

[CD1] A monitoring solution for patients to prevent re- ulceration on their feet

By Nur Faezah Sani (Snr Podiatrist, TTSH)

Problem Statement:

A device for diabetic patients to monitor their foot health daily



Description of the problem

- One of the foot complications often experienced by people with diabetes is loss of protective sensation (LOPS). The loss of an alarm mechanism on the feet increases a person's risk of undetected injury.
- Once a foot ulcer occurs, there is increased risk of infection and amputation
- Diabetic foot ulcers require regular follow-up with the podiatrist for wound management and specialized offloading devices to aid wound healing
- However, once healing occurs, patients often stop wearing the offloading devices which, in turn, increases the risk of the ulcer recurring
- The risk of foot ulcer recurrence is high
 - 40% of patients with a healed ulcer experienced a recurrence of the ulcer within a year and this increased to 60% and 65% in 3 years and 5 years respectively (Armstrong, Boulton, & Bus, 2017).
 - Based on our own records, 36.2% of wounds treated in TTSH Podiatry department from September 2017 to January 2019 were recurrent wounds.

Confidential

Problem Statement:

A device for diabetic patients to monitor their foot health daily



Pain points

1. Poor compliance to appropriate footwear with offloading devices due to humid weather, cultural practices and inability to resonate with self-image
2. Poor compliance with daily checking of feet for wounds and areas prone to ulceration due to poor eyesight (a possible diabetic complication) and perception of “no pain, no problem” in patients with LOPS
3. Foot ulcers take a long time to heal, ranging from months to years
4. Cost of treatment is high (consultation charges for appointments, wound dressings, offloading devices, transport cost, time off work)
5. Quality of life is affected (reduce mobility, unable to shower properly)
6. Risk of infection and amputation

Confidential

Problem Statement:

A device for diabetic patients to monitor their foot health daily



Scale of problem / Impact of solution

1. Only about 34% of people with diabetes check their feet daily (Gondal, Bano, Moin, Masood, & Ahmad, 2011)
2. The lifetime incidence rate of foot ulceration for diabetic patients is 19-34%. People with diabetic foot ulcers have been observed to have 2.5 times risk of death in 5 years when compared to those without (Armstrong, Boulton, & Bus, 2017).
3. 85% of lower limb amputations were reported to be preceded by foot ulcers (Tan & Ronald, 2016).
4. One of the factors highlighted to be a major risk factor for lower limb amputation is late presentations of foot lesions in healthcare facilities (Tan & Ronald, 2016).

What we need

- A device that can assist people with diabetes to monitor their feet to prevent onset of ulceration or re-ulceration

Confidential

References

- Gondal, M., Bano, U., Moin, S., Masood, R., & Ahmad, A. (2011). Evaluation of knowledge and practices of foot care in patients with chronic type 2 diabetes mellitus. *Journal of Postgraduate Medical Institute (Peshawar-Pakistan)*, 21(2).
- Armstrong, D., Boulton, A., & Bus, S. (2017). Diabetic foot ulcers and their recurrence. *The New England Journal of Medicine*, 2367-2375.
- Tan, T., & Ronald, M. (2016). SINGAPORE: ONE OF WORLD'S HIGHEST FOR DIABETES-RELATED LEG AMPUTATIONS. Singapore: National Healthcare Group

[CD2] Making digital home monitoring of eye conditions easy for all

By Dr Elton Tay
Consultant, WHC

Description of problem

1. There is a large population of patients who require life-long eye monitoring, who may not need to see doctors physically in hospitals (diabetic, mild age related macular degeneration, early glaucoma, early cataracts).
2. There are group of patients who have ocular conditions that are asymptomatic, and will not pick these up unless they get screened.
3. There are now work processes for patients to undergo ocular imaging (e.g. diabetic eye screening), without the need for them to see doctors physically. However, these patients still need to go to a physical institution for an operator to take these images.
4. The large volume of these patients create a strain on hospital and polyclinic resources, as there are no means for patients to take images of the own retina at home, and digitally send these images to the image readers in the hospitals.
5. Currently retina images without pupillary dilation need to be taken with expensive non-mydratic cameras by trained operators
6. Newer smart phone retinal imaging tools have started to become commercialised. But these requires pupil dilation which should not be done by non-medical professionals.

