



Medical Device Related Pressure Ulcers: The Hidden Epidemic Across the Lifespan

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Faculty Disclosure

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Dr. Baharestani has listed no financial interest/arrangement that would be considered a conflict of interest.

Objectives

- Define medical device related pressure ulcer.
- Examine medical device related pressure ulcer epidemiological data.
- Describe interventions aimed at the prevention of medical device related pressure ulcers across the lifespan.

Medical Device Related Pressure Ulcers (MDRPU): Defined

- Localized injury to the skin or underlying tissue as a result of sustained pressure from a device (e.g., nasal cannulae tubing, braces, splints, oxygen face masks, prostheses, etc).
- Tissue injury typically mimics the device shape

Medical Device Related Pressure Ulcers (MDRPU): Where Do They Occur?

- Directly under diagnostic or therapeutic devices
- Insertion sites for devices
- Tend to progress rapidly as they often occur over areas without adipose tissue

Medical Device Related Pressure Ulcers (MDRPU): Is This A New Phenomena?

- Yes
- No
- Not sure



Medical Device Related Pressure Ulcers (MDRPU): Is This A New Phenomena?

- Described in the literature over 40 yrs ago
- As “traditional PU” rates ↓, MDRPU become more apparent
- Often misidentified (e.g.as dried exudate build-up)
- Not typically tracked, trended & reported

Medical Device Related Pressure Ulcers (MDRPU): Avoidable or Unavoidable?

- Often more complicated than preventing usual PU as the device may be an essential diagnostic/therapeutic component of treatment
- Although most are avoidable, not all are



Medical Device Related Pressure Ulcers (MDRPU): Who Is At Highest Risk?

- Those individuals with:
 - Impaired sensory perception
 - Paralysis
 - Neuropathy
 - Impaired ability to communicate discomfort
 - Oral intubation
 - Presence of language barriers
 - Unconscious
 - Nonverbal state

**Premature
Infants &
Neonates**

**Critical
Care**

Medical Device Related Pressure Ulcers (MDRPU): Why Do They Occur?

- Rigidity & inelasticity of devices
- Difficulties in adjusting/securing to the body
- May be difficult to safely remove/lift
- Prolonged pressure in the same place
- Altered microclimate
 - ↑ **Moisture** (e.g. secretions, diaphoresis) & **heat**

Medical Device Related Pressure Ulcers (MDRPU): Why Do They Occur?

- Tight securement (e.g. ETT, trach plates)
- Poor positioning or fixation of device
- Inappropriate size, selection
- Obscure skin from visualization
- Lack of awareness of edema impact

Medical Device Related Pressure Ulcers (MDRPU): Why Do They Occur?

- Failure to check tubing
- Lack of awareness of need to remove, reposition & provide basic care to skin under devices
- Lack of best practice guidelines
- Lack of standardized practice

Medical Device Related Pressure Ulcers (MDRPU): Scope of the Problem

- **Apold & Rydrych (2012, J Nurs Care Qual)**
 - MN Statewide Reporting System
 - Nearly 1/3 of reported serious PU were device related



Medical Device Related Pressure Ulcers (MDRPU): Scope of the Problem

- **Apold & Rydrych (2012, J Nurs Care Qual)**
 - 70% were on the head, face & neck

Location	Device	Non-Device
Head/face/neck	70.3%	7.8%
Other/multiple	21.9%	5.8%
Heel/ankle/foot	20.3%	16.9%
Coccyx/buttocks	7.8%	67.5%
Sacrum	1.6%	16.9%

