USE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TO ASSIST DEVELOPMENT OF PREDICTION ALGORITHMS AND RISK STRATIFICATION FOR DIABETES FOOT ULCERATION, AMPUTATIONS AND MORTALITY IN SCOTLAND

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BACKGROUND

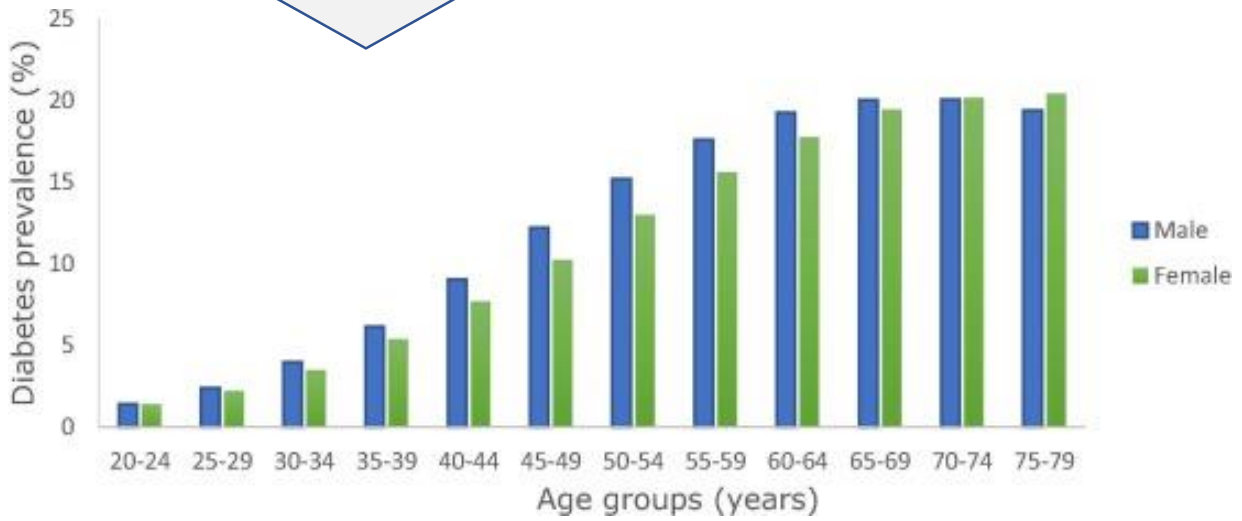
415 million adults living with diabetes **worldwide**; by **2040** this will rise to **642 million.**

