Clinical **Applications of Pressure Mapping**



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3. Click SIGN IN.

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| | Biological Pressure Injury and Wound Care Con 5: 244(6):2 271 Second completed SEARCE LUNCEVED WORK |
|------------------|--|
| THAT LEASING NOW | How would you rate this course? $\bigcirc \odot \odot \odot \odot \bigcirc$ |
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6. Click BEGIN THE SURVEY.



|) How would you rate the program overall? | 1. Diserves | | 3. Maither array or | | 5. Strengthe | |
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| | streegly | Disagree | disagree | Agree | Agree | N/A |
| The stated goals & objectives of the program were met | 0 | 0 | 0 | 0 | 0 | 0 |
| The topics were covered in sufficient detail | 0 | 0 | 0 | 0 | 0 | 0 |
| The subject matter will improve my clinical reactive | 0 | 0 | 0 | 0 | 0 | 0 |
| I would recommend this program to others | 0 | 0 | 0 | 0 | 0 | 0 |
| A commercial company or product was not unlainly or overly promoted? | 0 | 0 | 0 | 0 | 0 | 0 |
| instructor was well prepared | 0 | 0 | 0 | 0 | 0 | 0 |

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2 weeks (10/20/23) to complete survey and download CE certificate



Karen A. Lerner, RN, MSN, ATP, CWS Clinical VP for Drive DeVilbiss Healthcare

Monetary support received from Drive DeVilbiss Healthcare





- 1) Describe the proper set up for interface pressure mapping(IPM)
- Define 4 test methods of pressure mapping/sensing
- 3) List at least 3 client educational feedback derived from pressure mapping



References

National Pressure Injury Advisory Panel (NPIAP) 2019 Guidelines



Support Surface Standards Initiative (S3I)



ISO/TR 16840-9:2015 has been produced to guide users in the performance of the tasks that are directly involved in the clinical use of interface pressure mapping (IPM) or are synergistic with its use in a comprehensive wheelchair seating evaluation

International Best Practice Guidelines

BPG2 Clinical Guidelines for the Use of Interface Pressure Mapping for Seating



•Interface pressure- pressure load between skin & support surface; Interface Pressure Mapping (IPM)

•Peak interface pressure- highest pressure load between skin & support surface; highest value of the pressures recorded by the sensor units in the mat

•Average interface pressure- average pressure load between skin & support surface of a full body or the specific area calculated by pressure mapping device; the average value of the pressure recorded by a group of sensors of predefined location and disposition around a significant landmark

•Skin contact area-total contact area between skin & support surface



Pressure Injuries

They're not called "mystery injuries"

A pressure injury is localized damage to the skin and underlying soft tissue usually over a bony prominence or related to a medical or other device. The injury can present as intact skin or an open ulcer and may be painful. The injury occurs as a result of intense and/or prolonged pressure or pressure in combination with shear. The tolerance of soft tissue for pressure and shear may also be affected by microclimate, nutrition, perfusion, co-morbidities and condition of the soft tissue



Pressure Redistribution

Kosiak's model of the relationship between applied pressure and time for pressure ulcer development

The ability of a support surface to distribute load over the contact areas of the human body. This term replaces prior terminology of pressure reduction and pressure relief surfaces



Pressure = Force / unit area



Peak & Average Surface Interface Pressure

Peak: Highest pressure over a small contact area (usually over bony prominences)Average: Calculated by computer; depicts body surface average interface pressure

Pressure redistribution: Peak pressures over a small area being dispersed or redistributed over a larger area to relieve higher pressure areas





What is Pressure Mapping?



- A pressure map is a computerized clinical tool for assessing pressure distribution
- Surface interface pressure is measured as both peak & average pressures between the body and the surface





4 types of pressure mapping

- Single sensor, single measurement
- Multiple sensor, single measurement
- Single sensor, continuous measurement
- Multiple sensor, continuous measurement X



Components of IPM System





Multiple sensor, continuous measurement

Most common in clinical settings:

- Multiple sensor pad placed between a support surface and the client
- Displays digital reading of pressure information on computer screen
- Colors and numbers correspond to pressure readings expressed as millimeters of mercury (mmHg)
- Higher pressures are shown in red
- Lower pressures are shown in blue

Useful:

- Assessing pressure distribution
- Peak pressure areas
- Information on how postural and seating adjustments impact pressure distribution
- Client visualization of position changes impact on pressure distribution







Uses for IPM Assessment

Most common use:

Compare cushions for prescription for a client by measuring each cushion's ability to distribute pressure evenly across the body minimize pressure at bony prominences



What Interface Pressure Mapping is NOT

IPM is NOT a sub

- IPM does not measure Shear
- Pressure mapping can indicat pressure between two points.
- Shear strain is the deformatic bony movement of tissues in re



+++ Under pressure Unaffected skin Shear strain

"Shear may be 10 times more destructive to the tissues than pressure."

(Fontaine et al. (1998))

ecision making

greater range of change in

ment of tissues in relation to nation



Can Pressure Mapping Predict Pressure Injuries?

PI risk factors

Existing pressure injuries

Sensation

Mobility limitations

Increased skin moisture & boriginate in deeper tissues

Impaired circulation Poor nutritional status

- Provides a superficial assessment of external tissue load & shear/friction & trauma to the external tissues
- Deep tissue injuries (DTIs) may evolve into stage 3, 4, or unstageable PIs
- Currently, no tool exists to measure deep tissue pressure or perfusion (Positron emission tomography (PET) & single-photon emission computed tomography (SPECT) not used for PIs; Limited data on Thermal Imaging to detect DTIs)

Postural/orthopedic deformines Exposure to friction or shear pressure distribution and areas of potential tissue damage Medical conditions & general health status

Client's daily activities, including the client's use of medical equipment, to assess the risk of pressure and shear forces

Visually inspect skin & bony prominences, skin folds, and where skin is in contact with medical devices



Pressure Mapping Successes

C

- 2005 OTs used pressure mapping to assess wheelchair (WC) cushions of 40 patients; found 19 should have
- Level 5 studies (indirect evidence) e.g., studies in normal human subjects, humans with other types of chronic wounds, animal models

