Track 1 Breakout Session - Cost Effective Clinical Tools for Improved Diabetic Foot Outcomes (Hands-on session)

R. Gary Sibbald, MD, M.Ed, D.Sc (Hons)
FRCP (Med, Derm), FAAD, MAPWCA

Elizabeth A. Ayello, PhD, RN, ACNS-BC, CWON, MAPWCA, FAAN

Kathya Zinszer, DPM, MPH FAPWCA

Participants Will:

- Describe an evidence based 60-second screening tool for the high risk diabetic foot
- Demonstrate the use of infrared thermography in the care of persons with diabetes mellitus
- Identify areas of high pressure and shear on the diabetic foot that can lead to ulceration

Global Type 2 Diabetes Tsunami

<table>
<thead>
<tr>
<th>Year</th>
<th>Persons with Diabetes</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>365 million</td>
<td>• 4.6 million DM related deaths annually&lt;br&gt;• Spending on DM $465 million US</td>
</tr>
<tr>
<td>2030</td>
<td>552 million</td>
<td>• 50% increase&lt;br&gt;• Additional $389 million at high risk</td>
</tr>
</tbody>
</table>

75% of people with diabetes now live in low-and middle-income countries

4th leading cause of death

Diabetes Control Priorities in Developing Countries

- Highest level priority: Cost saving AND Highly feasible
- Type 2 Diabetes
  - Foot care if high risk
  - Glycemic control to HbA1c < 9%
  - Blood pressure control to BP < 160/95

Plantar Pressure Redistribution

You do not need a lot of money or resources to make a big difference
Plantar Pressure Redistribution Standards of Care - Affordable

In Canada
$150-200

In Guyana
250 patients treated for less than $7000 Canadian

A Variety of Standard Offloading Boots and shoes

Darco Forefoot & Heel Offloading Shoe & GlobalPed

Bledsoe & Pneumatic Walking Boots

Total Contact Cast: Gold Standard for Plantar Diabetic Foot Ulcers

Felted Foam: Lower risk for Plantar Diabetic Foot Ulcers with severe PDN
**Diabetic Foot – Global View**

- Every 20 seconds a lower limb is lost to diabetes somewhere in the world.
- Vast majority are preventable through patient centred interprofessional care (integrated, coordinated).
- Diabetic foot screening (high risk foot) is one of the three most cost-savings diabetes interventions – yet the most neglected (others: HbA1c, blood pressure).


**Phase 1** - Developed Center of Excellence at GPHC – Diabetic Foot Centre

- Interprofessional teams  
  - MD, Nurse, Rehab
- Develop Key opinion leaders
- 4 levels of education – multi faceted, longitudinal strategies
- Focus on Prevention
- Wound Bed Preparation Paradigm (Sibbald et al. 2011)
- In clinic preceptorships: Doppler, infra-red thermometer, footwear
- Conservative debridement

**Diabetic Foot Ulcer Admissions and Amputation Rates at Georgetown Public Hospital Corporation**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-DFC (30 months)</th>
<th>Post-DFC (22 months)</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF admissions (ward records)</td>
<td>633</td>
<td>924</td>
<td></td>
</tr>
<tr>
<td>N Amputations</td>
<td>262</td>
<td>110</td>
<td>P&lt;0.0001</td>
</tr>
<tr>
<td>Avg. Monthly Proportion DFU patient with Maj. Amp.</td>
<td>41.4%</td>
<td>11.9%</td>
<td>71% reduction</td>
</tr>
</tbody>
</table>

**Benchmark HbA1c Data**

Mean HbA1c from DFC patients 13% higher than from other facilities. High risk foot status is associated with poor glycemic control.

- Percentage with HbA1c > 9%
  - All persons with diabetes 38%
  - Diabetic Foot patients 44%

**Major Amputations at GPHC**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Before DFC</th>
<th>After DFC</th>
<th>T test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk</td>
<td>42</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Months</td>
<td>7.95</td>
<td>6.14</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>3.99</td>
<td>3.36</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>1.24</td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td>CI</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

48% reduction from pre-project levels.
68% reduction in monthly proportion of DFU despite 75% increase in DFU admissions.
48 limbs saved each year = 192 limbs to July 2012.

