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

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 Faculty Disclosure

Dr. Baharestani, PhD, ANP, CWON, FACCWS

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

Fletcher (2012) Wounds UK
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

Apold & Rydrych (2012) J Nurs Care Qual
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

Apold & Rydrych (2012) J Nurs Care Qual
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

Apold & Rydrych (2010) J Nurs Care Qual
Medical Device Related Pressure Ulcers (MDRPU): Scope of the Problem

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

<table>
<thead>
<tr>
<th>Location</th>
<th>Device</th>
<th>Non-Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head/face/neck</td>
<td>70.3%</td>
<td>7.8%</td>
</tr>
<tr>
<td>Other/multiple</td>
<td>21.9%</td>
<td>5.8%</td>
</tr>
<tr>
<td>Heel/ankle/foot</td>
<td>20.3%</td>
<td>16.9%</td>
</tr>
<tr>
<td>Coccyx/buttocks</td>
<td>7.8%</td>
<td>67.5%</td>
</tr>
<tr>
<td>Sacrum</td>
<td>1.6%</td>
<td>16.9%</td>
</tr>
</tbody>
</table>
• 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
    • Skin inspections
Medical Device Related Pressure Ulcers (MDRPU): Most Common Causes

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

![Pie chart showing pressure ulcer stages and sDTI](chart.png)
Anatomical Distribution of MDRPU in Adults (n=39)

- Ears (35%)
- Nose (5%)
- Mouth/lips (3%)
- Ribs (1.5%)
- Arm (1.5%)
- Thigh (5%)
- Knee (5%)
- Lower leg (11%)
- Ankle (5%)
- Feet (5%)
- Occiput (1.5%)
- Buttock (3%)
- Sacrum/coccyx (3%)
- Ischium (1.5%)
- Heels (8%)
- Toes (6%)

Black et al. (2010) International J of Wound Care
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

<table>
<thead>
<tr>
<th>Type of Device</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory</td>
<td>14.7%</td>
</tr>
<tr>
<td>Heel Relief</td>
<td>7.7%</td>
</tr>
<tr>
<td>Splint/brace/boots</td>
<td>18.9%</td>
</tr>
<tr>
<td>Tubing (urine/fecal)</td>
<td>14.7%</td>
</tr>
<tr>
<td>PEG Flange</td>
<td>5.6%</td>
</tr>
<tr>
<td>Other</td>
<td>38.5%</td>
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</tbody>
</table>
Medical Device Related Pressure Ulcers (MDRPU): Epidemiologic Data

Long, Ayer & Borchert (2011, WOCN Poster)

- Anatomical Distribution:

<table>
<thead>
<tr>
<th>Location</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Head/Neck</td>
<td>28.1%</td>
</tr>
<tr>
<td>Foot</td>
<td>14.1%</td>
</tr>
<tr>
<td>Pelvis</td>
<td>15.5%</td>
</tr>
<tr>
<td>Lower Leg</td>
<td>21%</td>
</tr>
<tr>
<td>Arm/Hand</td>
<td>6.3%</td>
</tr>
<tr>
<td>Back</td>
<td>5.6%</td>
</tr>
<tr>
<td>Penis</td>
<td>2.8%</td>
</tr>
</tbody>
</table>
Medical Device Related Pressure Ulcers (MDRPU): Most Common Sites in Adults

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

Mathison (2003) J WOCN
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)

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Film Dsg.</th>
<th>HCD Dsg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDRPU+</td>
<td>96.7%</td>
<td>53.3%</td>
<td>40%</td>
</tr>
<tr>
<td>MDRPU-</td>
<td>3.3%</td>
<td>46.7%</td>
<td>60%</td>
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p< 0.01
Prevention Measures:

- Assess skin & mucosa (neck, lips, oral mucosa, tongue & mouth)
- Rotate position of ETT (right, middle, left)
- Interprofessional collaboration/education
Common MDRPU: $O_2$ via Nasal Cannula

- **Incidence:** 37%
- **Location:** Post auricular

**Turjanica et al. (2011, MedSurg Nsg)**
- Design: Descriptive, correlational
- Sample: N=100, convenience sample (pts using $O_2$)
- Setting: 42 bed acute MedSurg unit, Level 1 Trauma
Common MDRPU: $O_2$ 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 $O_2$ users (47% vs. 23%)
Common MDRPU: $O_2$ 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

<table>
<thead>
<tr>
<th>Days in c-collar</th>
<th>% of Pts. MDRPU+</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5 days</td>
<td>33%</td>
</tr>
<tr>
<td>≥ 5 days</td>
<td>55%</td>
</tr>
</tbody>
</table>

- 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% ↓ 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

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

Apold & Rydrych (2012) J Nurs Care Qual
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

Apold & Rydrych (2012) J Nurs Care Qual
Common MDRPU: Nasogatric 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切割 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:
  - nCPAP
  - BiPAP
  - DPAP
  - Pulse O₂ probes

Baharestani (2012) NPUAP Pressure Ulcers: Prevalence, Incidence, & Implications for the Future
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)

<table>
<thead>
<tr>
<th>Gestational Age</th>
<th>Ulcer Rate</th>
</tr>
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<tbody>
<tr>
<td>&lt; 28 weeks</td>
<td>90%</td>
</tr>
<tr>
<td>&lt; 32 weeks</td>
<td>77%</td>
</tr>
<tr>
<td>≥ 32 weeks</td>
<td>28%</td>
</tr>
<tr>
<td>Term Neonates</td>
<td>11%</td>
</tr>
</tbody>
</table>
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%)

![Pie chart showing distribution of stages of TRPU]
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

Black et al. (2010) International J of Wound Care
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
Visit the NPUAP website at www.npuap.org for an upcoming “Medical Device Relate Pressure Ulcer Prevention” Poster