9th Annual Comprehensive Wound Care Symposium

# Pressure Injuries and the Complexity of Underlying Mechanisms

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# Learning Objectives

1. Recognize major factors contributing to development of pressure injuries.
2. Differentiate interdependencies and relationships between risk factors.
3. Describe the effect of reduced skin perfusion on the development of PI despite maximum preventive measures.



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# Disclosure

I have no financial disclosure or conflicts of interest with the discussed material in this presentation.



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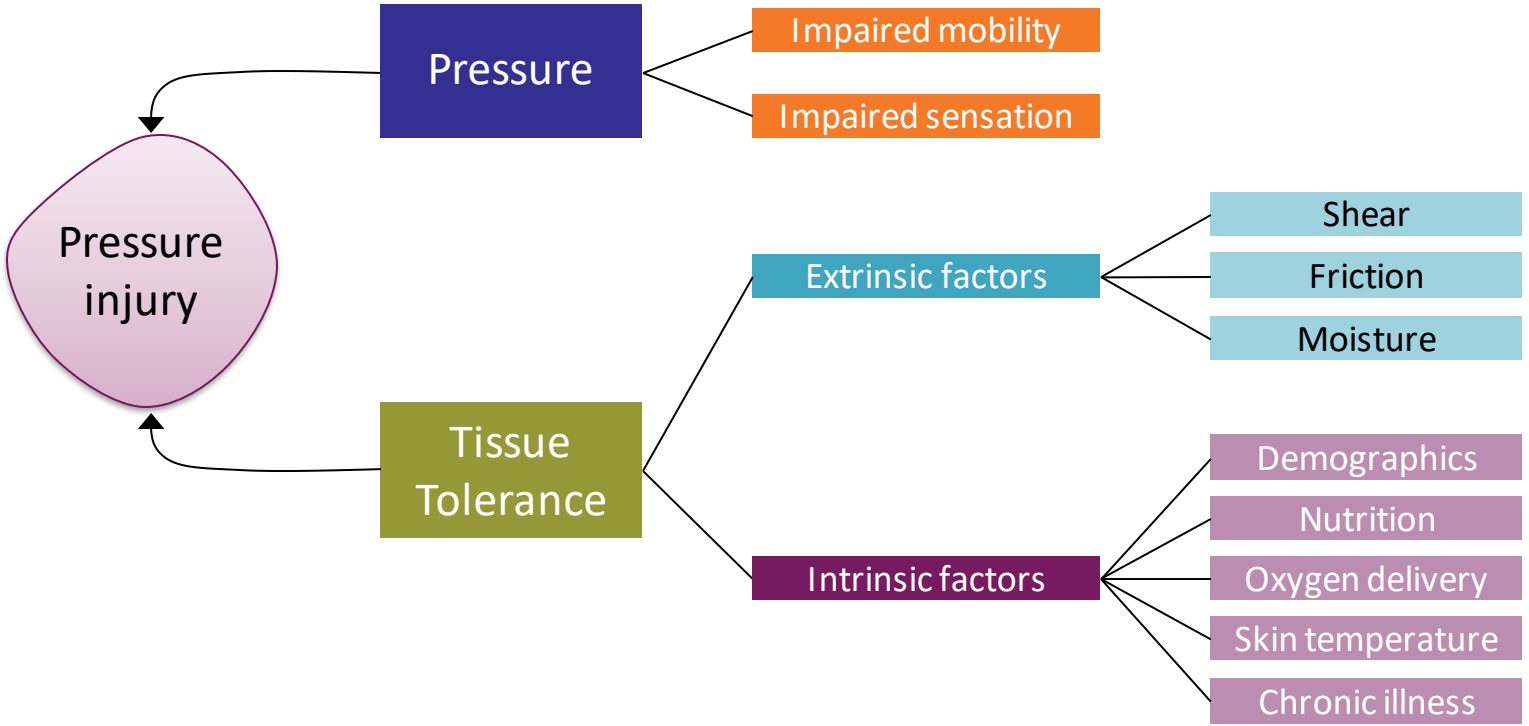
# Pressure Injury Development Model




Braden B, Bergstrom N. Rehab Nur 1987;12:8-16.