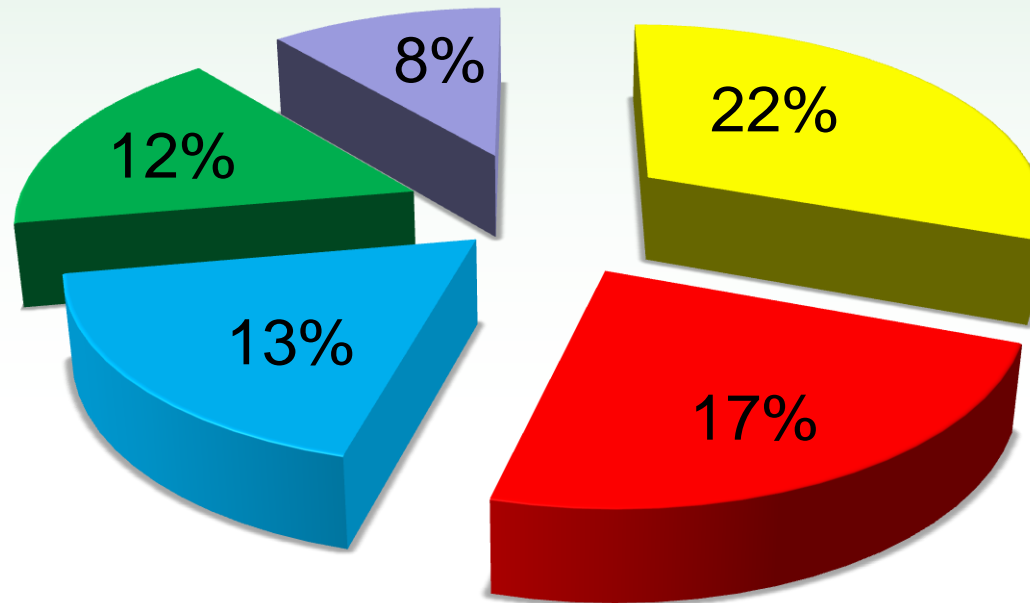
Medical Device Related Pressure Ulcers (MDRPU): Scope of the Problem

- **Apold & Rydrych (2012, J Nurs Care Qual)**
 - 74% were not identified until they were Stage III, IV or Unstageable
 - 63% had no documentation of:
 - Device removal/q shift
 - Pressure relief -or-
 - Skin inspections

Medical Device Related Pressure Ulcers (MDRPU): Most Common Causes

- **Apold & Rydrych (2012, J Nurs Care Qual)**

■ Cervical collars or braces ■ Other immobilizers ■ O2 Tubing ■ Stockings or boots ■ NGT





Medical Device Related Pressure Ulcers (MDRPU): Epidemiologic Data

Black et al. (2010, IJWC)

- Secondary analysis from 8 quarterly point prevalence studies
- N= 2,079 hospitalized patients
- Exclusion Criteria:
 - (\geq age 17)
 - Psychiatric units
 - Obstetric patients with LOS < 3 days
 - Patients refusing participation
 - Patients with pressure ulcers POA



Medical Device Related Pressure Ulcers (MDRPU): Epidemiologic Data

Black et al. (2010, IJWC)

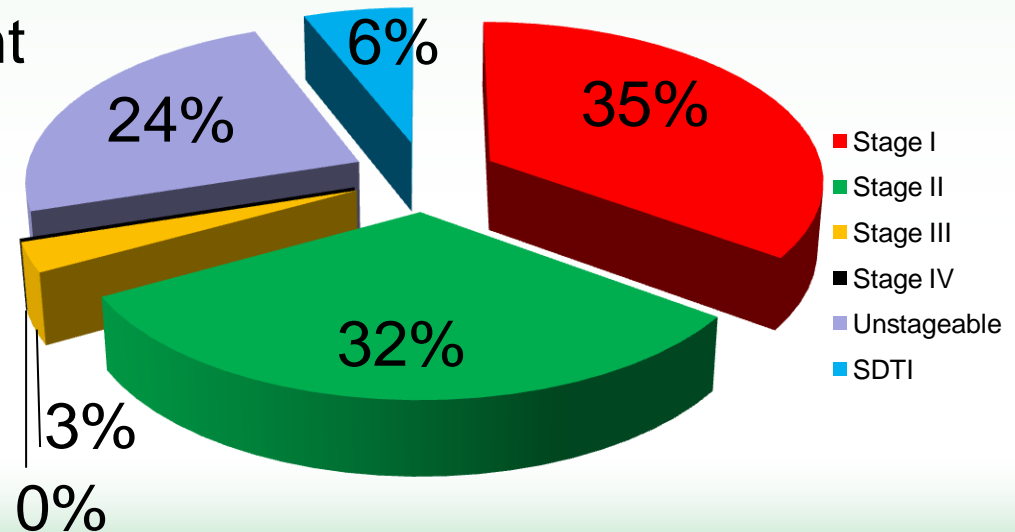
- HAPU Rates:
 - Overall = 5.4% (113 of 2,079)
 - 34.5% (39/113) were MDRPU
 - MDR = 1.3%
- Risk factors:
 - Pressure from device
 - Humidity & heat develop between device & skin
 - Tight securement
 - Edematous skin



