appearance</p> <p>Depth</p> <p>Stage 4</p> <ul style="list-style-type: none"> ■ Full-thickness skin and tissue loss. ■ Exposed or directly palpable fascia, muscle, tendon, ligament, cartilage, or bone. ■ With or without infection. ■ Often includes undermining and tunneling. 	<p>Clinical appearance</p> <p>Depth</p> <p>Unstageable pressure injury</p> <ul style="list-style-type: none"> ■ Full-thickness skin and tissue loss. ■ Base of the ulcer is covered by slough or eschar. 	<p>Clinical appearance</p> <p>Depth</p> <p>Deep tissue pressure injury</p> <ul style="list-style-type: none"> ■ Localized persistent, non-blanchable, discolored, but intact skin or blood-filled blister. ■ Potential for deep tissue damage.

CLINICAL PREVENTION – EXTRINSIC FACTORS

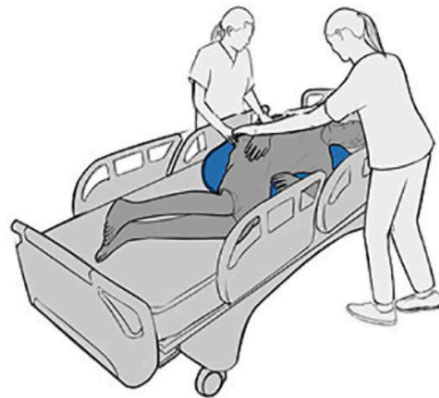


Behavior modification:

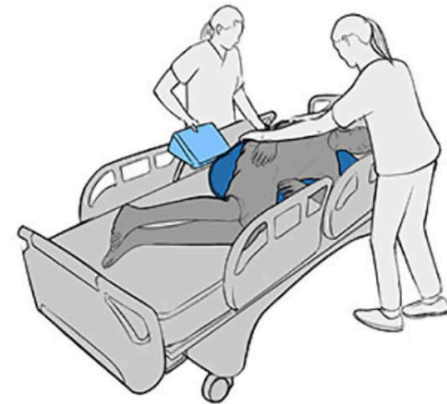
- Mobilize/reposition
- Avoid prolonged sitting
- Smoking cessation
- Minimize moisture
- Minimize soilage, maceration from toileting



Using a slide sheet, the patient is prepared for repositioning at 0 degrees



The patient is turned 90 degrees using the slide sheet



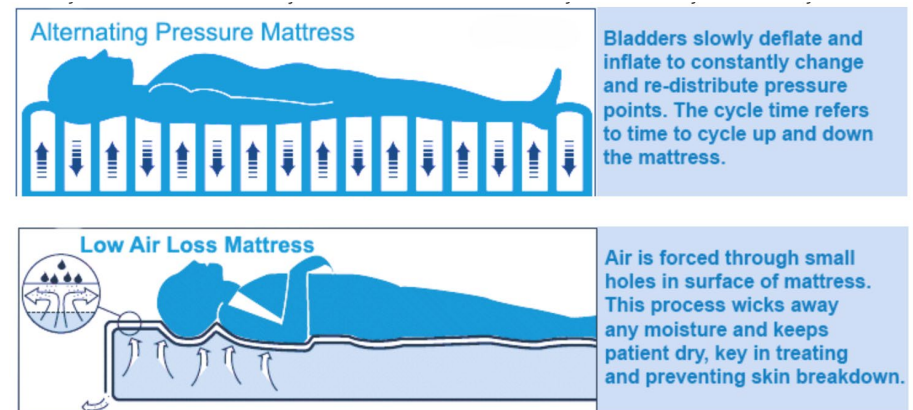
Next a healthcare worker places foam wedges or pillows under the patient

CLINICAL PREVENTION – EXTRINSIC FACTORS



Pressure relief:

- Minimize HOB elevation to reduce shearing (<45deg)
- Reposition q2h, encourage mobility
- Float heels, pad pressure points
- Pressure-offloading mattresses or seating
- Prophylactic foam dressings on high-risk surfaces



CLINICAL PREVENTION – INTRINSIC FACTORS



Medical optimization:

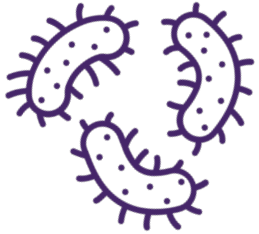
- Optimize comorbidities, kidney function
- Manage urinary and fecal incontinence
- Manage uncontrolled fistulas
- Optimize BG control, HbA1c <6%
- Correct anemia



Correct malnutrition:

- Consult nutritionist
- Lab tests (albumin, prealbumin, micronutrients)
- Swallow evaluation
- Consider TPN, PPN

CLINICAL PREVENTION – INTRINSIC FACTORS



Infection management:

- Septicemia, pneumonia, UTI common
- Inflammation and infection markers
- Cultures for antibiotic tailoring



Neurologic spasm and contracture management:

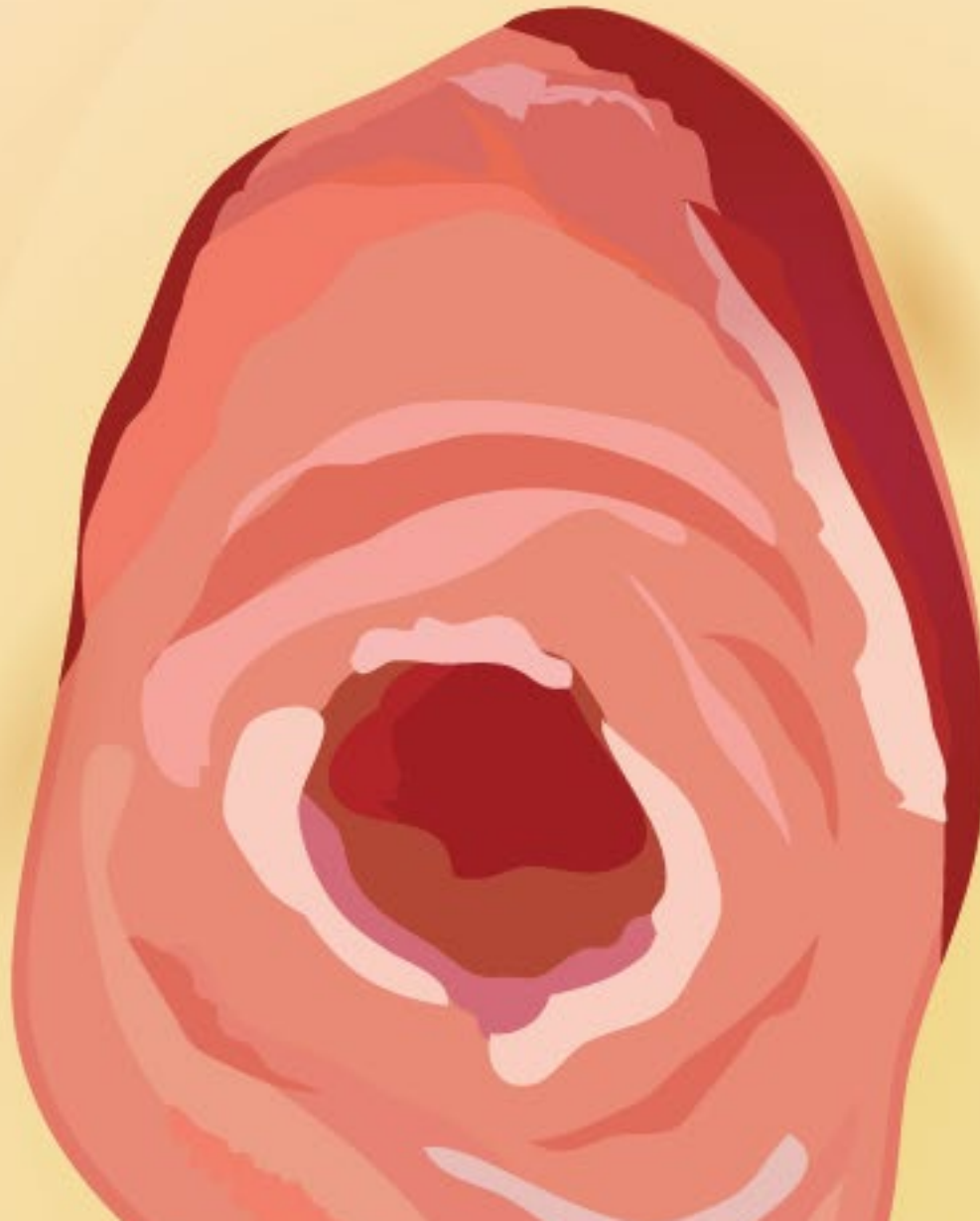
- Common in SCI
- Spasm & contracture create shear forces
- Antispasmodic therapy – baclofen, diazepam, dantrolene
- Surgical release of contracture