• A body of evidence with inconsistencies that cannot be explained, reflecting genuine uncertainty surrounding the topic

- 2009 Pressure mapping used to determine how often individuals shift their posture; found nondisabled
 Subjects change notifier a V/br. to relieve subcutaneous tissue pressures. These researchers recommend WC
- Using Pressure Mapping to Optimize Hospital–
 Acquired Pressure Injury Prevention Strategies in the ided for patients on Burn Intensive Care Unit
 Ideal Strategies in the idea of the id

DeVilbiss

visually check patients with every turn, looking for incontinence and evidence of skin breakdown



BEFORE

TYPICAL POSITIONING



Original Investigation | Physical Medicine and Rehabilitation Effect of a Continuous Bedside Pressure Mapping System for Reducing Interface Pressures A Randomized Clinical Trial

Chester Ho, MD-Wrechelle Ocamoo, MRT- Danielle A. Southern, MSC- Darlene Sola, RScN, CCRP- Rarry Ravlis, MD-

Pressure mapping had a low to inverse correlation to pressure ulcer prevalence



Sue Girolami

Designer for ergonomic support surfaces Published Aug 20, 2014

support surface.

5.6: Reposition the individual to relive or redistribute pressure using manual handling techniques and equipment that reduce friction and shear. (Strength of Evidence=82; Strength of Recommendation=1)¹ 5.7: Consider using continuous bedside pressure mapping as a visual cue to guide repositioning. (Strength of Evidence=C: Strength of Recommendation=→)

*Continuous bedside pressure mapping Imag

'European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel, & Pan Pacific Pressure Injury Alivna. (2 Ulcers/Injuries: Chrical Practice Guideline: The International Guideline 2019 (pp. 115–144). European Pressure Ulcer Adv readings greater than 40 mm Hg was 99.6% in both the control and intervention groups.

CONCLUSIONS AND RELEVANCE In this randomized clinical trial to evaluate the efficacy of CBPM technology in the reduction of interface pressure and the incidence of PIs in a tertiary acute care center, no statistically significant benefit was seen for any of the primary outcomes. These results suggest that longer duration of monitoring and adequately powered studies where CBPM feedback is integrated into a multifaceted intervention to prevent PI are needed.

TRIAL REGISTRATION Clinical Trials.gov Identifier: NCT02325388

JAMA Network Open. 2023;6(6):e2316480. doi:10.1001/jamanetworkopen.2023.16480



Pressure mapping allows us to move away from opinion & tradition towards objective assessment & flexibility

Using pressure mapping when positioning patient in a WC or bed or on an operating table makes it possible to control amount of pressure experienced by patient by making adjustments according to objective measurements rather than assumptions

Pressure mapping equipment can be used to alert personnel and/or patient of need for repositioning & can also facilitate repositioning as caregivers and/or patient are provided with feedback on pressure points

Pressure mapping is a noninvasive, objective & reliable way to measure the surface interface pressure & pressure redistribution



<u>Current Standard for Testing Support Surfaces</u> (American National Standards Institute / Rehabilitation Engineering Society of North America (ANSI/RESNA)

- •<u>S3I Terms and Definitions : Updates</u>
- Immersion and Envelopment Performance Tests
- Support Surface Standard Horizontal Stiffness Test
- Support Surface Standards Tests for Microclimate Management
- <u>Support Surface Selection Steps: Using Standards to Choose Wisely</u>



Pressure Redistribution

| | Support Surface A | Support Surface B | Support Surface C | Support Surface D | Support Surface E | Considerations to take into account, based on results and patient population/setting. | | | | | |
|-------------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|---|--|--|--|--|--|
| Support Surface Name | | | | | | | | | | | |
| Pressure Redistribution Category | All thre | e methods ass | ess pressure rec | distribution perf | ormance but the | e test report different metrics | | | | | |
| IMMERSION (Section 2) | | | | | | | | | | | |
| Calculated Immersion | | | | | | | | | | | |
| ENVELOPMENT and IMMERSIO | N: HEMISPHER | ICAL INDENTE | R (Section 6) | - | - | - | | | | | |
| Immersion | | | | | | | | | | | |
| % Envelopment | | | | | | | | | | | |
| Peak Pressure | | | | | | | | | | | |
| Peak Pressure/ Immersion | | | | | | | | | | | |
| Peak Pressure/Mean Pressure | | | | | | | | | | | |
| ENVELOPMENT: DUAL SEMISHI | ERICALINDENT | ER (Section 7) | - | - | - | | | | | | |
| Avg immersion depth | | | | | | | | | | | |
| Avg pressures (levels 1 & 4) | | | | | | | | | | | |





| Performance Test | Test Overview | Performance Measures | Interpretation of Results | |
|---|--|---|---|--|
| Performance Test Envelopment and Immersion: Hemispherical Indenter Test Intent of Method: This method provides measures of how well a surface immerses and conforms to the shape of the indenter that represents the pelvic region. | Test Overview The Hemispherical Indenter method measures both immersion and envelopment - the ability of a surface to conform around irregularities of the body to redistribute pressure and immersion. The hemispherical indenter has 61 high accuracy pressure sensors positioned in concentric rings at 10 elevations (height of indenter) around the test device | Performance Measures Validated Outputs: (1) Immersion depth (mm) (2) % Envelopment (contact depth / immersion depth) (3) Peak Pressure (mm Hg) (4) Peak Pressure / Immersion (mm Hg/mm depth) Peak Pressure / Mean Pressure on bottom two levels of sensor rings | Interpretation of Results Softer surfaces show greater immersion and envelopment than stiffer surfaces. Air fluidized therapy surfaces may envelop full depth. Powered air products can be used to set different levels of stiffness by adjusting the internal pressure in the surface High levels of immersion with high levels of envelopment is consistent with a high degree of pressure redistribution. | <image/> <image/> <image/> <image/> <image/> |
| | | | | |

Peak Pressure (mmHg)

- Consideration of the peak pressure can be used to confirm high immersion & high envelopment result in force redistribution.
- We expect high immersion & high envelopment result in a low peak pressure The opposite would also be expected to be true

Peak Pressure/Immersion (mmHg)

- A higher number indicates high pressure with low immersion. A lower number indicates low pressure with high immersion
- This is another indication of envelopment. High peak pressure with high immersion would indicate poor conformance of the surface

Peak Pressure/Mean Pressure

- A result close to 1 indicates to lower pressure gradient at the bottom of the indenter
- As the result increases greater than 1 it indicates a higher pressure gradient at the bottom of the indenter





A p value <0.008 is considered significant and is represented by a *

Goal: Redistribute (or reduce) pressure

How? What do you measure?