**Major Amputations by type at Georgetown Public Hospital Corporation**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-Intervention</th>
<th>Post Intervention</th>
<th>Test-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time in months</td>
<td>42</td>
<td>48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N Above knee amp</td>
<td>124</td>
<td>113*</td>
<td>-1.82 (t)</td>
<td>0.07</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>2.95 (2.44)</td>
<td>2.13 (1.81)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N Below knee amp</td>
<td>166</td>
<td>41*</td>
<td>-7.35 (t)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>3.95 (2.64)</td>
<td>0.77 (1.05)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Represents total with available dates. One AKA and 3 BKAs were not dated.
Why were BKAs markedly lowered but AKAs were not?

Hypothesis:
Patients requiring AKAs are more likely to have associated peripheral vascular insufficiency (ischemia) which GDFP did not address.
Test:
Compare indices of PVD in patients with AKA and BKA

The 4 S’s of DM Ulcer Prevention

Screening

Stop

Smoking

Shoes

Skin Temperature

Focus on Prevention:
60 Second Screening

Available at
www.diabeticfootscreen.com
www.WoundPedia.com
(4 out 10 negative)

After Inlow 60 sec exam

Reverse Innovation

…"innovation seen first, or likely to be used first, in the developing world before spreading to the industrialized world". Wikipedia

What innovations were applied in this project that are not currently part of integrated coordinated care in North America?

Screening – high risk status

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>User yearly incidence rate %</th>
<th>Odds ratio (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 0 (no PN, no PVD)</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>Group 1 (PN, no PVD or deformity)</td>
<td>4.5%</td>
<td>2.4 (1.5-3.9)</td>
</tr>
<tr>
<td>Group 2B (PVD)</td>
<td>13.8%</td>
<td>9.3 (5.7-16.2)</td>
</tr>
<tr>
<td>Group 3 PN/PVD (history of ulcer or amputation)</td>
<td>32.2%</td>
<td>52.7 (27.3-100.4)</td>
</tr>
</tbody>
</table>


What % persons with DM have a high risk foot?

- BLUE: 14%
- GREEN: 27%
- RED: 48%
- YELLOW: 73%
- PINK: 92%
The Guyana Diabetes and Foot Care Project: A Complex Quality Improvement Intervention to Decrease Diabetes-Related Major Lower Extremity Amputations and Improve Diabetes Care in a Lower-Middle-Income Country

Interprofessional team
- Center of excellence
- Footwear - Footcare + VIPs
- Reduced amputations 60-72%

Profile: 1266 consecutive PWD

<table>
<thead>
<tr>
<th>ITEM</th>
<th>NO %</th>
<th>YES %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous Ulcer</td>
<td>91</td>
<td>9</td>
</tr>
<tr>
<td>Previous Amp</td>
<td>96</td>
<td>4</td>
</tr>
<tr>
<td>Deformity</td>
<td>92.1</td>
<td>7.9</td>
</tr>
<tr>
<td>Absent pulses</td>
<td>56</td>
<td>44</td>
</tr>
<tr>
<td>Active DFU</td>
<td>92.3</td>
<td>7.7</td>
</tr>
<tr>
<td>Regrown Ulcer</td>
<td>91.7</td>
<td>8.3</td>
</tr>
<tr>
<td>Callus</td>
<td>77.7</td>
<td>22.3</td>
</tr>
<tr>
<td>Pressure</td>
<td>29.5</td>
<td>70.5</td>
</tr>
<tr>
<td>Neuropathy</td>
<td>46</td>
<td>54</td>
</tr>
</tbody>
</table>


The Guyana Diabetes and Foot Care Project: A Complex Quality Improvement Intervention to Decrease Diabetes-Related Major Lower Extremity Amputations and Improve Diabetes Care in a Lower-Middle-Income Country

Interprofessional team
- Center of excellence
- Footwear - Footcare + VIPs
- Reduced amputations 60-72%

Julie Lowe, R. Gary Sibbald, Neelam S. Taha, Gerald Lebovic, Carles Martíndelaho Blaj, Rohsha Kirton, Brian Ostrow, and the Guyana Diabetes and Foot Care Project Team