Problem statement / Title

Making digital home monitoring of eye conditions easy for all

Pain points

1. Large volume of less complex eye patients that need lifelong monitoring (diabetics, glaucoma, age related macular degeneration, cataracts)
2. No affordable or easy to use home based solution to take retinal images by self, or family member to monitor mild eye conditions or to do self screening.
3. Available cameras that can take retinal images from undilated eyes are large, expensive and need trained operator
4. Smart phone based retinal cameras require pupil dilation which is unsafe to do without prior medical assessment
5. There is no home based/ smart phone based, easy to use, and affordable retina camera that do not require pupil dilation, to reduce the volume of low complexity eye patients coming to hospitals or polyclinics.

Scale of problem / Impact of solution

1. In the world, there were 425 million patients with diabetes mellitus in 2017.
2. It is estimated that in 2020, there will be 197 million patients with age related macular degeneration in the world.
3. In Singapore, it is projected that we will have 1 million diabetic patients in Singapore by 2050. (Saw Swee Hock School of Public Health)
4. In Singapore, 3% of people over 50yrs of age have glaucoma. This rises to 10% for those over 70 yrs of age (Singapore National Eye Centre).

What you need from external partners

Company that can develop and engineer a home-based, self-capture or easy to use imaging solution to capture retina images without pupillary dilation.

[CD3] Footwear for diabetic patients or patients with foot conditions/complications

By Ms. Tiffany Chew
Sr Podiatrist, TTSH

Description of problem

1. There is no company delivering this service to provide customised footwear for patients with diabetes in Singapore
2. People with diabetes have difficulties in finding shoes that fit as they often develop foot deformities due to diabetic complications. Also, they would have abnormal peak pressure areas on their feet which necessitates the use of custom-made insoles. As such, the shoes that they require have to accommodate their foot deformities safely while being supportive and deep enough for the fitting of insoles within the shoes.



3. Healthcare professionals, especially podiatrists and orthotists, face the challenge of fitting and prescribing footwear to this group of patients

4. International guidelines have recommended prescription of specialist footwear in patients with foot deformity, intermediate or high risk. Foot deformities were found in 54.3% of people with diabetes .

Pain points

1. There is no local company or factory which is able to produce bespoke footwear for patients with diabetes or people with feet deformities. Bespoke footwear is too costly and have to be made overseas. In Tan Tock Seng Hospital, the prosthetics & orthotics department outsourced this service from a company in Holland; SGD 900-SGD1200. To make a pair of custom-made shoes, it may take 2-3 months.
2. An intervention average cost from a UK health economic paper estimated a cost of about £525 for bespoke orthotic footwear, inserts and education on their use.

Scale of problem / Impact of solution

1. The prevalence of diabetes in Singapore is 11.3%; an estimated figure of 637094 people with diabetes; 10% will develop wounds in their lifetime, an estimated figure of 63709.
2. Base-case cost-utility results have suggested that providing bespoke footwear to high-risk patients is cost saving. The intervention is cost effective when provided to moderate- and high-risk patients as additional QALYs are generated at additional cost, leading to an ICER of approximately £14,000 per QALY.
There is an impetus for custom-made footwear, in fact, an increasingly urgent one as the number of people with diabetes increases globally.

What you need from external partners

A novel solution to provide safe bespoke footwear of good supportive and accommodative properties for moderate and high risk patients with diabetes.

