Technology in Medicine
#Podiatric

Technology in Medicine

@APMA
#YPI2017
Technology in medicine

- The past, the present, and the future
- Impact on day-to-day practice
- Podiatric Medicine & Technology
- Have we become too dependent?
The Ether Dome

First public surgery using anesthetic (ether), in 1846.
http://www.massgeneral.org
The “smart operating room”

Sacred Heart Hospital, Eau Claire, Wisconsin
https://mcdmag.com
The past

Amputation in the 18th century by Christopher Fisher
@DrLindseyFitz
The Past (late 20th century)

- Paper Charts
- Handwritten orders and instructions
- Pagers (and oversized cell phones!)
- Unencrypted lists and messages containing protected health information (PHI)
The Present

- Electronic medical records (EMR)
- Secure (HIPAA-compliant) text and video messages between providers
- Video and telephone appointments
- Direct messages from patients
- Data mining
Technology in medicine

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Electronic Medical Record (EMR)

- All patient records in one place
- Easy access for multiple providers
- Integrated surgical and clinic schedules
- e-consult (instant referral system)
- e-prescriptions
Snap Shot
e-consult
e-consult
e-prescribe
e-prescribe
Remote, remote access
Mobile EMR
Mobile EMR
Mobile EMR
Secure communications

- **Cortext (Imprivata)**
  - Pager replacement
  - Direct messaging between physicians and other healthcare providers
  - HIPAA compliant
  - Works with smartphones, tablets, and desktops
  - Know when a message is read, and who is available
  - Decrease distraction and focus care
Secure communications
Secure communications
Secure communications

What do you think of this wound?

Is the plate exposed??
Secure communications
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Diabetic foot ulcer

• Up to **25%** of people with diabetes will develop a foot ulcer at some point during their lifetime³

• **Half** will become infected and require hospitalization⁴

• **One in five** will go on to amputation⁴

• People with a history of a diabetic foot ulcer have a **40%** greater ten-year mortality rate than diabetic patients without a foot ulcer⁵

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Amputation

• Of the people who undergo a major amputation, **20-50%** will have the contralateral limb amputated in 1-3 years

• Greater than **50%** will require an amputation in 5 years

Amputation

- Mortality rates following an amputation\textsuperscript{3}
  - 13\% to 40\% at 1 year
  - 35\% to 65\% at 3 years
  - 39\% to 80\% at 5 years

- This is \textit{worse} than for most malignancies\textsuperscript{7,8}

Relative 5 Year Mortality

Prostate CA: 8%
Breast CA: 18%
Hodgkin's: 18%
Neuropathic Ulcer: 45%
Colon Cancer: 48%
Amputation: 63%
PAD: 64%
Lung CA: 86%

Pancreatic CA:
Aulivola, et al, Arch Surg, 2004
American Cancer Society, 2000
Moulik, et al, Diabetes Care, 2003
Office Natl. Statistics, UK, 2006
Singh, Armstrong, Lipsky, JAMA, 2006
Cost of Diabetic Foot Compared with 5 Most Costly Cancers

Wound Healing = Remission

Armstrong & Mills, JAPMA 2013
Recurrence

• Between 30-40% of patients develop at least one new foot ulcer in the first year after healing\textsuperscript{10-15}
• By year 3, about 60% of patients have reulcerated
• Re-ulceration decreases the farther you are from closure date
• Goal is to shift as many patients as possible to the right, past one year

![Graph showing percentage ulcer free over months after previous ulcer healing]
Remission: Now What?
Infrared Dermal Thermometry for the High-risk Diabetic Foot (1997)

- 143 consecutive patients
  - Neuropathy without acute pathology (78)
  - Charcot arthropathy (21)
  - Active DFU (44)

- Skin temperatures from 6 corresponding sites on the plantar aspect of both feet

- Differences in skin temperature between corresponding sites on contralateral limbs were noted in the Charcot and active DFU groups; no difference was noted in the asymptomatic sensory neuropathy group

- Temperature asymmetry may be useful for identifying patients at risk for developing DFU

Infrared Dermal Thermometry for the High-risk Diabetic Foot (1997)

Conclusion
These data suggest that infrared dermal thermography may provide valuable information to the clinician to assist in the detection, treatment, and prevention of neuropathic lower-extremity sequelae. Because dermal thermometry is simple, noninvasive, and relatively inexpensive, in the future patients at risk for ulceration may be able to use a temperature probe on a daily basis at home to detect sites of inflammation in the same manner that home glucometers are used to monitor glucose levels. Patients with diabetes may be able to learn to adjust their activity just as they do their insulin. In addition, skin temperature measurements may be used to monitor the effectiveness of footwear or other prosthetic devices designed to decrease high-pressure areas as well as to monitor the progress of therapy for ulcers and Charcot’s arthropathy.
Skin Temperature Monitoring Reduces the Risk for Diabetic Foot Ulceration in High-risk Patients (2007)