60 Second Screen - History

1. Previous Ulceration
2. Previous Amputation

Simplified 60 Second Screen Tool (2012)©

Physical Examination

3. Deformity OR Charcot Change

4. Pulses absent
   Dorsalis Pedis and/or Posterior Tibial

60 Second Screen - Foot Lesions

5. Active Ulcer
6. Ingrown toenail

7. Calluses = increased pressure
Validation of the 60 second screening tool

**PLoS Medicine, June 2015 (Woodbury, Sibbald et.al)**

- **Multiple raters**
  - 6 Canadians
  - 6 Guyanese KOL
- **18 subjects** with various high risk diabetic foot features examined by all 12 raters clinicians

**Statistical analysis**
- Cronbach’s alpha as a measure of internal consistency
- Set of items vs raters
- 0 to 1 (perfect agreement)
- Statistical cut off at 0.6
Validation of the Simplified 60 Second Tool

Tool for Rapid & Easy Identification of High Risk Diabetic Foot: Validation & Clinical Pilot of the Simplified 60 Second Diabetic Foot Screening Tool
M. Gail Woodbury, R. Gary Sibbald,* Brian Ostrow, Reneeka Persaud, and Julia M. Lowe
Published June 29, 2015

<table>
<thead>
<tr>
<th>Simplified 60-second screen items</th>
<th>Canadians</th>
<th>Guyanese</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous Ulcer</td>
<td>.965</td>
<td>.975</td>
<td>.942</td>
</tr>
<tr>
<td>Previous Amputation</td>
<td>.969</td>
<td>.920</td>
<td>.946</td>
</tr>
<tr>
<td>Deformity</td>
<td>.874</td>
<td>.833</td>
<td>.665</td>
</tr>
<tr>
<td>Ulceral Pusles</td>
<td>.868</td>
<td>.828</td>
<td>.665</td>
</tr>
<tr>
<td>Foot Ulcer</td>
<td>.909</td>
<td>.809</td>
<td>.759</td>
</tr>
<tr>
<td>Foot Toe</td>
<td>.798</td>
<td>.500</td>
<td>.596</td>
</tr>
<tr>
<td>Active Ulcer</td>
<td>.971</td>
<td>.823</td>
<td>.961</td>
</tr>
<tr>
<td>Callus</td>
<td>.723</td>
<td>.481</td>
<td>.636</td>
</tr>
<tr>
<td>Deficiency</td>
<td>.874</td>
<td>.882</td>
<td>.690</td>
</tr>
<tr>
<td>Pressure</td>
<td>.953</td>
<td>.245</td>
<td>.415</td>
</tr>
<tr>
<td>Sensation (60 vs 120 feet)</td>
<td>.983</td>
<td>.356</td>
<td>.971</td>
</tr>
<tr>
<td>Sensation (60 vs 120 feet)</td>
<td>.978</td>
<td>.965</td>
<td>.955</td>
</tr>
</tbody>
</table>

Why should we look for fungus?
Answer: Higher Incidence of Secondary Infections in Persons with Diabetes & Onychomycosis

Perform a 60 second screen exam with your neighbour

- How easy was the test to perform?
- Where would you suggest the test be performed/implemented?
- What type of referral network should be set up for individuals with a positive test result?

Why should we look for fungus?
Answer: Higher Incidence of Secondary Infections in Persons with Diabetes & Onychomycosis
Fungal Nail Infections (L.I.O.N.)
Evans EG, Sigurgeirsson B: Br Med J 99

<table>
<thead>
<tr>
<th>Dose and Time</th>
<th>Mycological Cure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terbinafine 250 od for 3 months</td>
<td>75.7%</td>
</tr>
<tr>
<td>Terbinafine 250 od for 4 months</td>
<td>80.8%</td>
</tr>
<tr>
<td>Itraconazole 400 od x 1 wk /mo x3</td>
<td>38.3%</td>
</tr>
<tr>
<td>Itraconazole 400 od x 1 wk /mo x3</td>
<td>69.1%</td>
</tr>
</tbody>
</table>

A evidence: Double blind random study of more than 120 patients in each group.