Medical Device Related Pressure Ulcers (MDRPU): Epidemiologic Data

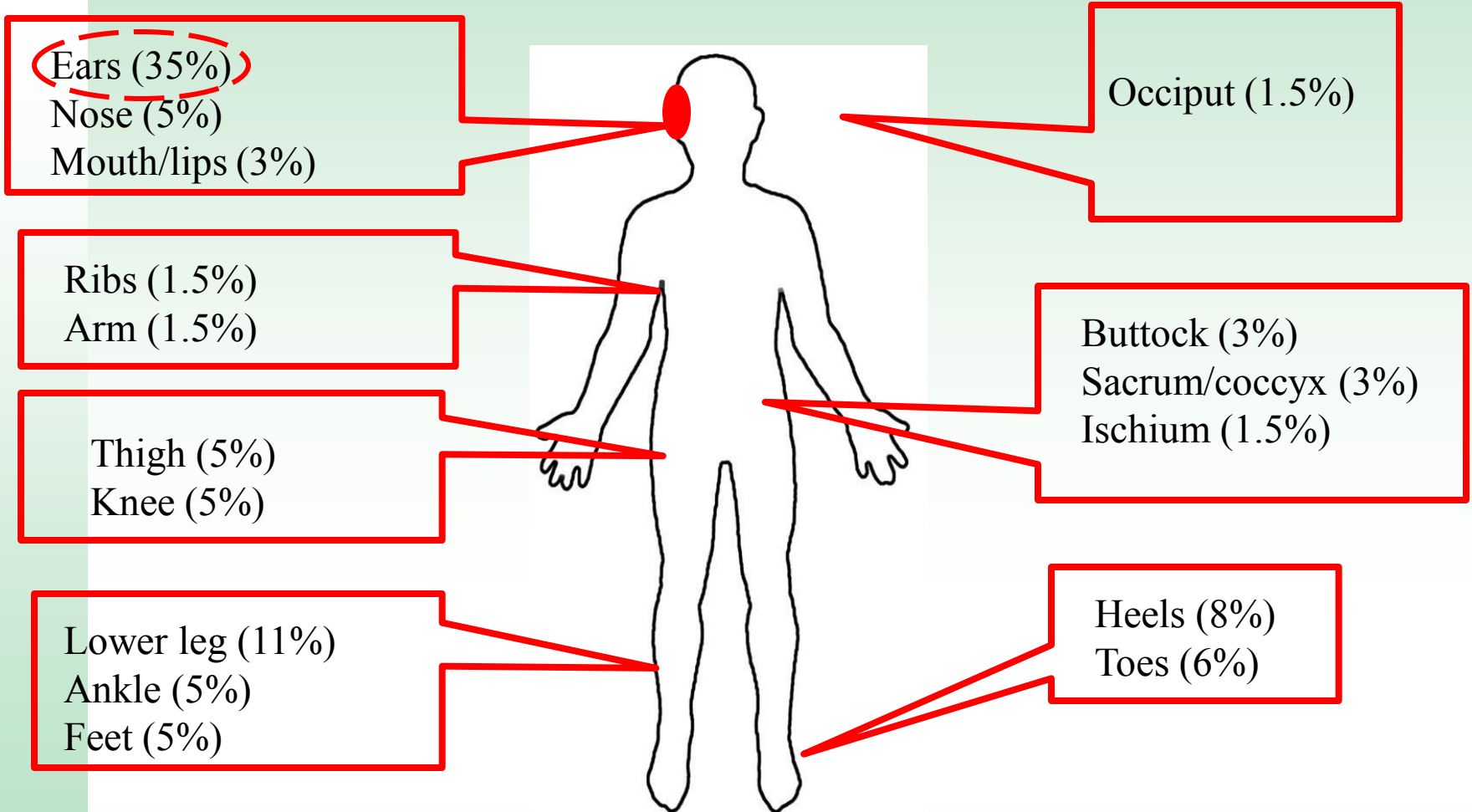
Black et al. (2010, IJWC)