WOUND EVAL

Clinical ass

- Dime
- Pr
- Ir

- De
- Co
- Vas



NONOPERATIVE MANAGEMENT

Dressings

- *Debridement*: hydrogels, WTD
- *Granulation*: foam and low-adherence dressings
- *Epithelialization*: hydrocolloid and low-adherence dressings



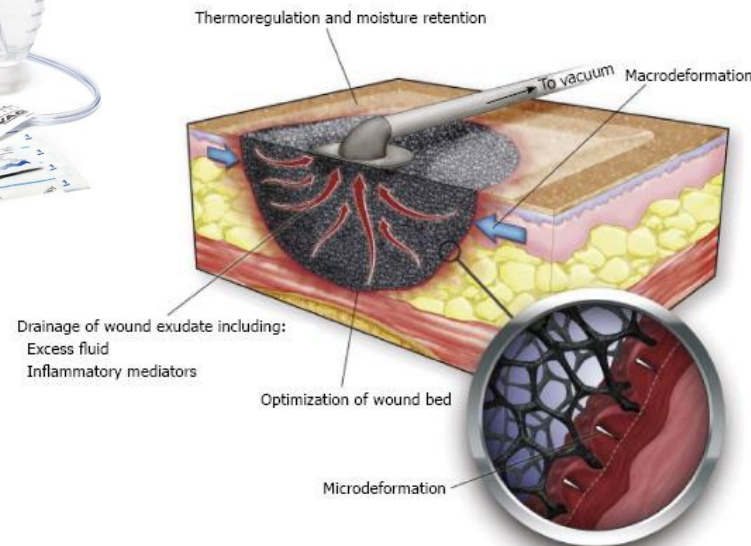
NPWT

- Traditional
- Instill



HBO

Biologic



SURGICAL MANAGEMENT

Debridement

Soft Tissue

- Early and aggressive debridement of infected or devitalized tissue
- Goals:
 - Remove necrotic or devitalized tissue
 - Reduce bacterial count and biofilm
 - Convert chronic wound into an acute wound
- Bedside vs OR
- Send deep tissue for cx (superior to superficial)

Bone

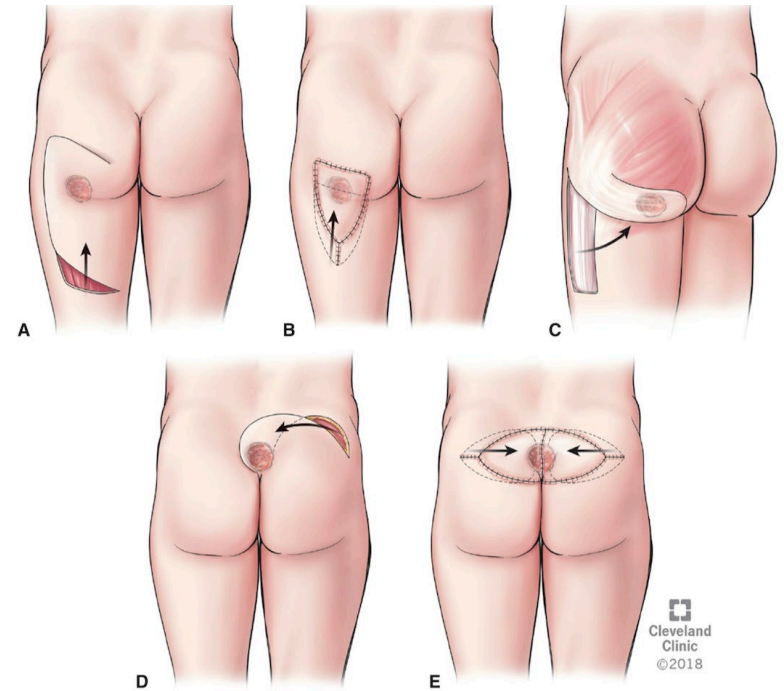
- High rates of positive bone biopsies for OM
- Remove as minimal bone as possible