Pathway to the Prevention & Treatment of Toenail Onychomycosis

Detail: III
Treatment strategies

Dry Diabetic Foot: What cream should I use:

Fungus:
- X2 per day for 2 weeks
  - Cicloprox Rx – 60%
  - Azoles: 70%-80%
    - Miconazole
    - Clotrimazole
    - Econazole
    - Ketoconazole
- X1 per day for 1 week
  - Allylamines – 90%
    - Terbinafine Rx

Mycological Cure
- Terbinafine 250 od for 3 months
- Terbinafine 250 od for 4 months
- Itraconazole 400 od x 1 wk /mo x3
- Itraconazole 400 od x 1 wk /mo x3

Dry Skin: Moisturizers
- Humectants
  - Urea
  - Lactic Acid
  - Glycerin
  - Ceramides
- Lubricants
  - Silicone, dimethacone
  - Lanolin, petrolatum

When in doubt, RX
- 1% hydrocortisone powder in Clotrimazole cream
  - Twice daily (BID) and give 100 grams

Bacterial Soup
- Compress a wound with saline or water
- Do not use foot soaks or you are spreading any bacteria anywhere on the foot into the open areas (toe webs, nail folds, fissures or ulcers)

No Smoking: Double indemnity
- Every cigarette will decrease the circulation in the leg or foot up to 30% for an hour or increase sympathetic tone for 8 hours

How can you determine if shoes are too small?

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© WoundPedia
The 4 S’s of DM Ulcer Prevention

Screening  Stop Smoking  Shoes

© Sibbald & Ayello 2012

Skin Temperature

© WoundPedia

SUMMARY OF PATIENT SELF-MONITORING RCTS: INFRARED THERMOMETERS VERSUS NORMAL FOOT CARE OR STRUCTURED FOOT EXAMINATIONS

<table>
<thead>
<tr>
<th>Study</th>
<th>Baseline Followed</th>
<th>No. of Patients in Study</th>
<th>% Foot Ulcers – Infrared Thermometer</th>
<th>% Foot Ulcers – Standard Care</th>
<th>% Foot Ulcers – Foot Exam Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lavery et al. (2004)</td>
<td>6 months</td>
<td>85</td>
<td>2%</td>
<td>20% P = .01</td>
<td></td>
</tr>
<tr>
<td>Lavery et al. (2007)</td>
<td>15 months</td>
<td>173</td>
<td>6.5%</td>
<td>20.3% P = .046</td>
<td>38.4% P = .320</td>
</tr>
<tr>
<td>Armstrong et al. (2007)</td>
<td>18 months</td>
<td>225</td>
<td>4.7%</td>
<td>12.2% P = .008</td>
<td></td>
</tr>
</tbody>
</table>

Infrared Thermometry
CE-Sibbald, Multi, Armstrong
Advances Skin + Wound Care 2015

Acute Charcot & Infrared Dermal Thermometry

Temperature

- Provides an *early warning sign* with patient self-monitoring of repetitive trauma
- Acute stage may be 10-15 degrees Fahrenheit warmer than the mirror image on the other foot
- Temperature normalization may allow gradual re-ambulation with partial pressure redistribution devices


Management of the Charcot Foot:
Use the infrared thermometry to measure stages

<table>
<thead>
<tr>
<th>Stage</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - Prodromal</td>
<td>Non-weight-bearing cast</td>
</tr>
<tr>
<td>1 - Developmental, acute</td>
<td>Non-weight-bearing cast</td>
</tr>
<tr>
<td>2 - Coalescence, subacute</td>
<td>Immobilization or graduate to a removable cast walker</td>
</tr>
<tr>
<td>3 - Reconstruction, chronic</td>
<td>Patellar tendon-bearing brace (PTB)</td>
</tr>
<tr>
<td></td>
<td>Custom-made shoes with or without a brace</td>
</tr>
</tbody>
</table>

Charcot foot – Neurological Exam

- **Sensory** –
  - Semmes - Weinstein 5.07 monofilament
  - Vibratory test - Diminished
- **Autonomic** - Dry skin (R/O Tinea)
- **Motor** -
  - Reflex - ankle jerk diminished

© WoundPedia
Pillars of Charcot Treatment

1. Early recognition
2. Off-loading to reduce the deformity that will result from continued weight-bearing and
3. Management of complications

Validation of Commercially Available Infrared Thermometers for Measuring Skin Surface Temperature Associated with Deep and Surrounding Wound Infection

Asfandyar Multi MD (c)
P. Coutts RN, IIWCC
R. Gary Sibbald MD
Advances in Skin + Wound Care Jan 2015

