How social determinants of health can affect diabetic foot disease and how policy and community development may be used to address outcomes within the Scottish context

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Key words

- Diabetes-related foot disease
- House of Care model
- Scotland
- Social deprivation
- Social determinants of health
- Technology enabled care

Article points

1. Social deprivation, access to healthcare, educational attainment, income, health literacy and food security all have a detrimental effect on diabetic foot disease.
2. Policies committed to equity of access utilising the House of Care philosophy seek to address the effects of social determinants of health.
3. Community involvement can be used to support people with diabetes-related foot disease.
4. Technology can be used to empower people and help them manage their risk of foot ulceration.

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There is increasing evidence that alongside traditional risk factors, such as ischaemia, neuropathy and structural anomalies, social deprivation plays a significant role in the development of diabetic foot ulceration. This paper examines social deprivation in the Scottish context and evaluates how social determinants of health can impact people with diabetic foot ulcers in Scotland; assess the suitability of the 'House of Care' model and consider how community development can be used to improve outcomes.

Diabetic foot ulceration (DFU) is a global concern affecting 6.3% of people with diabetes (PWD), which can lead to lower-limb amputation and has a 5-year mortality rate comparable to all cancers (Zhang et al, 2017; Armstrong et al, 2020). In Scotland, there were 327,927 people (6%) with a diagnosis of diabetes in 2021 and 10,425 people (3.2%) were recorded as either having or being at a high-risk of DFU (Scottish Diabetes Group, 2021). It may be argued that these numbers are low and insignificant; however, reduced figures could be related to a lack of data collection during the Covid-19 pandemic as previously reported years indicate a greater prevalence of DFU (Scottish Diabetes Data Group, 2019, 2020; Scottish Diabetes Group, 2021; Siddiqui et al, 2022).

DFU has a high economic cost to society and the NHS, and a significant detrimental effect on patients and carers (Nabuurs-Franssen et al, 2005; Guest el al, 2017; O'Neill et al, 2017) (Kerr et al, 2019). Furthermore, diabetes-related lower-extremity complications have been ranked as the 10th heaviest global disability burden; higher than diabetes-related ischaemic stroke, ischaemic heart disease and chronic kidney disease (Zhang et al, 2020). There is increasing evidence that alongside traditional risk factors, such as ischaemia, neuropathy and structural anomalies, social deprivation (SD) plays a significant role in developing DFU (McDermott et al, 2023; Bonnet and Sultan, 2022; Ahmed et al, 2021; Hurst et al, 2020).

The Scottish Government Diabetes Improvement Plan (2021) commits to developing care models aligned to the House of Care (HoC) philosophy, a person-centred approach based on the chronic care model first introduced by Wagner (1998).

This paper will critically evaluate how social determinants of health (SDoH) can impact people with DFU in Scotland; assess the suitability of the HoC model and consider how community development can be used to improve outcomes.

Social determinants of health and diabetic foot disease

Public Health Scotland (2021) defines SDoH as the conditions into which people are born, grow, age, work and live; these can include several and varied factors such as education, employment, income, housing, social support and access to healthcare.

Many studies accurately identify that DFU and diabetic foot disease (DFD) are inextricably linked to SDoH, but they do not necessarily explain how SDoH may lead to DFU; to do that, a wider lens is required to consider diabetes in general. Hill-Briggs et al (2020) conducted a scientific review of SDoH

Table 1. Social determinants of health and component factors (Hills-Briggs et al, 2020)

Socioeconomic status	Neighbourhood and physical environment	Food environment	Health care	Social context
Education	Housing	Food security	Access	Social cohesion
Income	Built environment	Food access	Affordability	Social capital
Occupation	Toxic environmental exposures	Food availability	Quality	Social support

and diabetes and grouped the relevant SDoH under five broad headings (*Table 1*).

In the first study considering SD and DFD in Scotland, Leese et al (2013) showed that DFU risk was 1.7-fold higher in socially deprived areas (using the Scottish Index of Multiple Deprivation [SIMD]), but there was no association with DFU and distance from the healthcare setting. However, their study failed to include renal function as a risk factor for DFU and this is also related to SD (Grant et al, 2023).

Other UK-based studies include a retrospective cohort with a 10.5 year follow-up of 13,955 PWD that showed a 77% higher likelihood of DFU in the highest quintile of SD than the lowest quintile (Anderson et al, 2018). However, the authors used the Townsend index score for deprivation, which some argue is not as well-defined as the SIMD (Bonnet and Sultan, 2022).

To predict SD as a risk factor for DFD in newly diagnosed PWD, Riley et al (2021) retrospectively reviewed 15 years of data from a UK health database. They revealed that people from the most deprived quintiles were more likely to be younger at entry to the study, have obesity, be current smokers and have higher blood glucose. Interestingly, they showed SD as a risk factor for all forms of DFD, including peripheral neuropathy, peripheral vascular disease and lower-extremity amputation (LEA), not only DFU. This study also used the Townsend index score and the authors noted a large proportion of missing ethnicity data; nevertheless, it is the largest SD population study in the UK in relation to diabetes-related foot disease.

