

Institution: Cardiff Metropolitan University		
Unit of Assessment: UOA03: Allied Health Professions, Dentistry, Nursing and Pharmacy		
Title of case study: Saving lives and limbs: Mauritius' first systematic Peripheral Arterial Disease screening programme for people with Diabetes.		
Period when the underpinning research was undertaken: September 2014 – December 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): Dr Jane Lewis	Role(s) (e.g. job title): Senior Lecturer in Podiatry	Period(s) employed by submitting HEI: Sept 2014 - present
Period when the claimed impact occurred: November 2014 – December 2020		
Is this case study continued from a case study submitted in 2014? No		
1. Summary of the impact (indicative maximum 100 words) Mauritius has the world's 2 nd highest Diabetes fatality rate. Lewis's expertise in the early identification of Peripheral Arterial Disease (PAD) and experience establishing UK screening led to her appointment to establish Diabetic foot screening within a Mauritian national screening programme. As a result, 78 Nurses covering 149 centres have been trained, conducting 239,888 screenings between 2016 and 2019. Actions taken as a direct result of these PAD screenings will save at least 2,144 lives by 2029 and the success of the Mauritius screenings has led to requests for a similar programme from the government of Trinidad .		
2. Underpinning research (indicative maximum 500 words) Background As an experienced clinician by 2002, Lewis had concerns over the lack of systematic early intervention programmes for Peripheral Arterial Disease (PAD). These concerns led to her embarking on a PhD at Cardiff University under the supervision of Prof. David Owens, then Director of the Diabetes Research Network for Wales, Consultant Diabetologist and Clinical Lead for Diabetes at Cardiff & Vale University Health Board. Her novel PhD research showed that Pulse Volume Waveform (PVW) profiles were more effective in identifying PAD than the standard method for measuring peripheral lower limb blood flow – known as 'manual ankle-brachial pressure' (ABI). ABI has known limitations in detecting lower limb arterial diseases, partly because Diabetes can cause arterial stiffening. As a direct result of Lewis' PhD findings, Huntleigh Diagnostics developed a PVW capability for their 'Dopplex Ability' Automatic Ankle Brachial Index System machine, which was launched in (2010) ¹ . Research at Cardiff Metropolitan University On joining Cardiff Met, Lewis continued her research into developing efficient, low cost and accurate PAD screening, the findings of which underpinned the Diabetic foot screening programme in Mauritius. For example, it involved validating PVW's accuracy, testing efficiency concepts in foot screening to save time and money and developing further insights into the connections between rapid expert assessment of lower-limb ulcer episodes and healing.		

¹ This device has since been sold in 66 countries, generating £8,675,000. A letter from Huntleigh is available to confirm Lewis' influence on its design development but is not included in this submission because both Lewis' PhD and the Dopplex launch predate her employment with Cardiff Metropolitan University. Details included here for contextual information only.

As part of this programme of research, between 2014 and 2017, Lewis established the accuracy of the low cost, easy-to-use PVW method, testing it on **189** patients against the datum of the current 'gold standard' test - an expensive, non-portable ultrasound duplex scanner operated by a highly trained Medical Physicist. The Dopplex Ability in PVW mode gave **97%** similar results [R1]. A further study of **326** patients examined the feasibility of reducing costs and improving screening through increased efficiency by conducting Diabetes foot screening as part of an existing national Diabetes Retinopathy Screening programme. This study used the Dopplex Ability's now clinically proven PVW function to automate PAD measurement. A non-technical healthcare worker conducted 3-5-minute tests during an existing 20-minute pupil dilation break in the screening required for retinal photographs to be taken. Previously undiagnosed PAD was found in **26.4%** of patients. Following the trial **100** patients were contacted at random and asked about the experience. **All** supported the approach becoming standard practice [R2]. Lewis was also part of a team behind the National Diabetes Foot Care Audit (NDFCA) that collected details of over 33,000 ulcer episodes in over 27,000 people in England and Wales between 2015 and 2018. The team confirmed the critical need for early diagnosis, and found ulcers referred for assessment within 14 days were significantly less severe and likely to heal within 12 weeks [R3].

Why Mauritius?