Infrared Thermometer Screens

Device Specifications and Features

<table>
<thead>
<tr>
<th>Device</th>
<th>Measurement Range</th>
<th>Accuracy</th>
<th>Ambient temperature correction</th>
<th>Continuous Scanning</th>
<th>“Maximum” temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exergen DermaTemp 1001™</td>
<td>18 to 43°C (65 to 110°F)</td>
<td>±0.1°C (0.2°F)</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Mastercraft Digital Temperature Reader™</td>
<td>0 to 50°C (32 to 122°F)</td>
<td>±2.0°C (4.0°F)</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ATD Tools 7000 Infrared Thermometer®</td>
<td>60 to 550°C (140 to 1022°F)</td>
<td>±1.5°C (2.7°F)</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Pro Point Infrared Thermometer®</td>
<td>60 to 500°C (140 to 932°F)</td>
<td>±1.0°C (1.8°F)</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Mastercool MSC52224</td>
<td>58 to 932°C (50 to 500°F)</td>
<td>±2.0°C (4.0°F)</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Validation Commercially available low cost infrared thermometers

OBJECTIVE:
- Compare less expensive, commercially available non-contact infrared thermometers to the scientifically accepted Exergen DermaTemp 1001™.

DESIGN, SETTING, AND PARTICIPANTS:
- Observational study design
- Consenting participants with open wounds were sequentially selected from a chronic wound clinic (n=108).
- Skin temperatures were recorded using five non-contact infrared thermometers under consistent environmental conditions.

MAIN RESULTS:
- No statistical difference was reported between the “ΔT” values for the five different thermometers (F(4, 514) = 0.339, p=0.852).
- Intraclass correlation showed high reliability and agreement between raters, as the ICC values for all thermometers were >0.95.

STUDY PATIENT WOUND ETIOLOGY INFRARED THERMOMETER STUDY

Arterial Ulcer: 6%
Trauma: 11%
Pressure Ulcer: 7%
Post Surgical Wound: 8%
Venous Lymphatic Ulcers: 26%
Neuropathic Foot Ulcer: 22%
Malignancy: 3%
Infection: 4%
Inflammation: 18%
RESULTS – “Mean Temperature Gradients”

<table>
<thead>
<tr>
<th>Thermometer</th>
<th>Mean “ΔT”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exergen DermaTemp 1001(TM)</td>
<td>2.39°F (SD = 3.54)</td>
</tr>
<tr>
<td>Mastercool® MSC52224-A</td>
<td>3.45°F (SD = 4.29)</td>
</tr>
<tr>
<td>ATD Tools 79001 Infrared Thermometer</td>
<td>2.35°F (SD = 3.89)</td>
</tr>
<tr>
<td>Mastercool Digital Temperature Reader®</td>
<td>2.72°F (SD = 3.80)</td>
</tr>
<tr>
<td>ProPoint Infrared Thermometer</td>
<td>3.06°F (SD = 3.98)</td>
</tr>
</tbody>
</table>

*p = 0.987; **p = 0.985; ***p = 0.972; ****p = 0.774  

RESULTS – “Inter- Rater Reliability”

<table>
<thead>
<tr>
<th>Thermometer</th>
<th>ICC²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exergen DermaTemp 1001(TM)</td>
<td>0.967 (0.93, 0.987)</td>
</tr>
<tr>
<td>ATD Tools 79001 Infrared Thermometer</td>
<td>0.979 (0.95, 0.988)</td>
</tr>
<tr>
<td>ProPoint Infrared Thermometer</td>
<td>0.964 (0.92, 0.987)</td>
</tr>
<tr>
<td>Mastercool® MSC52224-A</td>
<td>0.965 (0.92, 0.987)</td>
</tr>
<tr>
<td>Mastercraft Digital Temperature Reader®</td>
<td>0.962 (0.89, 0.981)</td>
</tr>
</tbody>
</table>

95% CI values stated in parenthesis.

Conclusion:

Mastercool MSC52224-A
Exergen DermaTemp 1001(TM)
ATD Tools 79001 Infrared Thermometer®
ProPoint Infrared Thermometer
Mastercool Digital Temperature Reader®

less expensive, industrial grade non-contact infrared thermometers have reliable temperature readings

Asfandyar Mufti MD (c)
Pat Coutts RN, JWCC
R. Gary Sibbald MD
Advances in Skin + Wound Care Jan 2015