90% type 2; 10% type 1

Global prevalence 9.3%

1.6 M deaths directly due to diabetes 2016

12% of global health spending on diabetes



Diabetes Federation Diabetes Atlas
Diabs Res & Clin Pract 2019; 157

DIABETES IN SCOTLAND

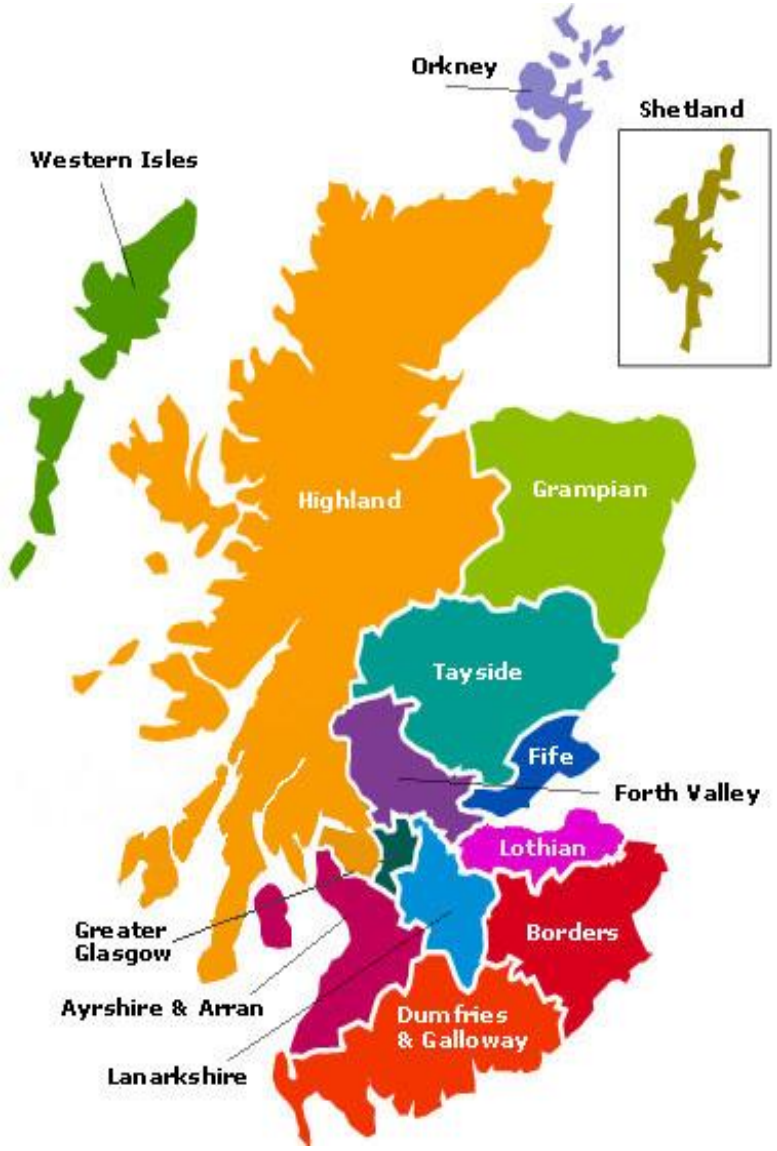
Scottish Diabetes Survey 2018

Scotland's population 5,373,000

Diabetes Prevalence 5.4%

Scotland total – 291,891

Highland total -18,083



DIABETES FOOT DISEASE

FACTORS

- **Neuropathy**
- **Peripheral vascular disease**
- **Smoking**
- **Poor diabetes control**
- **Age**
- **Duration of diabetes**
- **Male gender**