- No statistically significant difference among critical care, step-down units & medical/surgical units
- Patients with a medical device were 2.4 times more likely to develop a PU
- Stages I & II predominated, but unstageable & sDTI were also present





Anatomical Distribution of MDRPU in Adults (n=39)



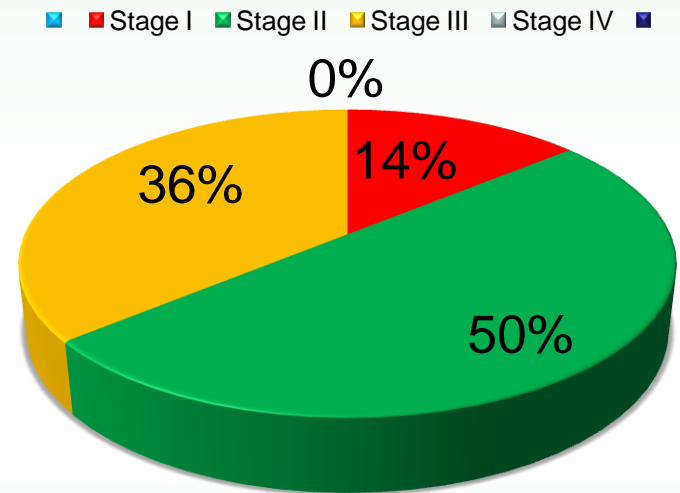


Medical Device Related Pressure Ulcers (MDRPU): Epidemiologic Data

Long, Ayer & Borchert (2011, WOCN Poster)

- Multi-center PU Prevalence Study
 - Settings: 3 LTACs (MA, OH, MN)
 - Duration: 11 months
 - N=304 HAPU
 - Mean (44%); (n=142) were MDRPU

Type of Device	%
Respiratory	14.7%
Heel Relief	7.7%
Splint/brace/boots	18.9%
Tubing (urine/fecal)	14.7%
PEG Flange	5.6%
Other	38.5%

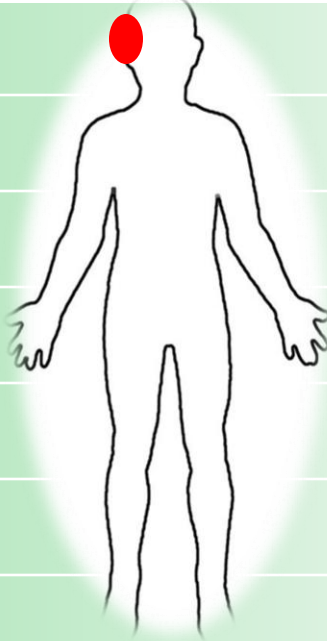


Medical Device Related Pressure Ulcers (MDRPU): Epidemiologic Data

Long, Ayer & Borchert (2011, WOCN Poster)

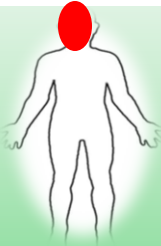
- Anatomical Distribution:

Location	%
Head/Neck	28.1%
Foot	14.1%
Pelvis	15.5%
Lower Leg	21%
Arm/Hand	6.3%
Back	5.6%
Penis	2.8%





Medical Device Related Pressure Ulcers (MDRPU): Most Common Sites in Adults

Location	Frequency (%)	Investigators
Head/Neck 	28-70% Ears (11-37%); Nose (5%); Mouth/lips (1-3%); Occiput (2%)	Apold & Rydrych; Turjanic; Long; Black; VanGilder; Zaratkiewicz et al.
Foot & Ankle	12-24%	Apold & Rydrych; Long; Black
Pelvis (sacrum, buttock, coccyx)	7.5-27%	Apold & Rydrych; Long; Black; VanGilder
Lower Extremity	21%	Long; Black
Arm/Hand	1.5-6.3%	Long; Black
Back	5.6%	Long
Genitalia	2.8%	Long

Medical Device Related Pressure Ulcers (MDRU) in Bariatric Individuals

- Skin folds may obscure medical devices (e.g. caps, tubing, etc.)
- Ensure equipment is not too small
 - SCD, stockings, boots, narrow trach ties, etc.