Wound Bed Preparation 2015

Identify & Treat the cause

Patient/Family Centered Concerns

Determine Healability for patient outcomes & local wound care

Debridement

Inflammation/Infection NERDS/STONEES

Moisture Balance

Edge Effect

Wound Bed Preparation

NERDS
Superficial Critical Colonization
Deep & Surrounding Infection

STONEES
Deep
Surrounding
Treat Systemically

PAIN AND WOUND
Superficial Critical Colonization
Deep / Surrounding Infection
Sibbald, Woo, Ayello 06
Woo, Sibbald 09

NERDS
• Non-healing
• Exudate
• Red + Bleeding
• Debris
• Smell

STONEES
• Size is bigger
• Temperature ↑
• Os (probes, exposed)
• New breakdown
• Exudate,
• Erythema, Edema
• Smell

Levine Technique

Figure 6-2 Levine Technique for Taking a Quantitative Wound Culture

Examine the wound in a 1 sq. inch area to check evidence of bacteria, pus, or debris within the wound tissue.
NERDS and STONEES
Woo & Sibbald 2009

<table>
<thead>
<tr>
<th>Critical Colonization</th>
<th>Deeper infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>N 0.42 (0.18-0.97) by history</td>
<td>S 5.00 (1.82-13.76)</td>
</tr>
<tr>
<td>E 5.36 (0.54-53.66)</td>
<td>T 8.05 (2.90-22.38)</td>
</tr>
<tr>
<td>R 5.07 (1.7-14.83)</td>
<td>O 2.76 (1.04-7.31)</td>
</tr>
<tr>
<td>D 5.63 (2.19-14.45)</td>
<td>N 5.71 (1.79-18.21)</td>
</tr>
<tr>
<td>S 3.59 (1.22-10.58)</td>
<td>E 4.88 (1.79-13.27)</td>
</tr>
<tr>
<td></td>
<td>E 4.13 (1.72-9.91)</td>
</tr>
<tr>
<td></td>
<td>S 3.59 (1.22-10.58)</td>
</tr>
</tbody>
</table>

Clinicians often need to triangulate and look for 2 or 3 of these signs and symptoms before they make a diagnosis of increased superficial bacterial burden.

**Infection vs. peri-wound skin temperature**

- **Mean**
  - 4.3°F +/− 2.44
  - 0.5°F +/− 4.89
  - 6.4°F +/− 6.93

Skin Temperatures group a & b

Fierheller Advances 2010

4 Point Technique

Whole Wound Technique
**Infrared Thermometry – Scanning Technique**

**OBJECTIVE:** Non-Contact Infrared Thermometer Comparison:
- “whole wound” continuous scanning technique vs. “head-to-toe/4 perimeter spot point” technique
  To detect the maximum wound temperature

**DESIGN, SETTING, AND PARTICIPANTS:**
- Observational study design,
- Participants with open wounds were randomly selected from a chronic wound clinic (n=100).
- Skin temperatures were recorded using four non-contact infrared thermometers under consistent environmental conditions.

**RESULTS – “Mean Temperature Gradients”**

<table>
<thead>
<tr>
<th>Thermometer</th>
<th>Mean “ΔT” Whole Wound Method</th>
<th>Mean “ΔT” 2 Point Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exergen Dermatemp 101™</td>
<td>1.91°F</td>
<td>2.03°F</td>
</tr>
<tr>
<td>Mastercool 1001™</td>
<td>2.67°F</td>
<td>2.83°F</td>
</tr>
<tr>
<td>Mastercool Digital Temperature Reader™</td>
<td>2.92°F</td>
<td>3.37°F</td>
</tr>
<tr>
<td>Dakota® ETC-8200 Temperature Heat Pen</td>
<td>2.68°F</td>
<td>2.86°F</td>
</tr>
</tbody>
</table>

**Conclusion:**
Results indicate Deep and Surrounding infection can be identified with:
- Less expensive, industrial grade non-contact infrared thermometers
- Similar results using either:
  - the 4-point method
  - whole wound method

**Infrared Thermometry should be part of my clinical practice**

- **PINK:** Strongly disagree
- **BLUE:** Somewhat disagree
- **YELLOW:** Equivocal
- **GREEN:** Somewhat agree
- **RED:** Strongly agree

**Wound Bed Preparation 2015**

- Identify & Treat the cause
- Prevent or Manage a Chronic Wound
- Debridement
- Inflammation/Infection
- Moisture Balance
- Determine Healability for patient outcomes & local wound care
- Patient/Family Centered Concerns
- Edge Effect
What is HbA1c and what does it reflect?