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# Overview of PI Risk Factors

100+ risk factors identified:

## *Extrinsic*

**Pressure** from any hard surface (e.g., bed, wheelchair, stretcher)
**Friction** from patient's inability to move well in bed
**Shear** from involuntary muscle movements
**Moisture**
- Bowel or bladder incontinence
- Excessive perspiration
- Wound drainage

Garcia AD, et al. Med Clin North Am. 2006;90(5):928–929
Lyder CH. 2003;289(2):223-226. doi:10.1001/jama.289.2.223



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## *Intrinsic*

**Limited mobility**
- Arthropathies
- Cerebrovascular accident
- Coma or sedation
- Fractures
- Pain
- Progressive neurologic disorders
- Postsurgical procedures
- Spinal cord injury

**Poor nutrition**
- Anorexia
- Dehydration
- Dietary restriction
- Poor dentition
- Poverty or lack of access to food
- Weak sense of smell or taste

**Comorbidities**
- Congestive heart failure
- COPD
- Depression or psychosis
- Decreased pain sensation
- Dementia
- Diabetes mellitus
- End-stage renal disease
- Immunodeficiency or use of CS
- Infection
- Malignancy
- Peripheral vascular disease
- Pressure injury present
- Vasculitis

**Aging skin**
- Changes in dermal pH
- Decreased cutaneous blood flow
- Decreased dermal-epidermal blood flow
- Flattening of rete ridges
- Loss of elasticity
- Loss of subcutaneous fat

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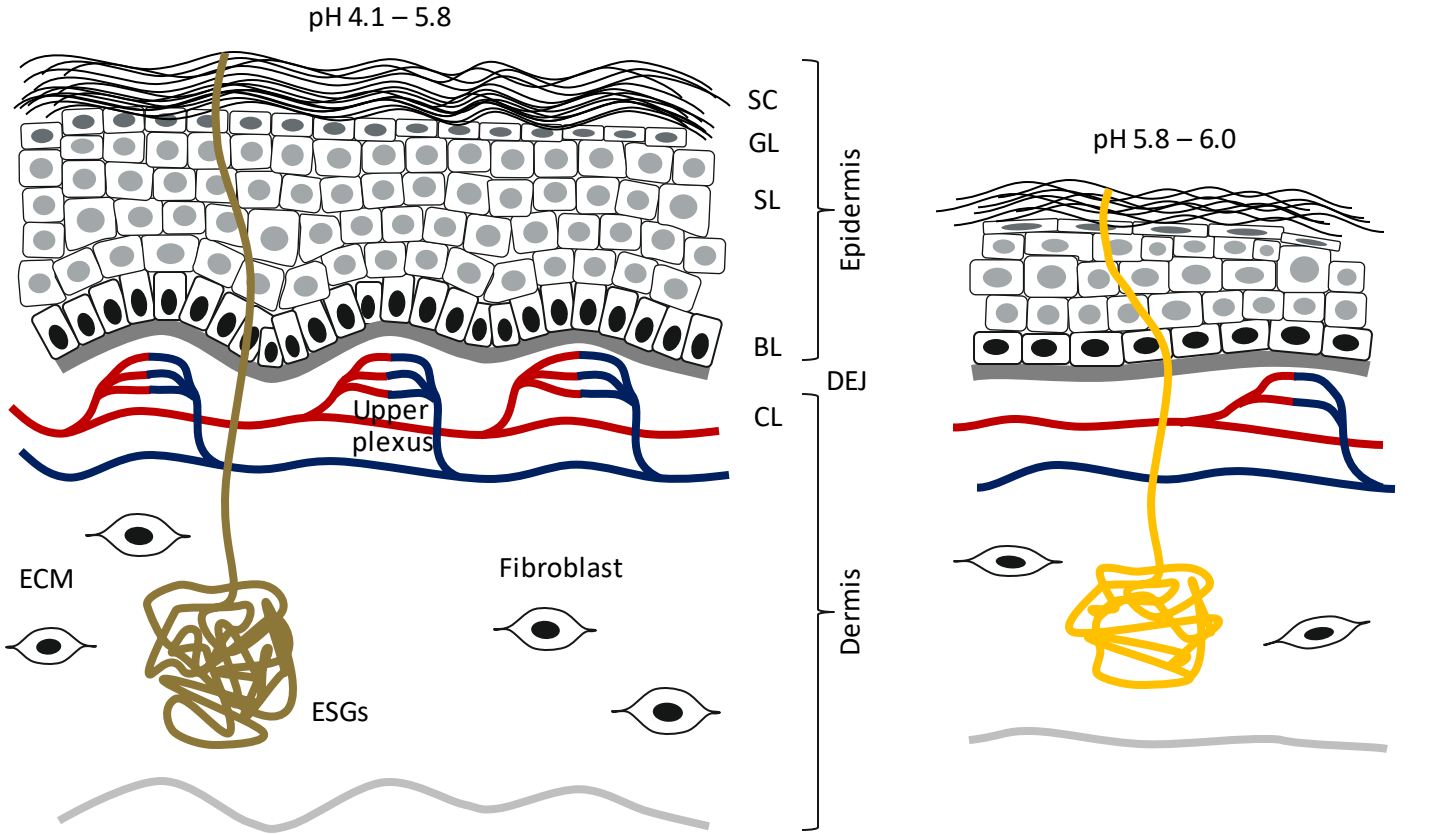
## Normal Skin