Medical Devices Commonly Associated With PU Development

- **Respiratory equipment** (cannula, CPAP, BiPAP, ETT, NTT, trach plates, trach ties/collars)
- **PEG** (flange, tubing)
- **Immobilizers** (splints/braces/traction, casts, c-collars)
- **Tubing** (A-lines, urinary/fecal tubing/fecal mgmt. pouch spigots/FMS, NPWT, dialysis catheters, GT/JT/NGT)
 - Urinary catheters/drainage tubing; condom catheters
 - Linear thigh ulcers
 - Ventral erosion of penis

Medical Devices Commonly Associated With PU Development

- Wrist bands
- Restraints
- Compression devices (SCD; TEDs)
- Binders
- Ostomy clips/spigots
- Halo rings
- External fixators
- IV hubs

Common MDRPU in Adults: Non-invasive Positive Pressure Ventilation (NIPPV)

- **Incidence:** 17-97%
- **Location:** Nasal bridge, nasolabial region, forehead, eyebrows, columella, nasal septal base
- **Challenges:**
 - Facial configuration variability
 - Rapid deterioration
 - Equipment:
 - If too large → air leak
 - If too tight → MDRPU

Common MDRPU: Non-invasive Positive Pressure Ventilation (NIPPV)

- **Prevention:**
 - Assess skin
 - Pad skin prior to device application
 - Weng (2008) ICCN
 - Design: Quasi-experimental study
 - Sample: N=90 (Med-Surg ICU)

PU Frequency (Stage I)

	Control	Film Dsg.	HCD Dsg.
MDRPU+	96.7%	53.3%	40%
MDRPU-	3.3%	46.7%	60%

p < 0.01



Common MDRPU: Endotracheal Tubes

- **Prevention Measures:**
 - Assess skin & mucosa (neck, lips, oral mucosa, tongue & mouth)
 - Rotate position of ETT (right, middle, left)
 - Interprofessional collaboration/education

Common MDRPU: O₂ via Nasal Cannula

- **Incidence:** 37%
- **Location:** Post auricular
- **Turjanica et al. (2011, MedSurg Nsg)**
 - Design: Descriptive, correlational
 - Sample: N=100, convenience sample (pts using O₂)
 - Setting: 42 bed acute MedSurg unit, Level 1 Trauma

Common MDRPU: O₂ via Nasal Cannula

- **Turjanica et al. (2011, MedSurg Nsg)**
 - Findings:
 - Only 2 patients with padding
 - Stage I ulcers; no FT
 - Rate of ulcers was 2 x greater among non-home users vs. home O₂ users (47% vs. 23%)

Common MDRPU: O₂ via Nasal Cannula

- **Prevention Measures:**
 - Inspect skin under & around tubing @ least q8-12 hrs
 - Educate patients/family to inform staff of discomfort
 - Clearly assign responsibility for assessment
 - Document findings
 - Use ear protectors on tubing (intervene early)
 - Check strap tension
 - Stock ear protectors close to nasal cannula

Common MDRPU: Cervical Collars

- **Incidence:** 6.8%-55%
- **Location:**
 - Cervical collar triad (junction of neck & shoulders; junction of neck & chest near sternal notch)
 - Occipital, chin, mandible & ears
- **Presentation:**
 - Partial & FT ulcers; sDTI; eschar

Common MDRPU: Cervical Collars

- **Risk Factors:**
 - # of days wearing c-collar

Days in c-collar	% of Pts. MDRPU+
< 5 days	33%
≥ 5 days	55%

- Presence of edema

Common MDRPU: Cervical Collars

- **Prevention Measures:**
 - Obtain an order to remove extrication collar & replace with acute care rigid collar
 - Ensure appropriate collar fit
 - Interprofessional collaboration
 - Assess skin q 12 hrs
 - Δ pads in collar q 24 hrs
 - Consistency in unit based standards
 - EBP guidelines
 - Jacobson et al. reported an 89% \downarrow in occipital PU/1 yr