- How know what interventions have redistributed (or relieved or reduced) pressure?
- Is a skin assessment enough?

Is a patient's self-assessment of comfort valuable or reliable? What if patient can't feel pressure relief because of neurologic impairment?



Limitations

- The mat itself can interfere with how the cushion interacts with the seated individual, limiting the true immersion into the cushion cover and materials
- IPM doesn't give internal tissue pressures or other data (some pressure maps measure shear)
- Virtually all manufactures have "pretty blue pictures"; but one size does not fit all
- Good pressure redistribution, but does client like it? Can they egress/ingress, too unstable?
- Pressure mapping is truly a snapshot in time; slightest movement will affect the pressure mapping
- How does client sit after an hour?
- The 'best' pressure map may have client in a non-functional position
- Can demonstrate a less expensive cushion can be as effective for client, for static pressure redistribution, as a more expensive one, but it may not indicate which cushion provides greater protection in dynamic situations





Calibration

Pressure mapping device must be properly calibrated to ensure accurate results

- An uncalibrated pressure mapping device can skew results by as much as 50%
- Pressure mapping devices need to be calibrated on a regular basis, e.g., Q month
- Recalibrate mat whenever the readings look suspicious, after excessive use, or at the manufacturer's recommended interval
- Keep track of the uses of mat & date of last calibration
- Scales can be changed (seating 200 mmHg; Bed lying 100 mmHg)





Variables

- "Settling time"
- Current protocols are not consistent
- A measure or error- ~ 10% error between measure and actual values
- Creep- slow increase in pressure over time with constant load applied (most IPM systems have built in software correction for sensor creep)

| apply 500N load using buttock models | | | | | | | | | | | | | |
|--------------------------------------|-----------------|-------------|-------------------|------------------|--|--|--|--|--|--|--|--|--|
| | Change force | es in total | Changes pressu | s in peak ure | | | | | | | | | |
| Time frame | Gel | Rigid | Gel | Rigid | | | | | | | | | |
| between 0-1 minute | 26% | 18% | 26% | 19% | | | | | | | | | |
| between 1-5 minutes | 18% | 15% | 21% | 26% | | | | | | | | | |
| between 5-8 minutes | 5% | 5% | 7% | 8% | | | | | | | | | |
| between 1-8 minutes | 44% | 36% | 50% | 51% | | | | | | | | | |



Total Force

Hysteresis error - Difference in 2 measurements of same quantity when measurement is approached from opposite directions or energy loss during loading and unloading sensors

- Generally, manifests itself in IPM applications as difference in pressure reading depending on whether that pressure was reached by increasing from a lower pressure or decreasing from a higher pressure
- Sensor hysteresis is a dynamic effect where sensor output 'lags' behind corresponding applied pressure as applied pressure rises or falls, i.e., for a rising pressure, displayed pressure will be lower than pressure applied at the sensor and vice versa

To Reduce Hysteresis:

- Unweight cushion and mat entirely between readings
- Use a calibration algorithm in the software



Determine Need for IPM Assessment

- 1. Client's risk for pressure injury
- 2. Functional activities of daily living (ADL), including sitting, lying, transfer surfaces, equipment
- 3. Conditions that may impact pressure mapping, such as pain or spasms
- 4. Post-operative surgical risk, e.g., flap or graft surgery
- 5. Client's ability to comprehend & participate in assessment processes, e.g., being able to rest/sit quietly during pressure measurements
- 6. Client's goals of care, including preferences for prevention & management of risk factors
- 7. Client's culture & traditions to determine if they facilitate the assessment process
- 8. As part of a comprehensive assessment to assist with diagnosing a condition/disorder
- 9. Requirement as part of a funding application(s) and/or RX for a sitting or lying surface or a transfer device



Determine Need for IPM Assessment - Consider

Beneficiary has a manual wheelchair or a power wheelchair with a sling/solid seat/back & beneficiary meets Medicare coverage criteria for it; and Beneficiary has either of the following (a or b):

- a. Current pressure ulcer or past history of a pressure ulcer on the area of contact with the seating surface as reflected in a pressure ulcer diagnosis code listed below; or
- b. b. Absent or impaired sensation in the area of contact with the seating surface or inability to carry out a functional weight shift as reflected in a diagnosis code listed below.

Beneficiary has any significant postural asymmetries that are due to one of the following diagnoses:



ICD-10 Code Description L89.130 Pressure ulcer of right lower back, unstageable L89.131 Pressure ulcer of right lower back, stage 1 L89.132 Pressure ulcer of right lower back, stage 2 L89.133 Pressure ulcer of right lower back, stage 3 L89.134 Pressure ulcer of right lower back, stage 4 L89.140 Pressure ulcer of left lower back, unstageable L89.141 Pressure ulcer of left lower back, stage 1 L89.142 Pressure ulcer of left lower back, stage 2 L89.143 Pressure ulcer of left lower back, stage 3 L89.144 Pressure ulcer of left lower back, stage 4 L89.150 Pressure ulcer of sacral region, unstageable L89.151 Pressure ulcer of sacral region, stage 1 L89.152 Pressure ulcer of sacral region, stage 2 L89.153 Pressure ulcer of sacral region, stage 3 L89.154 Pressure ulcer of sacral region, stage 4 L89.200 Pressure ulcer of unspecified hip, unstageable L89.201 Pressure ulcer of unspecified hip, stage 1 L89.202 Pressure ulcer of unspecified hip, stage 2 L89.203 Pressure ulcer of unspecified hip, stage 3 L89.204 Pressure ulcer of unspecified hip, stage 4 L89.210 Pressure ulcer of right hip, unstageable L89.211 Pressure ulcer of right hip, stage 1 L89.212 Pressure ulcer of right hip, stage 2 L89.213 Pressure ulcer of right hip, stage 3 L89.214 Pressure ulcer of right hip, stage 4 L89.220 Pressure ulcer of left hip, unstageable L89.221 Pressure ulcer of left hip, stage 1 L89.222 Pressure ulcer of left hip, stage 2 L89.223 Pressure ulcer of left hip, stage 3 L89.224 Pressure ulcer of left hip, stage 4 L89.300 Pressure ulcer of unspecified buttock, unstageable L89.301 Pressure ulcer of unspecified buttock, stage 1 L89.302 Pressure ulcer of unspecified buttock, stage 2 L89.303 Pressure ulcer of unspecified buttock, stage 3 L89.304 Pressure ulcer of unspecified buttock, stage 4 L89.310 Pressure ulcer of right buttock, unstageable L89.311 Pressure ulcer of right buttock, stage 1 L89.312 Pressure ulcer of right buttock, stage 2 L89.313 Pressure ulcer of right buttock, stage 3 L89.314 Pressure ulcer of right buttock, stage 4 L89.320 Pressure ulcer of left buttock, unstageable L89.321 Pressure ulcer of left buttock, stage 1 L89.322 Pressure ulcer of left buttock, stage 2 L89.323 Pressure ulcer of left buttock, stage 3 L89.324 Pressure ulcer of left buttock, stage 4 L89.41 Pressure ulcer of contiguous site of back, buttock and hip, stage 1 L89.42 Pressure ulcer of contiguous site of back, buttock and hip, stage 2 L89.43 Pressure ulcer of contiguous site of back, buttock and hip, stage 3 L89.44 Pressure ulcer of contiguous site of back, buttock and hip, stage 4 L89.45 Pressure ulcer of contiguous site of back, buttock and hip, unstageable



B91 Sequelae of poliomyelitis E75.00 GM2 gangliosidosis, unspecified E75.01 Sandhoff disease E75.02 Tay-Sachs disease E75.09 Other GM2 gangliosidosis E75.10 Unspecified gangliosidosis E75.11 Mucolipidosis IV E75.19 Other gangliosidosis E75.23 Krabbe disease E75.25 Metachromatic leukodystrophy E75.29 Other sphingolipidosis E75.4 Neuronal ceroid lipofuscinosis F84.2 Rett's syndrome G04.1 Tropical spastic paraplegia G04.89 Other myelitis G10 Huntington's disease G11.0 Congenital nonprogressive ataxia G11.1 Early-onset cerebellar ataxia G11.2 Late-onset cerebellar ataxia G11.3 Cerebellar ataxia with defective DNA repair G11.4 Hereditary spastic paraplegia G11.8 Other hereditary ataxias G11.9 Hereditary ataxia, unspecified G12.0 Infantile spinal muscular atrophy, type I [Werdnig-Hoffman] G12.1 Other inherited spinal muscular atrophy G12.20 Motor neuron disease, unspecified G12.21 Amyotrophic lateral sclerosis G12.23 Primary lateral sclerosis G12.24 Familial motor neuron disease G12.25 Progressive spinal muscle atrophy G12.29 Other motor neuron disease G12.8 Other spinal muscular atrophies and related syndromes G12.9 Spinal muscular atrophy, unspecified G14 Postpolio syndrome G20 Parkinson's disease G21.4 Vascular parkinsonism G24.1 Genetic torsion dystonia G30.0 Alzheimer's disease with early onset G30.1 Alzheimer's disease with late onset G30.8 Other Alzheimer's disease G30.9 Alzheimer's disease, unspecified G31.81 Alpers disease G31.82 Leigh's disease G32.0 Subacute combined degeneration of spinal cord in diseases classified elsewhere G32.81 Cerebellar ataxia in diseases classified elsewhere G32.89 Other specified degenerative disorders of nervous system in diseases classified elsewhere G35 Multiple sclerosis G36.0 Neuromyelitis optica [Devic] G36.1 Acute and subacute hemorrhagic leukoencephalitis [Hurst] G36.8 Other specified acute disseminated demyelination G36.9 Acute disseminated demyelination, unspecified ICD-10 Seating Diagnosis List Version 10.17 G37.0 Diffuse sclerosis of central nervous system



G37.1 Central demyelination of corpus callosum G37.2 Central pontine myelinolysis G37.3 Acute transverse myelitis in demyelinating disease of central nervous system G37.4 Subacute necrotizing myelitis of central nervous system G37.5 Concentric sclerosis [Balo] of central nervous system G37.8 Other specified demyelinating diseases of central nervous system G37.9 Demyelinating disease of central nervous system, unspecified G71.0 Muscular dystrophy G71.2 Congenital myopathies G80.0 Spastic quadriplegic cerebral palsy G80.1 Spastic diplegic cerebral palsy G80.2 Spastic hemiplegic cerebral palsy G80.3 Athetoid cerebral palsy G80.4 Ataxic cerebral palsy G80.8 Other cerebral palsy G80.9 Cerebral palsy, unspecified G81.00 Flaccid hemiplegia affecting unspecified side G81.01 Flaccid hemiplegia affecting right dominant side G81.02 Flaccid hemiplegia affecting left dominant side G81.03 Flaccid hemiplegia affecting right nondominant side G81.04 Flaccid hemiplegia affecting left nondominant side G81.10 Spastic hemiplegia affecting unspecified side G81.11 Spastic hemiplegia affecting right dominant side G81.12 Spastic hemiplegia affecting left dominant side G81.13 Spastic hemiplegia affecting right nondominant side G81.14 Spastic hemiplegia affecting left nondominant side G81.90 Hemiplegia, unspecified affecting unspecified side G81.91 Hemiplegia, unspecified affecting right dominant side G81.92 Hemiplegia, unspecified affecting left dominant side G81.93 Hemiplegia, unspecified affecting right nondominant side G81.94 Hemiplegia, unspecified affecting left nondominant side G82.20 Paraplegia, unspecified G82.21 Paraplegia, complete G82.22 Paraplegia, incomplete G82.50 Quadriplegia, unspecified G82.51 Quadriplegia, C1-C4 complete G82.52 Quadriplegia, C1-C4 incomplete G82.53 Quadriplegia, C5-C7 complete G82.54 Quadriplegia, C5-C7 incomplete G93.89 Other specified disorders of brain G93.9 Disorder of brain, unspecified G94 Other disorders of brain in diseases classified elsewhere G95.0 Syringomyelia and syringobulbia G95.11 Acute infarction of spinal cord (embolic) (nonembolic) G95.19 Other vascular myelopathies G99.2 Myelopathy in diseases classified elsewhere I69.051 Hemiplegia and hemiparesis following nontraumatic subarachnoid hemorrhage affecting right dominant side I69.052 Hemiplegia and hemiparesis following nontraumatic subarachnoid hemorrhage affecting left dominant side I69.053 Hemiplegia and hemiparesis following nontraumatic subarachnoid hemorrhage affecting right non-dominant side I69.054 Hemiplegia and hemiparesis following nontraumatic subarachnoid hemorrhage affecting left non-dominant side ICD-10 Seating D