## Aging Skin




de Bengy AF, et al. Biol Rev Camb Philos Soc. 2022;97(3):874-895. doi:10.1111/brv.12827



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# Ms. A

57-years-old with paraplegia admitted with cough and dyspnea due to bilateral pneumonia.

She has been wheelchair bound for 15 years. This is her first hospitalization in 10 years. At home, she requires transfer assistance of 1 person and is otherwise independent with ADLs. Her daughter says that Ms. A struggles with positioning in the hospital bed because everything is different than what she has set up at home.

The daughter keeps her sitting straight up in bed with the tray in front of her hoping she will eat between naps. She eventually eats over half her meal trays. Ms. A has intact skin but has started to have incontinent loose stools. She has a suprapubic catheter.

What's the most important risk factor for PI development?

This is a fictional description of a person.



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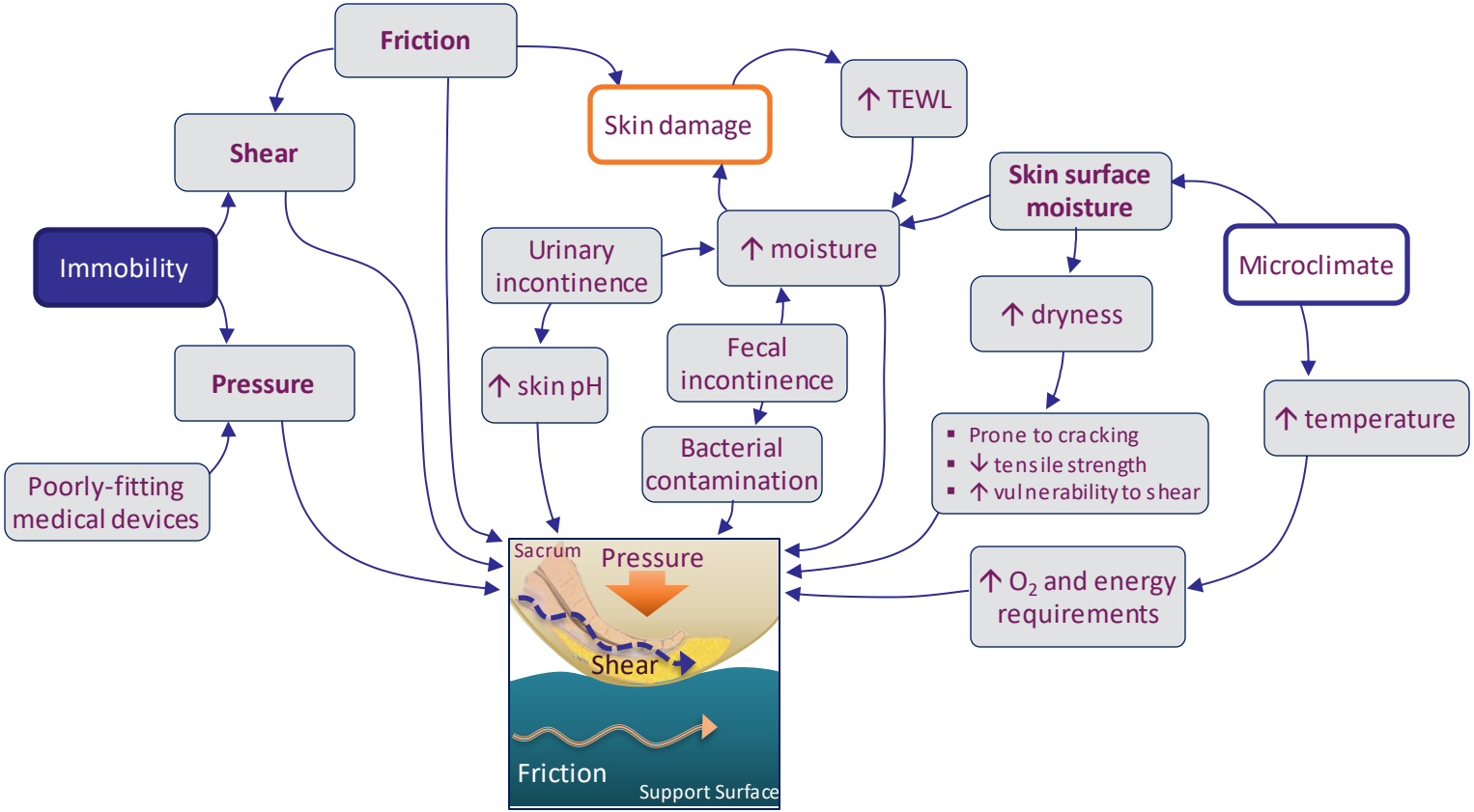