[CD4] Specialist footwear that is
functional and aesthetically
pleasing

By Melissa Phua
Principal Podiatrist, TTSH

Description of problem

- More than 8000 patients/ year are seen at TTSH Podiatry for a variety of foot conditions, like:
 - Diabetic ulcers, sports injuries, overloading issues etc
- These patients often require some form of specialised footwear with more internal volume to accommodate foot orthoses and offloading 'total contact insoles' in them.
- However, current models are chunky, non-aesthetic and costly which may affect patients' compliance to purchasing/wearing them:
 - This can delay patients' recovery
 - Increase costs for Hospital, caregivers, patients etc

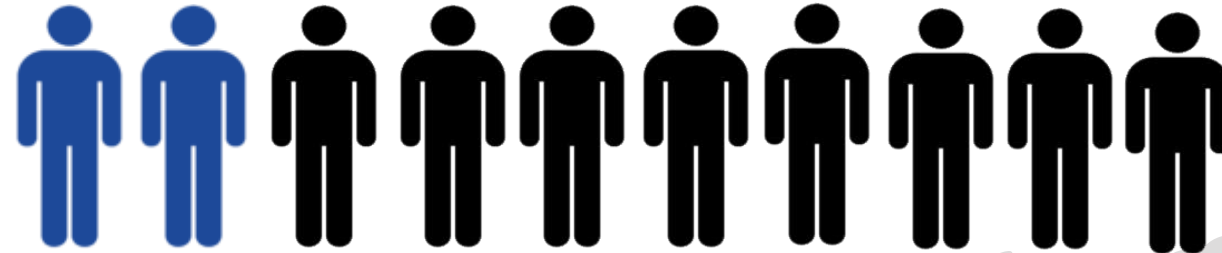
Pain point

1. Currently, there is only 1 supplier for a shoe and a sandal that is suitable and relatively more cost-effective.
2. Design of shoe is not aesthetically pleasing
 - More masculine-looking
 - Female patients may be reluctant to wear → reduction in compliance to wearing of footwear → impact recovery and healing.

Problem statement / Title

Specialist footwear that is functional and aesthetically pleasing

Scale of problem / Impact of solution

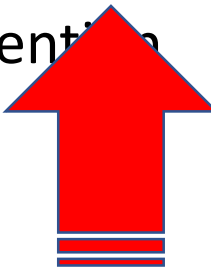


More admissions and visits
Dressing costs
Affects working abilities and daily life
Health and mental wellbeing

Confidential



Cost of:
Hospitalisation
Treatment
Screening/Prevention
Time
Manpower



[CD5] Diabetic Foot Screening, Stratification and Predictive Analysis

Dr Donna Tan

Assistant Director, Clinical Services
National Healthcare Group Polyclinics

20 Aug 2019

An integrative, risk-stratified and predictive prototype for large scale Diabetic Foot Screening to prevent Lower Limb Amputations

Integrative

Large-scale

Save limbs



Screen

**Risk
Stratify**

Predictive

In Primary Care

An integrative, risk-stratified and predictive prototype for large scale Diabetic Foot Screening to prevent Lower Limb Amputations

Description of problem

1. All patients with DM

- risk factors
- foot problems, wounds & LEA
- done manually



DFS



At least
Annual



Nurse & Podiatry
assistants

2. National Health Survey 2010, ~12% of population have DM

- increasing needs over next 5-10 years as Global and Sg population ages



Confidential

An integrative, risk-stratified and predictive prototype for large scale Diabetic Foot Screening to prevent Lower Limb Amputations

Description of problem

1. All patients with DM

- risk factors
- foot problems, wounds & LEA
- done manually



DFS



At least Annual



Nurse & Podiatry assistants

2. National Health Survey 2010, ~12% of population have DM

- increasing needs over next 5-10 years as Global and Sg population ages

3. LEA and foot ulcers associated with



Mobility loss



Poor QOL



Decreased productivity

**4 amputations
a day**

In Singapore

11.3% - 50.2%

1-year mortality

An integrative, risk-stratified and predictive prototype for large scale Diabetic Foot Screening to prevent Lower Limb Amputations