169.059 Hemiplegia and hemiparesis following nontraumatic subarachnoid hemorrhage affecting unspecified side 169.151 Hemiplegia and hemiparesis following nontraumatic intracerebral hemorrhage affecting right dominant side I69.152 Hemiplegia and hemiparesis following nontraumatic intracerebral hemorrhage affecting left dominant side I69.153 Hemiplegia and hemiparesis following nontraumatic intracerebral hemorrhage affecting right nondominant side I69.154 Hemiplegia and hemiparesis following nontraumatic intracerebral hemorrhage affecting left non-dominant side I69.159 Hemiplegia and hemiparesis following nontraumatic intracerebral hemorrhage affecting unspecified side I69.251 Hemiplegia and hemiparesis following other nontraumatic intracranial hemorrhage affecting right dominant side I69.252 Hemiplegia and hemiparesis following other nontraumatic intracranial hemorrhage affecting left dominant side I69.253 Hemiplegia and hemiparesis following other nontraumatic intracranial hemorrhage affecting right nondominant side I69.254 Hemiplegia and hemiparesis following other nontraumatic intracranial hemorrhage affecting left nondominant side I69.259 Hemiplegia and hemiparesis following other nontraumatic intracranial hemorrhage affecting unspecified side I69.351 Hemiplegia and hemiparesis following cerebral infarction affecting right dominant side I69.352 Hemiplegia and hemiparesis following cerebral infarction affecting left dominant side 169.353 Hemiplegia and hemiparesis following cerebral infarction affecting right non-dominant side 169.354 Hemiplegia and hemiparesis following cerebral infarction affecting left non-dominant side I69.359 Hemiplegia and hemiparesis following cerebral infarction affecting unspecified side I69.851 Hemiplegia and hemiparesis following other cerebrovascular disease affecting right dominant side I69.852 Hemiplegia and hemiparesis following other cerebrovascular disease affecting left dominant side I69.853 Hemiplegia and hemiparesis following other cerebrovascular disease affecting right nondominant side I69.854 Hemiplegia and hemiparesis following other cerebrovascular disease affecting left non-dominant side I69.859 Hemiplegia and hemiparesis following other cerebrovascular disease affecting unspecified side I69.951 Hemiplegia and hemiparesis following unspecified cerebrovascular disease affecting right dominant side I69.952 Hemiplegia and hemiparesis following unspecified cerebrovascular disease affecting left dominant side 169.953 Hemiplegia and hemiparesis following unspecified cerebrovascular disease affecting right nondominant side 169.954 Hemiplegia and hemiparesis following unspecified cerebrovascular disease affecting left non-dominant side I69.959 Hemiplegia and hemiparesis following unspecified cerebrovascular disease affecting unspecified side M62.3 Immobility syndrome (paraplegic) M62.89 Other specified disorders of muscle Q05.0 Cervical spina bifida with hydrocephalus Q05.1 Thoracic spina bifida with hydrocephalus Q05.2 Lumbar spina bifida with hydrocephalus Q05.3 Sacral spina bifida with hydrocephalus Q05.4 Unspecified spina bifida with hydrocephalus Q05.5 Cervical spina bifida without hydrocephalus Q05.6 Thoracic spina bifida without hydrocephalus Q05.7 Lumbar spina bifida without hydrocephalus Q05.8 Sacral spina bifida without hydrocephalus Q05.9 Spina bifida, unspecified Q07.00 Arnold-Chiari syndrome without spina bifida or hydrocephalus Q07.01 Arnold-Chiari syndrome with spina bifida Q07.02 Arnold-Chiari syndrome with hydrocephalusQ07.03 Arnold-Chiari syndrome with spina bifida and hydrocephalusQ67.8 Other congenital deformities of chestQ68.1 Congenital deformity of finger(s) and hand Q74.3 Arthrogryposis multiplex congenita Q78.0 Osteogenesis imperfecta