- Average blood sugar over 3 month period
  - Lifespan of red blood cell (RBC)
- Glycation of hemoglobin irreversible
  - Average level of glucose to which RBC exposed

Nathan DM et al. Diabetes Care 31 (8): 1473-8

Blood test which shows average blood sugar over past 3 months

<table>
<thead>
<tr>
<th>What is your A1C (%)</th>
<th>Your Average Blood Sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mmol/L</td>
</tr>
<tr>
<td></td>
<td>mg/dL</td>
</tr>
<tr>
<td>13</td>
<td>16 - 19</td>
</tr>
<tr>
<td>12</td>
<td>16 - 17</td>
</tr>
<tr>
<td>11</td>
<td>14 - 15</td>
</tr>
<tr>
<td>10</td>
<td>13 - 14</td>
</tr>
<tr>
<td>9</td>
<td>11 - 12</td>
</tr>
<tr>
<td>8</td>
<td>10 - 11</td>
</tr>
<tr>
<td>7</td>
<td>8 - 9</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

MH CCAC
CWCA 2012 - Diabetes Related Data

HbA1c blood test measures the percentage of red blood cells that have glucose attached. Normal levels for people with diabetes is <7.0%. HbA1c should be monitored regularly by physician and patient.

Client with Foot Ulcers: Has the client had HbA1c assessment in the last year
- Yes
- No

VIPS of Treat the Cause
- Vascular insufficiency
- Inflammation and / or infection
- Pressure downloading
- Sharp Surgical debridement

Diagnostic tests

VASCULAR SUPPLY AND HEALING ABILITY
- Palpable pulse >80 mm Hg
- Ankle-brachial pressure index (ABPI) >0.5 and <1.3
- Transcutaneous O₂ tension >30 mm Hg
- Toe pressure >55 mm Hg
- Audible hand held Doppler Trifasic, Biphasic Sound
Accuracy audible hand held Doppler ultrasound (AHHD) to identify PVD
- 200 patients, 379 legs
- All had ABPI, toe pressures at certified vascular lab (Gold Standard)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Meaning</th>
<th>Abnormality (AHHD)</th>
<th>Normal AHHD on PVD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specificity</td>
<td>No PVD</td>
<td>98.6% / 97.8%</td>
<td>98.6% / 97.8%</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>PVD identified</td>
<td>37.9% / 26.1%</td>
<td>37.5% / 30.19%</td>
</tr>
<tr>
<td>+ Pre.Value (PPV)</td>
<td>Abnormal AHHD on PVD</td>
<td>81.2% / 72.75%</td>
<td>81.2% / 72.75%</td>
</tr>
<tr>
<td>- Pre. Value (NPV)</td>
<td>Normal AHHD on PVD</td>
<td>90.91% / 88.10%</td>
<td>90.91% / 88.10%</td>
</tr>
</tbody>
</table>

Conclusion: AHHD reliable, simple, rapid, inexpensive bedside exclusion test for PVD in Diabetic/ non-diabetic subjects

Plantar Pressure Redistribution

Group A: Walking casts
- Pneumatic walker
- Contact cast

Group B: Special Shoes
- Med.-Surg. Shoe
- Rocker soles
- Special half shoes

Group C: Home Made
- Simple materials/ modifications

Option D: With Caution
- Surgical pressure offloading

The gold standard of plantar pressure redistribution is:
- GREEN: Removable Cast Walker
- BLUE: Orthopedic plaster of Paris cast
- YELLOW: Irremovable cast walker
- PINK: Contact cast
- RED: Deep toed shoes and custom orthotics

Results: RCW vs. ITCC

<table>
<thead>
<tr>
<th>Downloading</th>
<th>% healed</th>
<th>Time (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCW</td>
<td>51.9</td>
<td>58.0 +/- 15.2</td>
</tr>
<tr>
<td>ITCC</td>
<td>82.6</td>
<td>41.6 +/- 18.7</td>
</tr>
</tbody>
</table>

Examples- Demonstrations of Foot Wear
Give your approach to treating this foot:

Participants Have:

- Described an evidence based 60-second screening tool for the high risk diabetic foot
- Demonstrated the use of infrared thermography in the care of persons with diabetes mellitus
- Identified areas of high pressure and shear on the diabetic foot that can lead to ulceration