Common MDRPU: Tracheostomies

- **Jaul (2011, OWM)**
 - 6 month pilot study; skilled geriatric unit
 - 66.7% of FA-MDRPU were secondary to trach ties
- **Location:**
 - Under trach plate, around ostomy, under strap/ties
- **Presentation:**
 - Partial & FT ulcers; sDTI; Unstageable

Common MDRPU: Tracheostomies

- **Prevention Measures:**
 - Assess skin & strap tension @ least q 8-12 hrs
 - Use thicker, wider non-adherent foam collar straps
 - Pad under plate, around stoma

Common MDRPU: Pulse Oximetry

- Accounts for up to 52% of MDRPU in pediatrics
- **Location:**
 - Digital (under nails; digit/toe injuries)
 - Ear
- **Presentation:**
 - Partial & FT ulcers
 - sDTI → eschar

Noonan et al (2006) J Ped Nurs; Sloan (1988) Anesthes; Berge et al. (1988) Anesth Analog; Chemello et al. (1990) Oral Surg Oral Med Oral Path; Rubin et al. (1991) J Oral Maxillofac Surg

Common MDRPU: Ear Lobe Pulse Oximetry

- **Goodell (2012, OWM)**
 - In-vitro quantification of dressing pressure exerted on earlobe pressure
 - 20.7 mm Hg (0.24 lbs. of force exerted over an area of 0.3 sq inches)
 - Does not show causality, only that these devices exert pressure with potential to cause injury

Common MDRPU: Pulse Oximetry

- **Prevention Measures:**
 - Assess skin integrity prior to placement
 - Never place a probe over damaged skin
 - Follow manufacturer recommendations
 - Accurate placement
 - Rotate sites
 - Consider digital tape on design
 - Avoid too tight securement



Common MDRPU: Nasotracheal Tubes

- **Incidence:** A complication of oral & maxillofacial surgery
- **Location:**
 - Nasal-ala
- **Presentation:**
 - Partial & FT ulcers; Unstageable; sDTI

Common MDRPU: Nasotracheal Tubes

- **Prevention Measures:**
 - Huang et al. (J Oral Maxillofac Surg, 2009)
 - N=18
 - Cushioning with a HCD dsg. & soft-denture lining material resulted in a 40% ↓ in nasal ala PU formation



Common MDRPU: Endotracheal Tubes

- **Incidence:** 1.25%
- **Location:**
 - Lips; oral mucosa, mouth, tongue, neck
- **Presentation:**
 - Partial & FT ulcers; necrosis
 - Mucosal PU not to be staged

Common MDRPU: Endotracheal Tubes

- **Prevention Measures:**
 - Assess skin & mucosa
 - Neck, lips, oral mucosa, tongue & mouth
 - Rotate position of ETT
 - Right, middle, left
 - Interprofessional collaboration/education

Common MDRPU: Nasogastric Tubes

- **Prevention Measures:**
 - Secure so free-floating in the nare
 - When side-lying ensure not lying on cheek or ear

Common MDRPU: Urinary Catheters & Tubing

- Multiple case reports
- **Location:**
 - Medial thighs, abdomen; lower leg; penis (ventral erosion of glans & shaft); labia
- **Devices:**
 - Indwelling urethral catheters; suprapubic catheters; leg bags

Common MDRPU: Urinary Catheters & Tubing

- **Prevention Measures:**
 - Avoid use of indwelling catheters as feasible
 - Consider IC where feasible
 - When side-lying ensure not lying on tubing
 - Allow tubing slack when securing (if too taught → bow-string penile cutting will ensue)
 - ↑ Staff awareness in insensate patients & in areas of edema