Hajhosseini B, et al. Pressure Injury. Ann Surg. 2020;271(4):671-679. doi:10.1097/SLA.0000000000003567

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# Immobility

| Strength of Evidence | Strength of Rec |
| --- | --- |
| A | ↑↑ |

Most important risk factor

Immobility may be permanent or transient

Sedatives, hypnotics, and anesthetics reduce awareness of pressure discomfort and induce immobility.

Pressure redistribution is the cornerstone of PI prevention

- Frequent repositioning
- Low angle of bed incline
- Optimal patient positioning

Barbenel JC, et al. *J Am Geriatr Soc*. 1986;34(9):633-636. doi:10.1111/j.1532-5415.1986.tb04903.x
Mervis JS, et al. J Am Acad Dermatol. 2019;81(4):893-902. doi:10.1016/j.jaad.2018.12.068
EPUAP, NPIAP and PPPIA. Prevention and Treatment of Pressure Ulcers/Injuries: Quick Reference Guide. Emily Haesler (Ed.). EPUAP/NPIAP/PPPIA: 2019.



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# Mr. H

75-year-old man with CAD, AF, and THA 6 months ago, admitted from a SNF for mitral valve replacement. The operation was successful without any complications. Post surgery, he was admitted to the ICU. For the next several days he had recurrent hypotension, which worsened when he was repositioned.

The patient's wife, very concerned about his pain status, would stop staff from moving him if the patient moaned or cried out in pain.

He was transferred to regular unit on HD-8 and the nurse noted an open wound on the patient's sacrum. The wound was the size of an eraser with purple coloring around it.

In addition to immobility which risk factor should we consider?

This is a fictional description of a person.