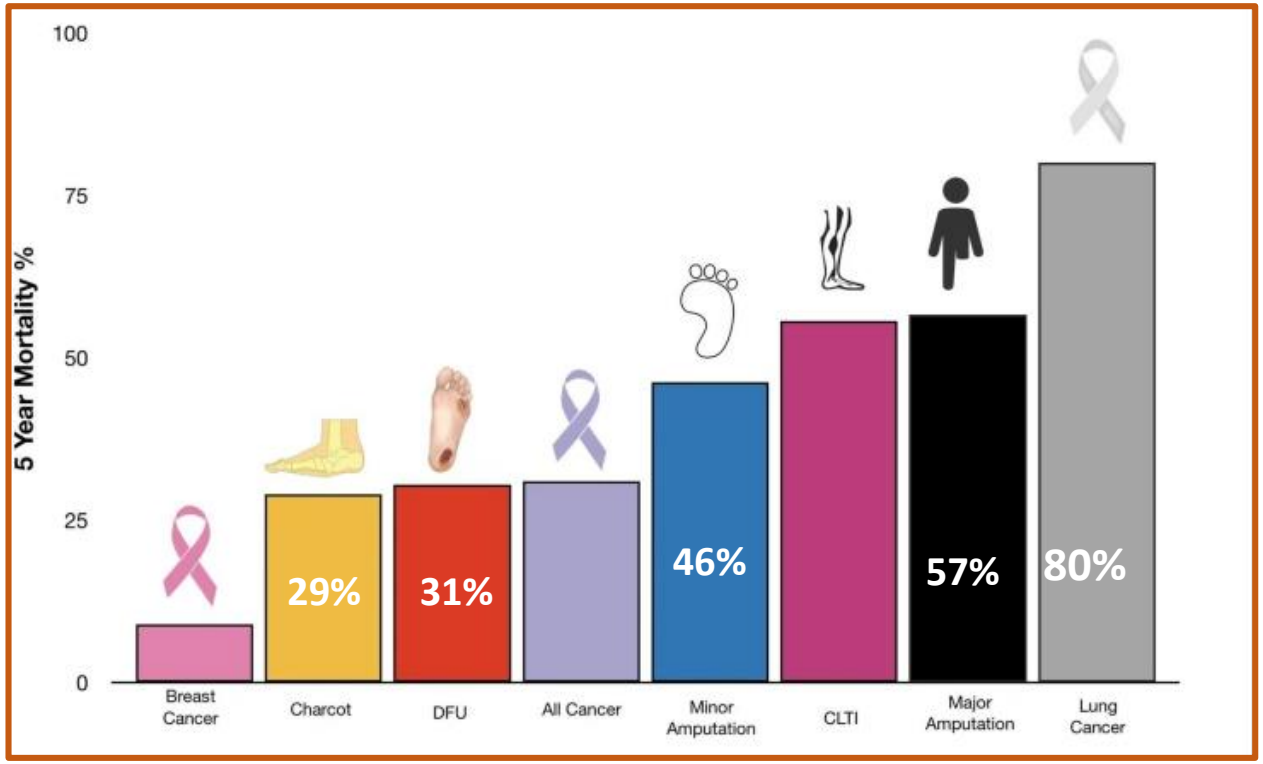
IMPACT

15% - 20% of the Diabetes population may develop a foot ulcer at some point

- Foot ulcers and amputations are the leading cause of diabetes-related hospital admissions
- Up to **50%** of those who have had a major amputation die within two years of this
- It is estimated that **£84-96M** is spent on foot ulcers and amputations in Scotland

DFU, AMPUTATION and MORTALITY

Five year mortality and direct costs of care for people with diabetic foot complications are comparable to cancer



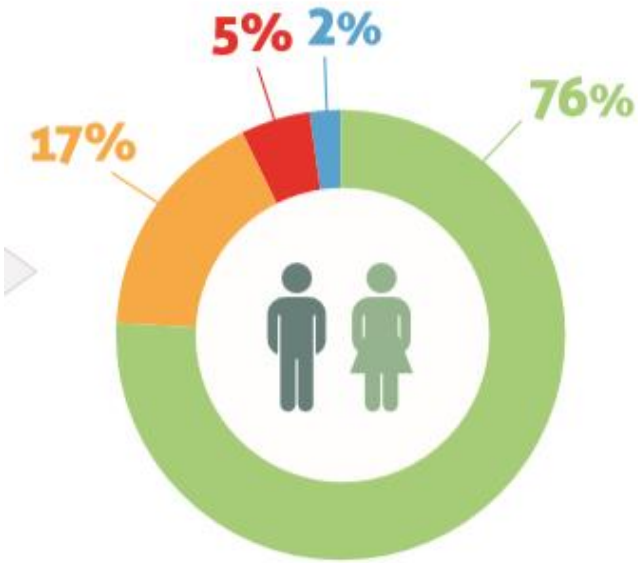
1. Third of direct costs for care in diabetes are due to lower extremity problems
2. DFU & amputation are independent risk factors for premature death
3. Primary prevention is essential