The use of Lewis's research expertise in Mauritius came via her PhD supervisor, Prof. Owens. In 2006 Owens was invited to advise the country on how to develop a proactive scheme to deal with Mauritius's Diabetes problem through retinopathy screening. Owens eventually realised that a wider-ranging programme was needed, so in 2013-14 he formed a foot screening team of seven. Lewis's PAD expertise led to her appointment as head of the PAD screening development programme [E1] and the impacts described here. It also contributed to a UK Royal College of Physicians Excellence in Patient Care International Award in 2018 [E2].

3. References to the research (indicative maximum of six references)

The underpinning research comprises five international peer-reviewed journal outputs. As an indicator of the quality of the outputs, the prestigious *SAGE Open Medicine* [R1, R2] is ranked in the top 40 to 50 (from approximately 30,000) international journals world-wide in the field of Health & Medical Sciences; *The Diabetic Foot Journal* [R3] is the only peer-reviewed publication journal for healthcare professionals involved in the care of the diabetic foot; *The European Wound Management Association Journal* [R4] was established to promote interdisciplinary and high-quality research in this area; and the *British Journal of General Practice* [R5] is one of the leading journals in primary care research world-wide, ranked 4th in the subject area of Primary Health Care.

[R1] **Lewis, JEA**, Williams, P, Davies, J.H. Non-invasive assessment of peripheral arterial disease: Automated ankle brachial index measurement and pulse volume analysis compared to duplex scan (2016). *SAGE Open Medicine*, July 12, 2016 10.1177/2050312116659088.

[R2] **Lewis, J.E.**, Morris, K., Powell, T., Thomas, R.L. and Owens, D.R. (2020) 'Combining Diabetic foot and retinopathy screening: A step in the right direction?—a feasibility study', *SAGE Open Medicine*, 8, p.2050312120946244.

[R3] Jeffcoate, W., Gooday, C., Harrington, A., **Lewis, J**, Cawley, S. and Young, R. (2020) The National Diabetes Foot Care Audit of England and Wales: achievements and challenges. *The Diabetic Foot Journal* 23(1): 70–3

[R4] Davies, J.H., **Lewis, J.E.A.** and Williams, E.M. (2014) 'The utility of pulse volume waveforms in the identification of lower limb arterial insufficiency', *EWMA Journal*, 14 (2), pp. 21-25.

[R5] Davies, J.H., Richards, J., Conway, K., Kenkre, J.E., **Lewis, J.E.** and Williams, E.M. (2017) 'Primary care screening for peripheral arterial disease: a cross-sectional observational study', *British Journal of General Practice*, 67(655), pp.e103-e110. DOI: 10.3399/bjgp17X689137.

4. Details of the impact (indicative maximum 750 words)

"Over the last five years, a huge leap has been made in terms of structuring the diabetic foot care clinics across Mauritius" - Head of Diabetic and Vascular Health Centre, Mauritius [E4].

Mauritius, a low to middle income country, is [world number 2 for Diabetes-related deaths](#)². The nation's intake of both sugar and alcohol is high, which goes some way to explaining why, according to the World Health Rankings, **26%** of all deaths in Mauritius are linked to Diabetes Mellitus. In part this is because, prior to 2014, Mauritius had no proactive, structured Diabetes screening programme.

Low levels of intensive care services further heightened the need for a structured and formal screening programme to reduce the burden on existing services: The UN's Department of Economic and Social Affairs Population Division [estimates Mauritius' population at 1,271,767](#), yet at the time of writing, there is only **one** Podiatrist, **one** Vascular Surgeon and **one** Orthotist to serve the entire island. Lowering the number of patients needing the services of these professions is therefore a critical step to improving survival rates from Diabetes Mellitus.

Lewis established Mauritius's first systematic Diabetic foot screening programme in 2014 [E3]. In doing so she drew on her experience of developing screening in the UK. For example, she is part of a comprehensive partnership including Welsh Government and Public Health Wales to pilot 'One Stop Shop' diabetes screening programme for the 196,000 people with Diabetes registered in Wales – an evolution of her feasibility study into combining PAD and retinopathy screening [R2].