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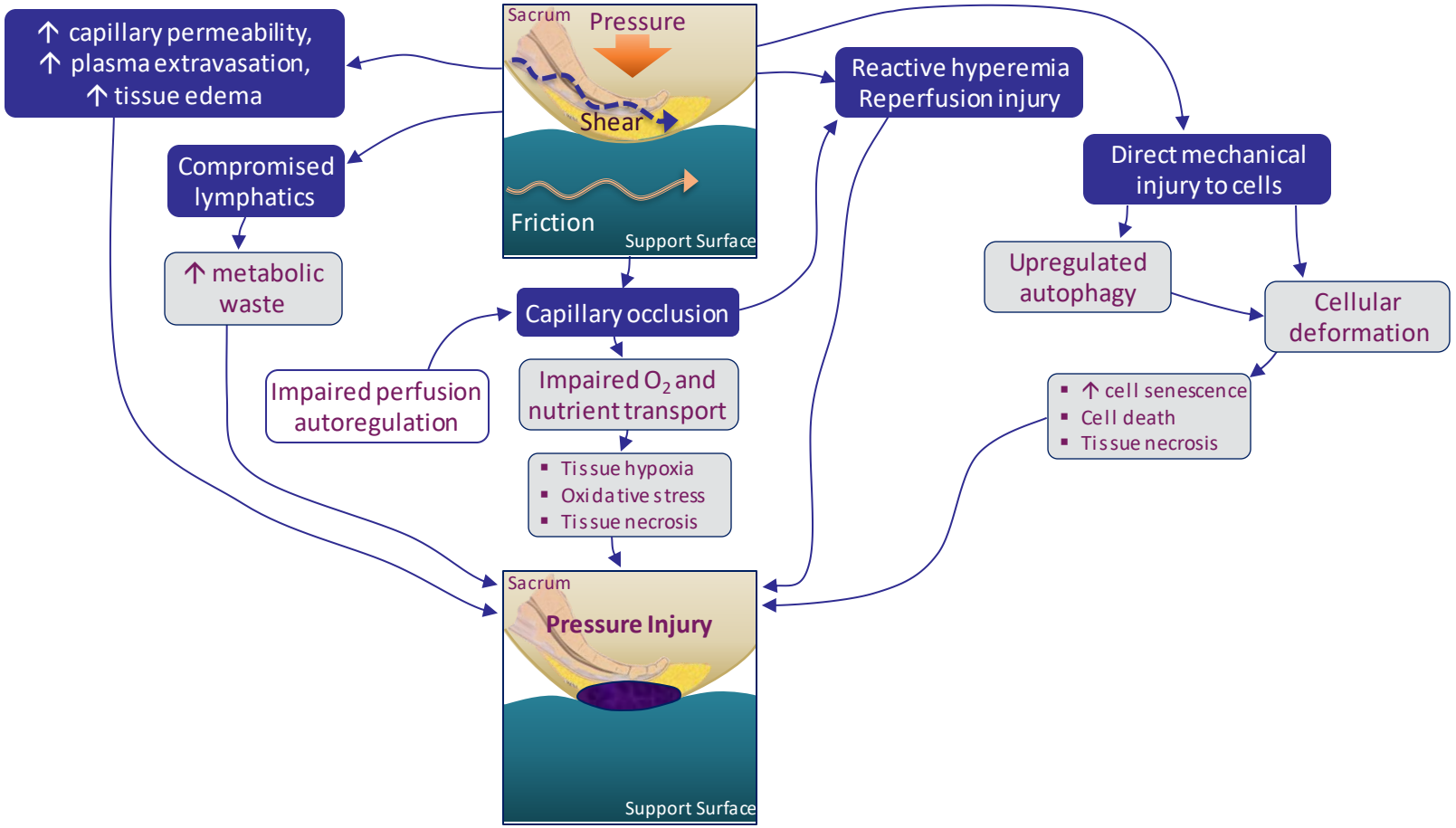




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# Reduced Skin Perfusion

| Strength of Evidence | Strength of Rec |
| --- | --- |
| B1 | ↑ |


When vital organs are not adequately perfused, blood flow to the skin will also be decreased.

Michel, et al. In: Bader, DL. Pressure Sores - Clinical Practice and Scientific Approach. Palgrave, 1990, London. https://doi.org/10.1007/978-1-349-10128-3_12
Bliss M, et al. BMJ. 1999;319(7214):863-864. doi:10.1136/bmj.319.7214.863
EPUAP, NPIAP and PPPIA. Prevention and Treatment of Pressure Ulcers/Injuries: Quick Reference Guide. Emily Haesler (Ed.). EPUAP/NPIAP/PPPIA: 2019.



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# Mrs. D

81-year-old with AD, PAD, DM2, recent left BKA, complicated by a right heel DTPI, who was admitted with confusion and diagnosed with acute renal failure and dehydration. She lost 25 lbs in the past 6 months.

There is a 4x3 cm right heel PI with a dry eschar. ABI in the right leg is 0.62. MRI indicates marrow signal changes in the posterior calcaneus compatible with osteomyelitis. Vascular surgery recommends conservative management.

Mrs. D improves and yet she requires assistance with all meals, often stopping after a few bites. Her advance directives indicate she would not want artificial nutrition.

How would you assess and manage her malnutrition?

This is a fictional description of a person.



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# Malnutrition

| Strength of Evidence | Strength of Rec |
|---|---|
| C | ↑ |

- More severe ischemia-induced skin destruction in malnourished organism
- Collagen fiber degeneration
- Presence of microthrombi
- ↑ necrosis of epidermis
- Suppressed healing
  - ↓ fibroblast proliferation,
  - ↓ capillary formation,
  - ↓ macrophage infiltration,
  - ↓ epidermal cell proliferation.

Principal elements of nutritional assessment

| History | Exam |
|---|---|
| Intake | Subcut fat |
| Weight change | Muscle wasting |
| GI sxs | Edema/ascites |
| Functional capacity | |

Positive findings in ≥2 of 6 of categories are suggestive of malnutrition.