SURGICAL MANAGEMENT

Reconstruction

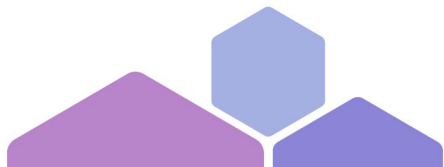
- Flap coverage does *not* address root cause of PS
- Considerations:
 - Avoid primary closure of PS due to high rates of breakdown and dehiscence
 - Contracture release and spasticity management
 - Management of urinary and fecal incontinence
 - Skin grafts likely fail
 - High rates of complications and recurrence after flap coverage, despite preventive measures postop
 - Limited tissue to use for recurrences



POSTOPERATIVE CONSIDERATIONS



Acute Management

- Strict bedrest on pressure-offloading bed
 - Recommendation for 2-6wks
 - Allows surgical incisions to heal w/o disruption
 - Avoid sitting upright in bed
 - DVT risk assessment
 - VTE incidence up to 11% in acute SCI population despite VTE ppx
 - Autonomic dysreflexia in SCI
 - Disordered responses such as bladder and bowel distension
 - Manifest as severe HTN, increased ICP, cardiac complications, pulmonary edema
- 

POSTOPERATIVE CONSIDERATIONS

Postoperative Complications

- Recurrence rates up to 80%
- Flap-related complications:
 - Wound dehiscence
 - Flap necrosis
 - Hematoma
 - Seroma
 - Surgical site infection
 - Partial or total flap loss

Recurrence/Reoperation

- Young age (<45 yr)
- Low albumin <3.5 g/dL
- African American
- Ischial location
- Flap choice: V-Y thigh flap ^a
- Smoking
- Premature sitting
- Anemia requiring perioperative blood transfusion

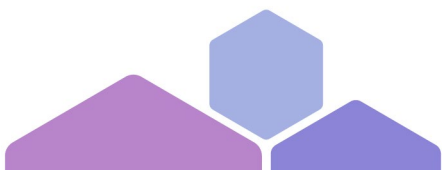
Infection

- Diabetes
- American Society of Anesthesiologists class >3
- Perioperative blood transfusion
- Longer operative times

Wound Dehiscence/Flap Failure

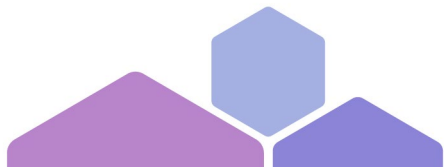
- Ischial location
- Low albumin <3.5 g/dL
- Anemia requiring perioperative blood transfusion
- Longer operative time
- Acute osteomyelitis
- HgbA1c >6%

^aControversial because of tension on closure.



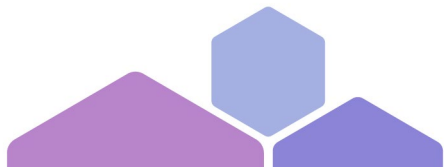


MORTALITY RISK

- **Increased association between PS and mortality**
 - Patients who developed PS in ICU have in-hospital mortality rate up to 48%
 - In-hospital mortality rate 4.2% for patients with primary dx of PS and 11.5% for secondary dx of PS
 - Versus 2.5% mortality rate for all other dxs
 - >3% of all patients undergoing closure for PS die within 30d of operation
 - Increased mortality risk:
 - Age >65y
 - DM
 - Total functional dependency
 - Discuss risks and benefits of surgery
- 



REHABILITATION

- **Address factors contributing to injury development** prior to returning home:
 - Time in bed vs. chair, help at home, access to offloading devices and specialty bed, wheelchair quality
 - Depending on needs, may require referral to rehab medicine and/or HH
 - Recovery at SNF or rehab facility
 - Social services to assist with home environment, safety, compliance, and provide resources for services/supplies
- 