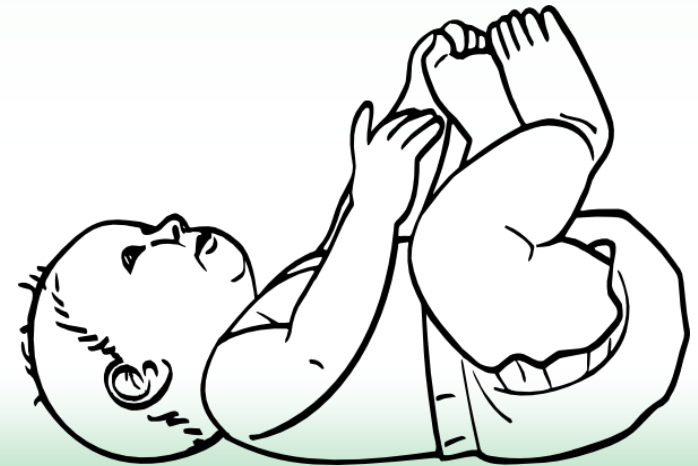
MDRPU in Neonates & Children

- Most frequently cited risk factor for PU
- Incidence rates as high as 50%
- Most common medical devices associated with PU were:



Medical Devices Commonly Associated With PU in Neonates & Children

- ETT, Trach plate, trach ties
- A-lines, central lines, CSF shunts, bladder caths
- Splints, braces, casts, external fixators
- Diaper tabs
- NGT/NJT/GT/JT
- Diathermy pads
- EKG leads

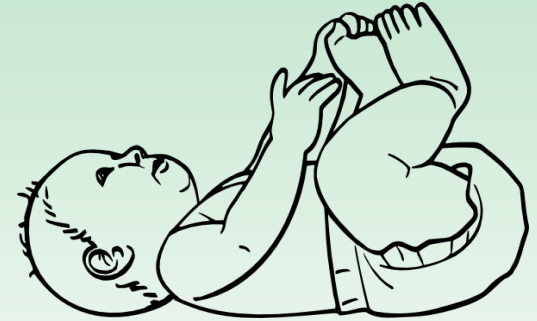


Medical Devices Commonly Associated With PU in Premature Infants & Neonates

- Arm boards, IV lines/hubs
- Head dressings/hats
- Pulse oximetry
- Blood pressure cuffs
- Name bands
- CPAP, nCPAP

MDRPU in Neonates & Children: nCPAP

- Infants < 1 year of age
 - Jatana et al.
 - Cross-sectional study
 - N=100 (200 nasal cavities)
 - Examined impact of nCPAP (n=91) & nasal cannula (n=9)
 - Findings:
 - Internal & external injury rate 13%
 - Columellar necrosis in 6% of population





The Incidence of MDRPU Among Premature Infants: nCPAP

- **Nasal prong CPAP:**

- 13 - 43% (Jatana, et al., 2010; Gunlemez, et al., 2010; Robertson, et al., 1996; Yang, et al., 2005; Buettiker, et al., 2004; Fischer, et al., 2009; Ligi, 2008)
- Ulcers development within 3-9 days (Fischer, et al., 2009)
- Incidence & severity inversely correlated with gestational age & birth wgt. (Fischer, et al., 2009)

Gestational Age	Ulcer Rate
< 28 weeks	90%
< 32 weeks	77%
≥ 32 weeks	28%
Term Neonates	11%

MDRPU Among Premature Infants: Mask CPAP

- **Mask CPAP:**
 - 35% (Yang, et al., 2005)
- **Hogeling et al. (2012, Ped Derm)**
 - Reported occurrence of pressure necrosis over the forehead & eyebrows

The Incidence of MDRPU Among Premature Infants

- Baharestani, 2005 (N=39)
 - 23% incidence
- Fuji, et al., 2010 (N=81)
 - 17% incidence (86% were using CPAP/DPAP)
- Waterlow, 1997; Willock, et al., 2005
 - 37–50% of neonatal & pediatric pressure ulcers were associated with equipment pressing on the skin