- 225 high-risk patients followed for 18 months (RCT)
  - Standard therapy
  - Dermal thermometry
- Both groups received therapeutic footwear, diabetic foot education, regular foot care, and performed daily foot inspection
  - Dermal Thermometry Group subjects used an infrared skin thermometer to measure temperatures on six corresponding sites, on each foot, twice daily
  - Temperature differences > 4°F between corresponding sites on the contralateral foot triggered patients to contact the study nurse, reduce activity until temperatures normalized
Skin Temperature Monitoring Reduces the Risk for Diabetic Foot Ulceration in High-risk Patients (2007)

- 8.4% (19) ulcerated over the 18-month follow-up period
  - Standard Therapy Group: 12.2% (14)
  - Dermal Thermometry Group: 4.7% (5)
- Subjects were one third as likely to ulcerate in the dermal thermometry group compared with standard therapy group

Challenges of Home Monitoring
Podimetrics Remote Temperature Monitoring System™
Podimetrics Remote Temperature Monitoring System™

• Automated, easy-to-use, telemedicine monitoring solution designed to address the shortcomings of existing thermometric devices

• Intended to be used to help identify patients with persistent foot inflammation who may benefit from early, non-invasive offloading therapies

• The system consists of a floor mat, an analytics cloud, and a clinical decision support web application
Podimetrics Remote Temperature Monitoring System™
Podimetrics Remote Temperature Monitoring System™

- Podimetrics Mat™ is a daily-use, wireless, in-home, FDA-cleared medical device with an array of thermometric sensors under a water-resistant cover.
- It is designed to be used directly out-of-the-box without configuration or setup by the patient.
- The device remains in standby until the patient is ready to use it, which is accomplished by stepping on the Mat™ and remaining stationary for approximately 20 seconds.
- During this time, the Mat™ records a high-resolution thermometric scan, or thermogram, of the patient's feet.
In-Home Assessment of a Smart Foot Mat for the Prevention of Diabetic Foot Ulcers (Frykberg, et al.)

• 129 high risk patient across 7 sites

• Inclusion criteria
  • History of plantar DFU, and no current or active plantar foot pathology (i.e. Charcot)
  • Enrollees were provided a Podimetrics Mat™ and instructed to use it daily for 34 consecutive weeks
  • 53 plantar DFU occurred in 37 patients over the course of 34 weeks
  • Distribution of temperature asymmetry was found to strongly differentiate the scans of those who developed DFU from those who did not
In-Home Assessment of a Smart Foot Mat for the Prevention of Diabetic Foot Ulcers (Frykberg, et al.)

Subject A did not reulcerate

Subject B formed ulcer 4 weeks later
In-Home Assessment of a Smart Foot Mat for the Prevention of Diabetic Foot Ulcers (Frykberg, et al.)

- **A**: 3 months after healing
- **B**: One month prior to reulceration
- **C**: Following 5 weeks treatment
Evaluation of a Remote Temperature Monitoring System for the Prevention of Diabetic Foot Ulcers

- IRB Number: MA-16-134
- Principal Investigator: Adam L. Isaac, DPM
  - Sub-investigator: Amey Kulkarni, MD
  - Co-investigator: Jonathan Bloom, MD
  - Co-investigator/Project Manager: Natalie Reid, MPH, MBA
- Primary outcome of interest:
  - To evaluate the use of Podimetrics Remote Temperature Monitoring System to reduce the occurrence and recurrence of diabetic foot ulcers and reduce total health care utilization for diabetic patients with a foot ulcer that have healed in the past two years
Evaluation of a Remote Temperature Monitoring System for the Prevention of Diabetic Foot Ulcers

• Secondary outcome of interest:
  • To observe ulcer-free survival over one year

• Other outcomes of interest:
  • Total ulcer days (number of days a participant has an open ulcer or wound under treatment)
  • Ulcer Grade based on the University of Texas Wound Classification System
  • Total health care utilization, including hospitalizations, emergency department visits, in-person or office visits
  • Number of amputations
  • Number of telephone encounters
  • Number of secure messages
Evaluation of a Remote Temperature Monitoring System for the Prevention of Diabetic Foot Ulcers

Inclusion criteria

- Male or female ≥ 18 years of age with a diagnosis of diabetes (Type I or II)
- History of healed plantar Diabetic Foot Ulcer(s) or healed amputation(s) within the last 24 months
- Ability to provide informed consent
- Adequate lower extremity blood supply
Evaluation of a Remote Temperature Monitoring System for the Prevention of Diabetic Foot Ulcers

Exclusion criteria

- Patients with ulcers or open lesions
- Active Charcot
- Active foot infection or gangrene
- Any mental health disorder, psychiatric disorder, or alcohol or drug abuse history such that, in the opinion of the investigator, the patient is unreliable as a study participant
Evaluation of a Remote Temperature Monitoring System for the Prevention of Diabetic Foot Ulcers

Exclusion criteria (Cont.)

- History of amputation more proximal than a transmetatarsal amputation in either foot.
- Inability to ambulate without the assistance of a wheelchair, walker, or crutches
- Any travel plans expected to result in an interruption of Podimetrics Mat™ use for greater than two consecutive weeks [Note: OK for participant to take device with them and use during travel]
- Unable to return to Physician Investigator for study visits and study related foot care for the duration of the study
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References

Thank you for your attention!

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