G83.10 Monoplegia of lower limb affecting unspecified side G83.11 Monoplegia of lower limb affecting right dominant side G83.12 Monoplegia of lower limb affecting left dominant side G83.13 Monoplegia of lower limb affecting right nondominant side G83.14 Monoplegia of lower limb affecting left nondominant side 169.041 Monoplegia of lower limb following nontraumatic subarachnoid hemorrhage affecting right dominant side 169.042 Monoplegia of lower limb following nontraumatic subarachnoid hemorrhage affecting left dominant side I69.043 Monoplegia of lower limb following nontraumatic subarachnoid hemorrhage affecting right non-dominant side I69.044 Monoplegia of lower limb following nontraumatic subarachnoid hemorrhage affecting left non-dominant side I69.049 Monoplegia of lower limb following nontraumatic subarachnoid hemorrhage affecting unspecified side I69.141 Monoplegia of lower limb following nontraumatic intracerebral hemorrhage affecting right dominant side I69.142 Monoplegia of lower limb following nontraumatic intracerebral hemorrhage affecting left dominant side I69.143 Monoplegia of lower limb following nontraumatic intracerebral hemorrhage affecting right non-dominant side I69.144 Monoplegia of lower limb following nontraumatic intracerebral hemorrhage affecting left non-dominant side I69.149 Monoplegia of lower limb following nontraumatic intracerebral hemorrhage affecting unspecified side I69.241 Monoplegia of lower limb following other nontraumatic intracranial hemorrhage affecting right dominant side I69.242 Monoplegia of lower limb following other nontraumatic intracranial hemorrhage affecting left dominant side I69.243 Monoplegia of lower limb following other nontraumatic intracranial hemorrhage affecting right non-dominant side I69.244 Monoplegia of lower limb following other nontraumatic intracranial hemorrhage affecting left non-dominant side I69.249 Monoplegia of lower limb following other nontraumatic intracranial hemorrhage affecting unspecified side I69.341 Monoplegia of lower limb following cerebral infarction affecting right dominant side I69.343 Monoplegia of lower limb following cerebral infarction affecting right non-dominant side I69.344 Monoplegia of lower limb following cerebral infarction affecting left non-dominant side I69.349 Monoplegia of lower limb following cerebral infarction affecting unspecified side I69.841 Monoplegia of lower limb following other cerebrovascular disease affecting right dominant side I69.842 Monoplegia of lower limb following other cerebrovascular disease affecting left dominant side I69.843 Monoplegia of lower limb following other cerebrovascular disease affecting right non-dominant side I69.844 Monoplegia of lower limb following other cerebrovascular disease affecting left nondominant side I69.849 Monoplegia of lower limb following other cerebrovascular disease affecting unspecified side I69.941 Monoplegia of lower limb following unspecified cerebrovascular disease affecting right dominant side I69.942 Monoplegia of lower limb following unspecified cerebrovascular disease affecting left dominant side I69.943 Monoplegia of lower limb following unspecified cerebrovascular disease affecting right non-dominant side I69.944 Monoplegia of lower limb following unspecified cerebrovascular disease affecting left non-dominant side I69.949 Monoplegia of lower limb following unspecified cerebrovascular disease affecting unspecified side Q78.0 Osteogenesis imperfecta S78.011A Complete traumatic amputation at right hip joint, initial encounter S78.011D Complete traumatic amputation at right hip joint, subsequent encounter S78.011S Complete traumatic amputation at right hip joint, sequela S78.012A Complete traumatic amputation at left hip joint, initial encounter S78.012D Complete traumatic amputation at left hip joint, subsequent encounter S78.012S Complete traumatic amputation at left hip joint, sequela S78.019A Complete traumatic amputation at unspecified hip joint, initial encounter S78.0199 (complete traumatic) is s amputation at unspecified hip joint, subsequent encounter S78.019S Complete traumatic amputation at unspecified hip joint, sequela

S78.021A Partial traumatic amputation at right hip joint, initial encounter S78.021D Partial traumatic amputation at right hip joint, subsequent encounter S78.021S Partial traumatic amputation at right hip joint, sequela S78.022A Partial traumatic amputation at left hip joint, initial encounter S78.022D Partial traumatic amputation at left hip joint, subsequent encounter S78.022S Partial traumatic amputation at left hip joint, seguela S78.029A Partial traumatic amputation at unspecified hip joint, initial encounter S78.029D Partial traumatic amputation at unspecified hip joint, subsequent encounter \$78,029\$ Partial traumatic amputation at unspecified hip joint, sequela \$78,111A Complete traumatic amputation at level between right hip and knee, initial encounter S78.111D Complete traumatic amputation at level between right hip and knee, subsequent encounter S78.111S Complete traumatic amputation at level between right hip and knee, sequela \$78.112A Complete traumatic amputation at 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thigh, level unspecified, subsequent encounter S78.929S Partial traumatic amputation of unspecified hip and thigh, level unspecified, sequela S88.011A Complete traumatic amputation at knee level, right lower leg, initial encounter \$88,011D Complete traumatic amputation at knee level, right lower leg, subsequent encounter \$88,011S Complete traumatic amputation at knee level, right lower leg, sequela \$88.012A Complete traumatic amputation at knee level, left lower leg, initial encounter \$88.012D Complete traumatic amputation at knee level, left lower leg, subsequent encounter S88.012S Complete traumatic amputation at knee level, left lower leg, sequela S88.019A Complete traumatic amputation at knee level, unspecified lower leg, initial encounter S88.019D Complete traumatic amputation at knee level, unspecified lower leg, subsequent encounter S88.019S Complete traumatic amputation at knee level, unspecified lower leg, sequela S88.021A Partial traumatic amputation at knee level, right lower leg, initial encounter ICD-10 Seating Diagnosis List Version 10.17 \$88,021D Partial traumatic amputation at knee level, right lower leg, subsequent encounter

IPM Best Practices:

Educate client and/or family regarding the pressure mapping procedure, including:

- Length of time needed to collect IPM data
- Coordination of wound dressing removal and reapplication, if needed
- Provision of effective pain management prior to pressure mapping procedure
- Positioning & re-positioning needed during the procedure
- How family can help with client transfers & positioning during the assessment, if needed
- Ensure client brings own's support surfaces and/or equipment, if it contributes to pressure issues
- Communicate with health care team if need a 2nd (or 3rd) person to assist with transfers and/or removal/reapplication of dressings
- Develop strategies to address lack of client participation, including scheduling times or having a support person available, if needed
- Ensure availability of equipment & surfaces to be assessed during IPM session/assessment





IPM Best Practices:

- Consistently place mat on the cushion or bed, per client session
- Have 2 people transfer & position clients with poor balance, low muscle tone, posterior pelvic tilt and/or an open hip angle
- Assure pressure mat is relaxed, unwrinkled and not "hammocked"
- Clothing has more of a hammocking affect than a modern IPM mat
- Protect integrity of the map
- Avoid transfer boards
- Do not swivel client while on mat
- Do not pull edges of mat while it's resting under a client
- Assure mat stays in place after transfer
- Buttocks and/or supine body fully on mat
- Ensure all support surfaces are at room temperature before IPM assessment
- Settling varies based on support surface materials
- Air-filled or elastic foam support surfaces have a short settling time (3-5 minutes)
- Viscous materials (viscous fluid or viscoelastic foam) take longer (5-7 minutes) (Davis & Call, 2013)
- Be consistent with postural supports, e.g., armrests, footrests, etc.
- Completely off-weight mat between readings