nCPAP Related Pressure Ulcers Among Premature Infants

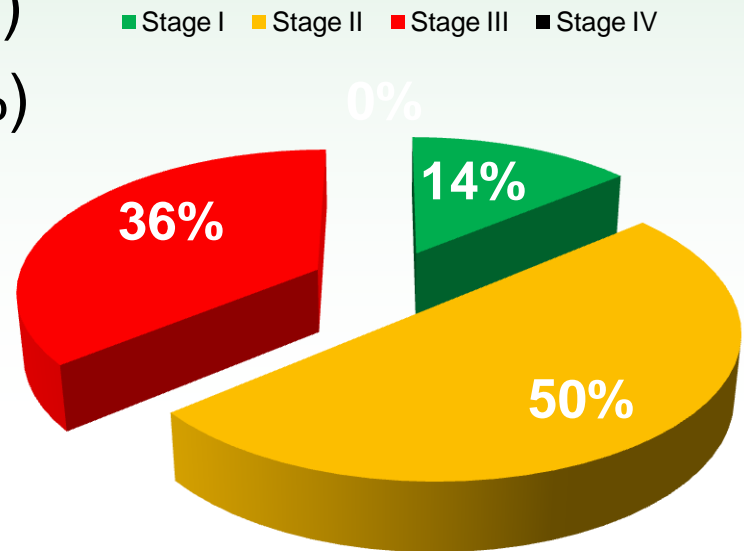
- Gunlemez, et al., 2010 (N=179)
 - Randomized controlled study
 - Group 1: (n=87) received no silicone gel dressing to nares
 - 14.9% (n=13) columella necrosis
 - Group 2: (n=92) + silicone gel dressing
 - 4.3% (n=4) columella necrosis

Tracheostomy Related PU (TRPU) in Infants & Children

- **Boesch et al. (2012, Pediatrics)**
 - Pediatric Hospital Collaborative examined HAPU
 - N=834 chronic vent dependent patients
 - Infants & children
 - Duration: 2008-2010
 - Findings: 75% of HAPU 2° devices (mainly trach & positive pressure masks)

Tracheostomy Related PU (TRPU) in Infants & Children

- **Boesch et al. (2012, Pediatrics)**
 - Characteristics of TRPU (N=22)
 - Location:
 - Below stoma (73%)
 - Above flange (14%)
 - Above stoma (9%)
 - Under ties (4%)



Tracheostomy Related PU (TRPU) in Infants & Children

- **Boesch et al. (2012, Pediatrics)**

- **TRPU Prevention Bundle:**

- PU Risk & Skin assessment
 - Q 24 hr Braden Q
 - Full body assessment q day
 - Trach assessment q 8 hrs
 - Moisture-free device interface
 - Hydrophilic foam under trach ties
 - Pressure free device interface
 - Extended style trach as needed

TRPU

Pre-Bundle 8.1%

Post-Bundle 0.3%



MDRPU: Implications for Neonatal and Pediatric Practice

- Pad under devices with atraumatic dressings
- Secure hats to CPAP prongs horizontally
- Ensure proper fitting hat, straps & prongs/mask
- Alternate between nasal & mask CPAP
- Follow manufacturer guidelines

MDRPU: Implications for Practice

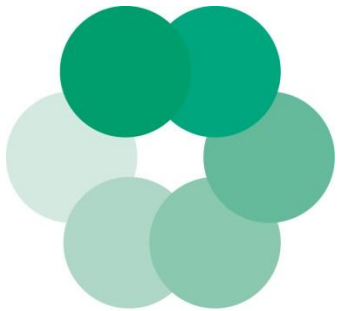
- Staff education regarding MDRPU risk
 - Be certain staff know what a “device” is
- Incorporate prevention measures into policy
- Pad under devices as feasible (e.g., silicone, hydrocolloid, foam or liquid filled dressings)
- Perform random audits
 - Examine & report trends

Medical Device Related Pressure Ulcers (MDRU): Implications for Practice

- Thorough skin assessment under devices q shift if not medically contraindicated
- Communication & collaboration with other health providers is critical (e.g., OT, PT, RT)
- Ensure that patients are not lying on tubes & monitoring equipment (tubing should be visible)
- Avoid replacing devices on injured skin as feasible

Medical Device Related Pressure Ulcers (MDRU): Implications for Practice

- Follow manufacturer guidelines
 - Report adverse events to the manufacturer
 - Product safety opportunity for industry
 - Collaborate with manufacturers to develop more skin sensitive products
- Ensure proper sizing (resize with edema)
- Use commercially available drain & tube securement devices that can be opened/closed
- Be cognizant of areas with minimal/no adipose



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Prevention” Poster