Takeda T et al. J Dermatol. 1992;19(10):602-609. doi:10.1111/j.1346-8138.1992.tb03737.x
Mervis JS, et al. J Am Acad Dermatol. 2019;81(4):893-902. doi:10.1016/j.jaad.2018.12.068
EPUAP, NPIAP and PPPIA. Prevention and Treatment of Pressure Ulcers/Injuries: Quick Reference Guide. Emily Haesler (Ed.). EPUAP/NPIAP/PPPIA: 2019.



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# Multidisciplinary Team Approach Needed

Sullivan N, et al. Ann Intern Med. 2013;158(5 Pt 2):410-416. doi:10.7326/0003-4819-158-5-201303051-00008
Miller MW, at al. Wounds. 2019;31(4):108-113.
Lyder CH, Ayello EA. In: Hughes RG, ed. Rockville (MD): AHRQ (US); 2008 Apr. Chapter 12. Available from: https://www.ncbi.nlm.nih.gov/books/NBK2650/



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# Prediction Tools

Nurse-reported scores that combine local skin factors (such as moisture, friction and shear) with patient-level factors (such as mobility, sensory perception and nutrition):

- Norton (1965),
- Waterlow (1985),
- Braden Scale (1987)

Highly variable sensitivity and specificity.
Poor prognostic accuracy.

Pancorbo-Hidalgo, PL, et al. J Adv Nurs. 2006. April; 54(1): 94–110. DOI: 10.1111/j.1365-2648.2006.03794.x



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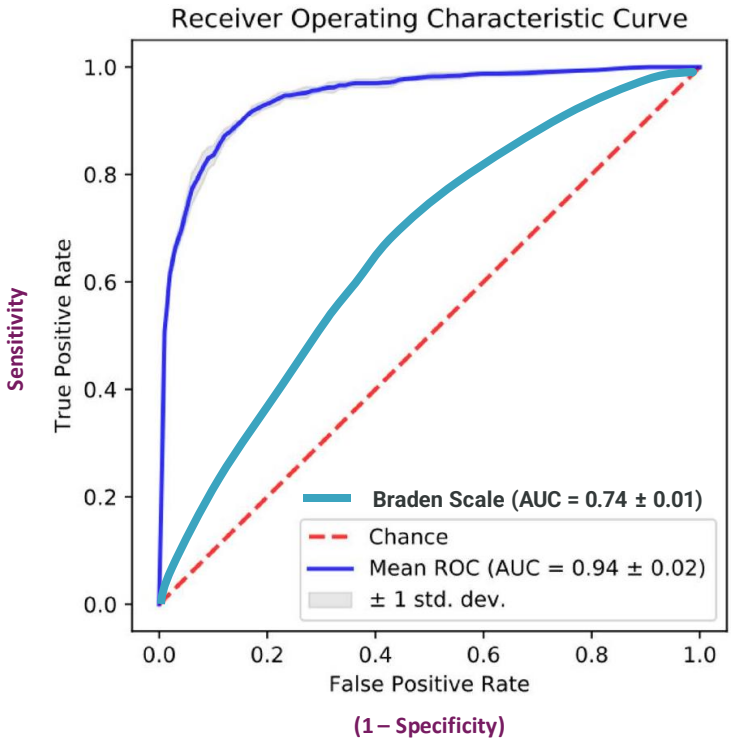
# Machine Learning for Predicting PIs

*Potential predictive variables*

| Definition | Electronic Health Record Measures |
|---|---|
| Pressure injury | Records from nurse flowsheet |
| Demographics | Race, gender, age |
| Nursing features | Glasgow coma scale, level of consciousness, gait/transferring, activity |
| Clinical features | Pain score, diabetes, peripheral vascular disease, spinal cord injury, stroke, anemia |
| Lab tests | Albumin, BUN, chloride, potassium, sodium, creatinine, Hgb, WBC, platelet blood count |




Song W, et al. J Am Med Inform Assoc. 2021;28(4):759-765. doi:10.1093/jamia/ocaa336
Hyun, S. et al. JMIR Medical Informatics. 7. e13785. 10.2196/13785.



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# Take Home

- Perfusion, nutrition, co-morbidities and other risk factors affect skin tolerance for pressure and shear.

- Hemodynamic instability and severe malnutrition can lead to unavoidable pressure injuries.



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# UPMC Presbyterian / Shadyside WOC Teams



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# Questions



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