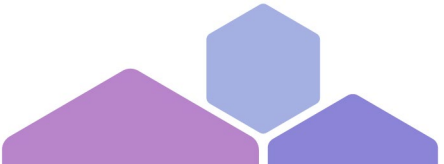
LONG-TERM MANAGEMENT

- **Many patients will never be surgical candidates**, requiring long-term wound care
- Social and financial limitations may limit long-term f/u and compliance with regimen
- Monitor chronic nonhealing injuries for progression to carcinoma (Marjolin ulcer) 2-25y from initial wound





TAKEAWAYS

- ✓ **Pressure injuries are preventable** with proper risk assessment and early intervention.
 - ✓ **Staging is critical** for accurate diagnosis and treatment.
 - ✓ **Prevention strategies** include repositioning, nutrition, pressure redistribution, and medical optimization.
 - ✓ **Effective treatment** varies between long-term wound care vs. operative closure. Risks and benefits of both need to be carefully weighed.
- 

REFERENCES

- Thorne, C. H., Chung, K. C., Gosain, A. K., Gurtner, G. C., Mehrara, B. J., Rubin, J. P., & Spear, S. L. (2013). *Grabb and Smith's Plastic Surgery: Seventh edition*. Wolters Kluwer Health Adis (ESP)
- Tchanque-Fossuo, CN, Kuzon, WM Jr. An evidence-based approach to pressure sores. *Plast Reconstr Surg*. 2011;127(2):932-939.
- Ricci, JA, Bayer, LR, Orgill, DP. Evidence-based medicine: the evaluation and treatment of pressure injuries. *Plast Reconstr Surg*. 2017;139(1):275e-286e.
- Reddy, M, Gill, SS, Rochon, PA. Preventing pressure ulcers: a systematic review. *JAMA*. 2006;296(8):974-984.
- Russo, CA, Steiner, C, Spector, W. Hospitalizations related to pressure ulcers among adults 18 years and older, 2006: statistical brief #64. *Healthcare Cost and Utilization Project (HCUP) Statistical Briefs*. Rockville, MD; 2006.
- Cushing, CA, Phillips, LG. Evidence-based medicine: pressure sores. *Plast Reconstr Surg*. 2013;132(6):1720-1732.
- Padula, WV, Mishra, MK, Makic, MB, Sullivan, PW. Improving the quality of pressure ulcer care with prevention: a cost-effectiveness analysis. *Med Care*. 2011;49(4):385-392.
- Description of NPUAP. National pressure ulcer advisory panel. *Adv Wound Care*. 1995;8(4 suppl):93-95.
- Tchanque-Fossuo, CN, Kuzon, WM Jr. An evidence-based approach to pressure sores. *Plast Reconstr Surg*. 2011;127(2):932-939.
- Ricci, JA, Bayer, LR, Orgill, DP. Evidence-based medicine: the evaluation and treatment of pressure injuries. *Plast Reconstr Surg*. 2017;139(1):275e-286e.
- Reddy, M, Gill, SS, Rochon, PA. Preventing pressure ulcers: a systematic review. *JAMA*. 2006;296(8):974-984.
- Russo, CA, Steiner, C, Spector, W. Hospitalizations related to pressure ulcers among adults 18 years and older, 2006: statistical brief #64. *Healthcare Cost and Utilization Project (HCUP) Statistical Briefs*. Rockville, MD; 2006.
- Cushing, CA, Phillips, LG. Evidence-based medicine: pressure sores. *Plast Reconstr Surg*. 2013;132(6):1720-1732.
- Padula, WV, Mishra, MK, Makic, MB, Sullivan, PW. Improving the quality of pressure ulcer care with prevention: a cost-effectiveness analysis. *Med Care*. 2011;49(4):385-392.
- Description of NPUAP. National pressure ulcer advisory panel. *Adv Wound Care*. 1995;8(4 suppl):93-95.
- Sameem, M, Au, M, Wood, T, et al. A systematic review of complication and recurrence rates of musculocutaneous, fasciocutaneous, and perforator-based flaps for treatment of pressure sores. *Plast Reconstr Surg*. 2012;130(1):67e-77e.
- Keys, KA, Daniali, LN, Warner, KJ, Mathes, DW. Multivariate predictors of failure after flap coverage of pressure ulcers. *Plast Reconstr Surg*. 2010;125(6):1725-1734.