Armstrong et al J Foot & Ankle Res 2020

PREVENTION

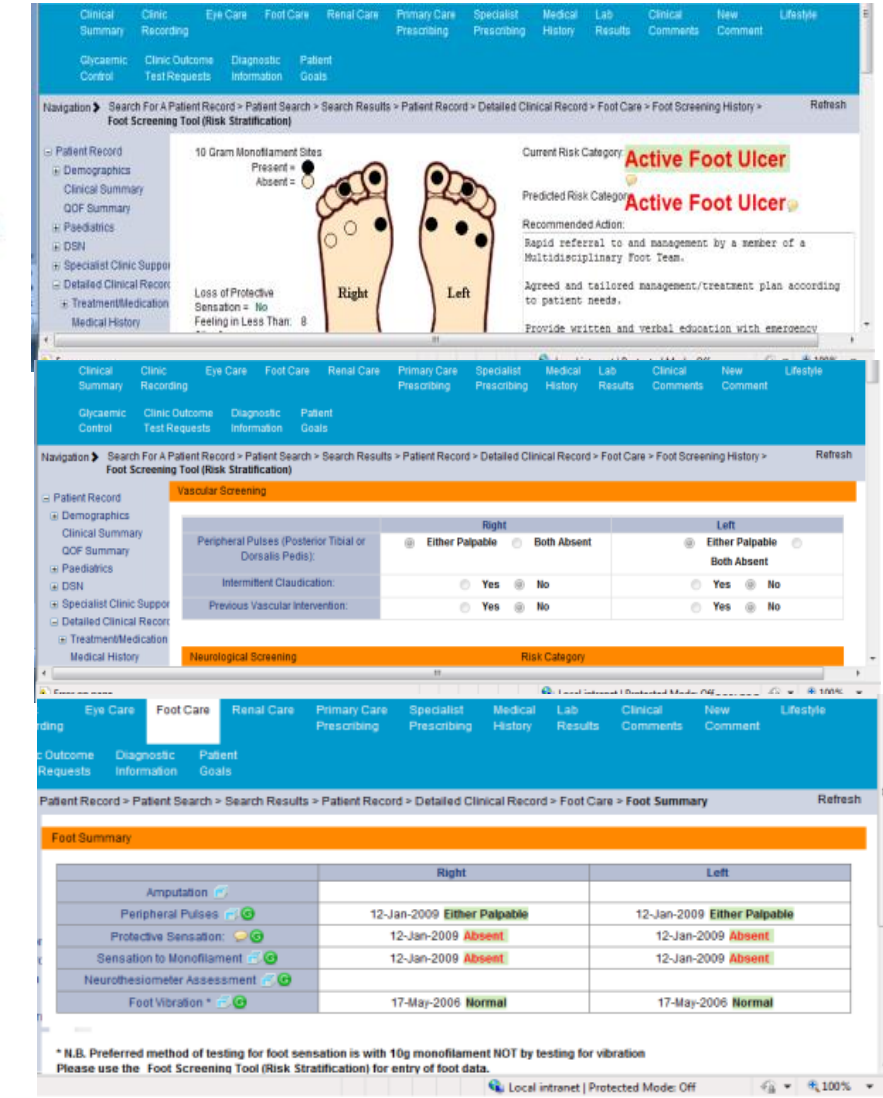
Up to 80% of amputations may be preventable
Early prevention strategies are cost-effective

FOOT SCREENING



Of people living with diabetes:

- **76%** will be at Low Risk of developing foot ulceration
- **17%** will be at Moderate Risk
- **5%** will be at High Risk
- **2%** will be suffering from active ulceration



VISION

- Patient-centric enhanced process of care
- Improved diabetes foot screening
- Reduced burden and improved quality of life
- Automated risk factor screening for diabetes complications through POC applications
- Early prediction of foot ulceration and mortality risk
- Improve the quality of life for the diabetes population by:
    - reducing ulceration, amputation and mortality rates
    - generation of personalised data feedback processes

AIMS

- Introduce foot screening mechanisms that are less human dependent
- Use screening and monitoring prophylactically to allow intervention before primary ulceration occurs
- Develop new prediction algorithms that lead to standardised care for enhanced diabetes foot screening and monitoring linked to patient datasets
- Empower the person with diabetes to address active self-management in prevention of foot ulceration and amputation

CHALLENGE

- Develop automated mechanisms of assessing risk of foot ulceration using recognised risk factors with POC applications
- Establish algorithms using artificial Intelligence and/or machine learning with new or extant datasets for individual risk stratification of foot ulceration, amputation cardiovascular morbidity and mortality
- Generate feedback comprising reports and alerts of foot and mortality risk through audio-visual, haptic or bio-feedback

WHAT ELSE?

- Technology will be acceptable to patients, carers and health care workers
- A scalable business model is essential
- Solutions should be effectively and securely integrated to NHS Scotland IT infrastructure
- Technology solutions must be economical sound and affordable for the NHS if adopted