Description of problem

1. All patients with DM

- risk factors
- foot problems, wounds & LEA
- done manually



DFS



At least
Annual



Nurse & Podiatry
assistants

2. National Health Survey 2010, ~12% of population have DM

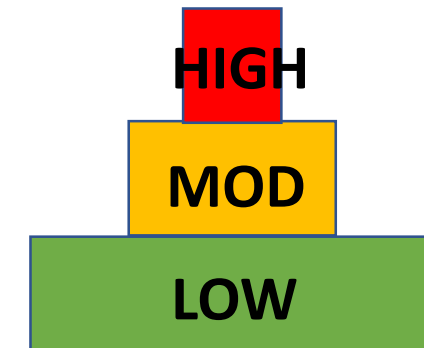
- increasing needs over next 5-10 years as Global and Sg population ages

3. LEA and foot ulcers associated with

4. At DFS, Risk Stratification identifies higher risk foot


- prevention and early treatment of foot problems prevent LEA

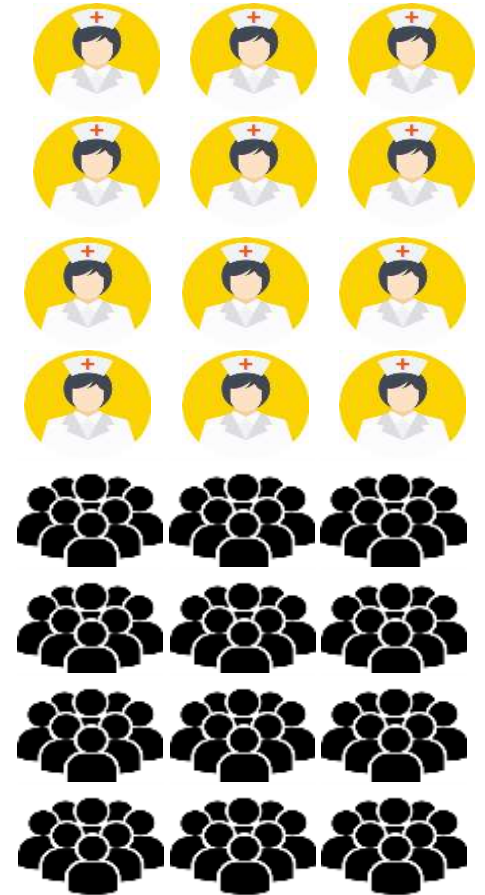
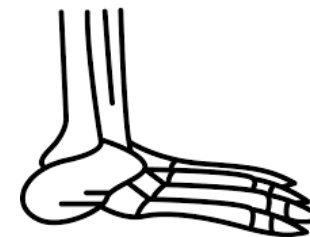
5. Currently, standard DFS does not collate foot data.



An integrative, risk-stratified and predictive prototype for large scale Diabetic Foot Screening to prevent Lower Limb Amputations

Pain points


1. Multiple service stations
2. Perceived Value: Additional trip or additional stop for their “normal” feet?

3. Nurses manually screen every patient
 - Training, time and manpower set aside
 - increasing need for DFS and at-risk foot.
4. Patients with additional risks at initial DFS, require additional time, manpower & visit for toe pressure check
5. Foot deformity and biomechanical issues not currently captured in standard DFS.
6. Limited clinician time and manpower resource



An integrative, risk-stratified and predictive prototype for large scale Diabetic Foot Screening to prevent Lower Limb Amputations

Scale of problem / Impact of solution

1. Between 1-10% in global population

 Target 100% of patients with DM
High risk patients are identified

2. Impact care for patient with DM

- drs, nurses, podiatrists, assistants



3. Savings



- clinician time & manpower
- cost to the healthcare system of preventable LEA.

>95 000
DM patients
In NHG DM Registry*

>70% DFS
In NHGP



An integrative, risk-stratified and predictive prototype for large scale Diabetic Foot Screening to prevent Lower Limb Amputations

What you need from external partners

Company that can develop and evaluate a prototype

Develop

Test

Evaluate

Screen

Risk Stratify

Predictive



Integrative

Cost-effective

Scalable