IPM Best Practices:

Positioning of the screen

- Consider having screen out of client's sight while you are taking readings
- Client may twist or adjust position to see screen & affect IPM assessment
- When Educating or for Bio-Feedback, use screen images to demonstrate points to the client or caregiver

Identify Boney Prominences

- Have the client sit upright on mat on a firmer surface (mat table or chair)
- Scan, store & describe boney prominences locations, confirming their existence with hands & noting on-screen coordinates:
- What is the client's boney architecture like?
- Is it all there?
- Flexible?
- Is there an obliquity? How rotated is the pelvis, etc.?







Metrics and Measures

Peak Pressure Indexaverage of peak and surrounding values



Leave well enough alone?

Greater Trochanter is reading ≥ 200 mmHg & has been for some time without incident Only alternative is high pressure on an alternative proven risk area, e.g., Ischial Tuberosity?

Best approach could be to leave things as they are - but monitor it over time





| | А | в | С | D | Е | F | G | н | I. | J | К | L | М | Ν | 0 | Ρ | | | | Α | в | С | D | Е | F | G | н | I | J | К | L | М | Ν | 0 | Ρ | _ | _ | 200 |
|----|-----|----|-----|-----|-----|----|-----|-----|-----|----|-------------------|-----|-----|-----|-----|----|---|-----|------|---|-----|-----|----|----|-----|-----|-----|-----|-----|-----|-----|-----------------|------------|-----|-----|---|-----|-----|
| 1 | 5.9 | 39 | 33 | 62 | 78 | 68 | 69 | 65 | 55 | 53 | 56 | 60 | 64 | 36 | 0 | 0 | | 30 | 1 | 0 | 0 | 0 | 0 | 0 | 2.4 | 11 | 15 | 24 | 20 | 14 | 9.4 | 0 | 0 | 0 | 0 | | | 300 |
| 2 | 14 | 49 | 21 | 58 | 38 | 80 | 67 | 69 | 59 | 62 | 53 <mark>.</mark> | 72 | 56 | 54 | 52 | 0 | | 27 | 0 2 | 0 | 0 | 0 | 0 | 20 | 41 | 41 | 66 | 73 | 66 | 44 | 52 | 4.7 | 0 | 0 | 0 | | | 270 |
| 3 | 26 | 51 | 101 | 65 | 68 | 67 | 75 | 69 | 86 | 60 | 62 | 75 | 49 | 46 | 67 | 11 | | | 3 | 0 | 0 | 0 | 11 | 48 | 48 | 88 | 75 | 93 | 49 | 48 | 42 | <mark>67</mark> | 24 | 0 | 0 | | | |
| 4 | 39 | 66 | 75 | 69 | 85 | 48 | 59 | 59 | 109 | 67 | 53 | 47 | 51 | 85 | 99 | 35 | | 24 | 0 4 | 0 | 0 | 9.4 | 29 | 40 | 71 | 75 | 51 | 74 | 68 | 60 | 53 | 65 | <u>59</u> | 14 | 0 | | | 240 |
| 5 | 55 | 59 | 81 | 64 | 41 | 80 | 41 | 104 | 88 | 58 | 61 | 68 | 55 | 71 | 87 | 34 | | 21 | 0 5 | 0 | 5.9 | 33 | 35 | 42 | 145 | 112 | 64 | 65 | 75 | 94 | 129 | 67 | 88 | 56 | 3.5 | | | 210 |
| 6 | 78 | 61 | 84 | 62 | 48 | 56 | 66 | 81 | 69 | 64 | 64 | 73 | 69 | 56 | 52 | 25 | | - | 6 | 0 | 24 | 54 | 46 | 75 | 109 | 119 | 106 | 81 | 135 | 93 | 145 | 112 | 101 | 133 | 25 | | | |
| 7 | 48 | 40 | 65 | 55 | 56 | 76 | 61 | 74 | 68 | 73 | 69 | 58 | 59 | 75 | 67 | 14 | | 18 | 0 7 | 0 | 45 | 126 | 82 | 93 | 75 | 61 | 119 | 139 | 111 | 82 | 91 | 74 | 92 | 111 | 27 | | | 180 |
| 8 | 16 | 16 | 60 | 54 | 34 | 49 | 73 | 59 | 67 | 40 | 62 | 62 | 60 | 46 | 51 | 31 | | 15 | 8 | 0 | 68 | 86 | 85 | 67 | 58 | 55 | 115 | 139 | 105 | 85 | 68 | 85 | 81 | 76 | 28 | | | 150 |
| 9 | 2.4 | 21 | 60 | 42 | 65 | 54 | 49 | 7.1 | 16 | 20 | 34 | 26 | 39 | 36 | 56 | 12 | | 1.5 | 9 | 0 | 38 | 64 | 81 | 72 | 66 | 61 | 82 | 88 | 88 | 67 | 48 | 55 | 6 <u>6</u> | 67 | 21 | | | |
| 10 | 0 | 0 | 18 | 7.1 | 20 | 25 | 16 | 0 | 0 | 14 | 60 | 33 | 46 | 28 | 46 | 0 | | 12 | 0 10 | 0 | 28 | 41 | 52 | 42 | 46 | 47 | 53 | 61 | 52 | 48 | 45 | 33 | 42 | 33 | 12 | | | 120 |
| 11 | 0 | 0 | 44 | 13 | 56 | 22 | 5.9 | 0 | 0 | 0 | 0 | 9.4 | 21 | 7.1 | 20 | 0 | | | 11 | 0 | 16 | 34 | 36 | 36 | 29 | 46 | 64 | 60 | 32 | 40 | 48 | 45 | 27 | 34 | 9.4 | | | 00 |
| 12 | 0 | 0 | 0 | 0 | 14 | 15 | 0 | 0 | 0 | 0 | 20 | 14 | 38 | 16 | 22 | 0 | | 90 | 12 | 0 | 8.2 | 20 | 36 | 35 | 26 | 32 | 19 | 28 | 5.9 | 20 | 22 | 36 | 46 | 42 | 3.5 | | | 90 |
| 13 | 0 | 0 | 8.2 | 8.2 | 8.2 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.7 | 0 | 0 | | 60 | 13 | 0 | 3.5 | 18 | 35 | 31 | 22 | 8.2 | 1.2 | 1.2 | 31 | 5.9 | 19 | 32 | 35 | 39 | 1.2 | | | 60 |
| 14 | 0 | 0 | 0 | 0 | 9.4 | 0 | 0 | 0 | 0 | 0 | 0 | 2.4 | 3.5 | 13 | 2.4 | 0 | | | 14 | 0 | 0 | 18 | 32 | 29 | 20 | 2.4 | 0 | 0 | 0 | 0 | 19 | 26 | 36 | 32 | 3.5 | | | |
| 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 30 | 15 | 0 | 0 | 7.1 | 32 | 31 | 24 | 11 | 0 | 0 | 0 | 0 | 21 | 27 | 33 | 34 | 1.2 | | | 30 |
| 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |] _ | 16 | 0 | 0 | 5.9 | 20 | 28 | 28 | 9.4 | 0 | 0 | 0 | 0 | 8.2 | 27 | 32 | 21 | 1.2 | | | 0 |
| | | | | | | | | | | | | | | | | | m | mHg | | | | | | | | | | | | | | | | | | r | nml | Hg |