In Mauritius, Lewis trained **18** nurses as fully qualified Diabetic Footcare Officers (DFCOs), dealing in ulcer management, foot screening and the use of PVW to test for PAD - one of the key signs of advancing Diabetes. These 18 DFCOs consequently established foot screening clinics in **all 6** of Mauritius's hospitals, training a further **60** Diabetes Specialist Nurses to serve **149** centres throughout Mauritius in the foot care of Diabetic patients [E4]. Further, all new trainee doctors and nurses also received intensive training by the DFCOs. This relationship between the DFCOs and medics has had a sizeable effect, with the referral rate of patients to specialist Diabetic Footcare Units rising **57%** from **3,263** in 2016 to **5,650** in 2018. The collective effect of this activity has been marked. Between 2016 and 2019, Mauritius moved from having **no** systematic Diabetic foot screening, to screening **239,888** people previously diagnosed with Diabetes, marking a critical breakthrough in dealing with a serious national health problem. Lewis's foot screening programme is therefore an **essential** step in improving the survival rates of people with Diabetes in Mauritius because it allows early detection of PAD **before** ulceration.

Mauritius's 26% Diabetes fatality rate means that in the normal course of events, at least **62,300** of these 239,888 people would have developed the fatally serious lower limb circulatory diseases associated with the advanced stages of Diabetes. One of the first signs of these diseases are Diabetic Foot Ulcers (DFUs). Between 2016 and 2019 **5,611** Mauritians had DFUs, but no previous diagnosis of Diabetes-related foot disease. Of these, **3,046** were healed thanks to early detection ([E5], [E6], [E7], [E8]). Ulcers that progress too far to be healed are the first point of a sequence of events that lead to limb amputations and death. In 2015, [a systematic review of studies](#) found that **40%** of patients with DFUs had **died** after **5** years. A [2012 study](#) found that **70.4%** had **died** after **10** years. We can therefore construe that between 2016 and 2019, **3,046** Mauritians were saved from the suffering associated with limb loss, that around **1,218** will not die of Diabetes by 2024 and that approximately **2,144** will not die of it by 2029 as the statistics suggest they otherwise would³. An [average Mauritian household of 3.5 people](#) means that for each of these 3,046 individuals whose ulcers were healed thanks to early detection, a further 2.5 individuals - **7,615** people - were saved from the direct consequences of the death of a family member. Since many people with Diabetes are parents and breadwinners, there is an extended but presently unquantifiable impact in terms of poverty prevented.

² Note that this data is subject to change. Accurate at time of writing – 25/11/20

³ Figures for the whole period would likely demonstrate further impacts but are unavailable.

Lastly, Coronary Heart Disease and Stroke are [Mauritius' 2nd and 3rd greatest killers](#) at 19.9% and 11.6% respectively⁴. PAD is a risk factor for both diseases meaning that an unknown number of Mauritians will also not develop these diseases because of Lewis' PAD screening.

Further reach

Following the success of PAD screening programme in Mauritius, Lewis has been asked to lead a PAD screening programme in **Trinidad** [E10] where Diabetes is the second leading cause of death at over [17% of all deaths](#), with coronary heart disease and strokes as the number 1 and number 3 causes of death respectively.

5. Sources to corroborate the impact (indicative maximum of 10 references)

- [E1] Letters from Ministry of Health & Quality of Life, Republic of Mauritius confirming collaboration with Professor Owens for a National Diabetic Care Programme and from Professor Owens confirming Lewis' role in leading the PAD screening aspect of the diabetic foot service in Mauritius
- [E2] [Webpage](#) documenting Professor Owens' team, including Lewis, winning the Royal College of Physicians "Excellence in Patient Care" award 2018
- [E3] Letter from Head of Diabetic and Vascular Health Centre, Mauritius acknowledging Lewis' role in establishing diabetic foot screening services
- [E4] Webpage [2020 WHO article](#) detailing cut in Diabetic foot amputations due to foot care clinics in Mauritius
- [E5] Mauritian Diabetes Foot Care Service: 5 year Report (2014-2019) to the Mauritian Health Service detailing progress of diabetic foot screening
- [E6] 2017 Annual Report to Mauritian Government on progress of Diabetes Foot Care Clinics in Mauritius
- [E7] 2018 Annual Report to Mauritian Government on progress of Diabetes Foot Care Clinics in Mauritius
- [E8] 2019 Annual Report to Mauritian Government on progress of Diabetes Foot Care Clinics in Mauritius
- [E9] 2020 Annual Report to Mauritian Government on progress of Diabetes Foot Care Clinics in Mauritius
- [E10] Letter from Professor Owens inviting Lewis to lead the Diabetes foot screening service in Trinidad & Tobago

⁴ Note that this data is subject to change. Accurate at time of writing – 25/11/20