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Data Interpretation

- Bony Prominences- greatest PI risk; palpate to confirm anatomy
- A high mmHg value suggests need for careful monitoring for areas identified at risk
- Ensure evidence of tissue damage isn't dismissed if IPM suggests there's not a problem
- Correct or accommodate asymmetric postures- look for envelopment





Data Interpretation

Avoid high gradients around bony prominences Goal is gentlest change possible



Maximize surface contact area if envelopment is goal



Data Interpretation







True or False

Pressures below 32mmHg do not cause pressure injuries?
 False. 1930 Landis study; healthy fingernail bed capillary closing pressure

2) 55 degrees of tilt is always needed to unload Ischial tuberosities (ITs)?
 False. Unloading ITs depends on person, their seating set up, their posture, etc.

3) Single peak pressures is the most important reading during IPM assessment? False.

- Research has shown single peak pressure values are not reliable and/or repeatable (Sprigle et al 2003).
- It's also important to know where pressure has gone after an intervention to reduce peak pressure has a new peak pressure appeared where client is more vulnerable to tissue damage?
- Assess distribution of pressure over entire support surface & relative comparisons thereof

4) Clothing can affect skin & skin integrity & pressure map assessments?







True.

Watch out for 'artefacts' - If they show on the image, they are possibly affecting the client & skin integrity Studs, pockets, seams Keys, combs, wallets









"Pretty Blue Pictures" but... Client has evidence of tissue damage

What is not obvious & unseen during the assessment? Review:

- Location of wound & clinical HX
- Activities away from WC

Conduct IPM assessments on other surfaces such as car seat or furniture

- Even if only have a seat sized mat, use it to pressure map client in bed or other surfaces
- Tissue problems may also be caused by microclimate issues, shear forces (arising from ADLs & reaching, propelling, or transferring)









Client Education

Visual feedback:

Effectiveness of weight shifting technique

- Proper body mechanics to:
- Achieve pelvic off-loading
- Perform proper setup

Moving body forward past wheelchair wheel to prevent contact

Performing full scapular depression for clearance

Placing a transfer board fully under thigh (visible between thighs prior to transferring)

Do not pressure map with patient lift sling between client and support surface (unless this is normal set-up)











Client Education



Swain (1997) showed that the most effective means of redistributing pressures across a cushion is by adjusting the height of foot supports



ISO Standard 16840-6

ISO 16840-6:2015 specifies apparatus, test methods, and disclosure requirements for generating aging effects in a seat cushion that reproduce those seen in use. It also provides methods of determining changes in the physical and mechanical properties of seat cushions based on their age and use







Vilbiss

Go beyond the cushion





Pressure Mapping Use in Clinical Settings

Documentation

- Cushion model, age, width x depth, thickness
- Back support model
- Wheelchair model, width x depth
- Seat to back angle
- Seat tilt
- Foot support (thigh loading- distribution of pressure)
- Posture: Note postural deformities or asymmetries
- Upper and lower extremity position as pertinent for pressure redistribution
- Risk level on a standardized scale (e.g., Braden, or Norton)
- Consistently label every reading & thoroughly describe
- Use correlative photos to confirm posture and seating set-ups
- Follow IPM manufacturer guidelines for washing mat between clients





Assist with individualized seated and bed support surface selection

Steps to achieve goal:

1. Evaluate and assess client's functional abilities, personal preferences, and lifestyle issues regarding mobility, bed and wheelchair issues

2. Perform a physical assessment to determine flexibility, range of motion and optimal postural alignment.

3. Pressure map each individual on different surfaces to assess pressure redistribution properties and positioning and provide color photos of pressure mapping outcomes for follow-up appointments and caregiver education.

4. Work closely with manufacturers, vendors, clinicians, and family members/caregivers to recommend the best seating and bed surfaces that meet the patient's specific needs for pressure redistribution





- IPM can be a useful assessment and comparative device
- Universal, evidence-based guidelines for pressure mapping don't exist. More research on & experience with pressure mapping is needed
- An IPM image should not be sole deciding factor
- Additional considerations for cushion selection include:
- Form, Fit, and Function Postural stability Functional mobility transfers Cushion weight• Heat/moisture Perceived comfort• Complexity maintenance & set-up requirements Client's ability to perform or direct, care Ability to provide client & care-giver education Number of care-givers /staff turnover
- Be consistent. Focus on relative comparisons. Respect your clinical mind



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Any Questions?