The Scottish Care Information – Diabetes Collaboration (SCI-DC) is an internationally acclaimed national database containing daily updated clinical and demographic data for all PWD in Scotland (SCI-DC, 2015; Siddiqui et al, 2022). Hurst et al (2020) retrospectively cross-referenced SCI-DC data with SIMD information from 112,231 PWD to geographically identify hot spots of DFU, LEA and mortality. They found a four- to fivefold difference between the most and least deprived areas. Interestingly, their data showed a concentration of equally poor outcomes in neighbouring areas, suggesting that cumulative poor health behaviours and multiple SDoH lead to a 'pull-down' effect. This study had some limitations – it did not account for age and sex, and the authors could not exclude reverse causality of DFU or LEA leading to SD, rather than being a consequence of it.

A population-based study conducted in New South Wales, Australia, highlights the effects of educational attainment and household income on DFU rates; estimating that in people with DFU, 53.2% had less than high school education and 60.5% had a household income of less than AUD20,000 (£10,800) (Ahmed et al, 2021). Although the study gives good insights into the relationships between DFU and social factors, it cannot prove the relationship between these factors and the variables due to the cross-sectional data used.

Access to healthcare was highlighted in a recent study from the US, where the authors considered people with peripheral artery disease (PAD) who lost insurance cover (Howell et al, 2023). They found that 64.2% of the cohort of 214,386 had diabetes and those who withdrew from commercial insurance had a 77% higher risk of major amputation and a 41% higher risk of a minor amputation. The study shows the catastrophic effects resulting from financial barriers; however, in the UK and other countries with publicly funded healthcare systems, this is less pertinent.

Hurst et al (2021) found a prevalence of 8.05% of PAD with a five-to-sevenfold difference in the least to most deprived quintiles. They observed high smoking rates and low attendance rates at primary

care, but noted they did not measure environmental exposures, which may be linked to Glasgow's industrial past. Interestingly, their novel geospatial mapping techniques showed higher levels of SD in the deindustrialised shipbuilding sites on the Clyde estuary.

Quality of healthcare, access to healthcare and health literacy were identified as barriers to seeking care in a qualitative study of 15 PWD in Arizona, US (Tan et al, 2021). Their subjects were sampled from a multidisciplinary limb salvage centre providing care in a low socioeconomic, suburban and rural area with 40% racial and ethnic minority groups, and the authors used semi-structured telephone interviewing in the language of their choice. The use of medical terminology and unfamiliarity with the term 'ulcer' was a barrier to health literacy resulting in delayed access to services. Subjects described financial restraints of travel to healthcare providers and out-of-pocket payments for specialist footwear and dressings that were not covered by their health insurance. Furthermore, one individual described an interaction with a healthcare professional (HCP) where they felt 'stupid'. Although a small sample size, the qualitative study design does highlight further SDoH barriers in accessing healthcare services for DFU.

Understandably, in a long-term condition like diabetes that is directly influenced by food intake, access to food and its nutritional qualities are of the upmost importance. Despite this, the current international guidelines and a Cochrane systematic review found no measurable benefits of using nutritional supplements in the management of DFU (Moore et al, 2020; Chen et al, 2023). All the randomised controlled trials reviewed had small sample sizes that could not justify the use of any systematic therapy of supplement use.

In a qualitative study considering diet quality, advice and interventions regarding DFU, Donnelly et al (2022) noted a complex relationship between their subjects and their food management and concluded that a personalised re-education of food agency was required. Their study included 19 subjects selected by a targeted sampling strategy to include people with a range of age, sex, BMI and living conditions using postcodes to measure the Index of Relative Socio-economic Disadvantage score of which they assessed all participants as relatively disadvantaged. Although they attempted to recruit a heterogeneous sample, this was not achieved as non-English speakers were excluded and ethnicity was not assessed.

These studies identify that the SDoH have a significant bearing on diabetes-related foot disease, but how can these factors be addressed? To do that, the strategies of policy and services must be assessed.

Policies and models seeking to address SDoH in relation to diabetic foot disease

In the Scottish Government Diabetes Improvement Plan, Priority 4 highlights a commitment to equity of access, including deprivation, ethnicity and other factors. Furthermore, Commitment 1.3 states: "We will ensure care pathways support individuals to have their processes of care completed while considering the principles of realistic medicine" (Scottish Government, 2021).

The government's chosen methodology is to develop care models aligned to the 'House of Care' philosophy (*Figure 1*), while utilising community hubs. The model is based on the chronic care model (CCM) introduced by Wagner and then evaluated for diabetes care in a randomised trial shortly after (Wagner, 1998; Wagner et al, 2001). They hypothesised that Chronic care clinics (including personalised visits with the HCP team together with a peer support session) would improve the process and outcome of diabetes care. It included 707 PWD randomised to intervention and control groups. Although not specifically addressing SD factors, it is interesting to observe that only 8.1% of subjects earned more than USD15,000 per annum. Results demonstrated that all measures of process were improved in the intervention group but not all (including foot examination) were statistically significant (Wagner et al, 2001).

Systematic reviews of several chronic care model interventions in diabetes care note small to moderate improvements in patient outcomes (HbA_{1c}, blood pressure and total cholesterol), although common criticisms include the additional time constraints of setting up new or unfamiliar chronic care model interventions and the observation that chronic care models may not be able to address all components of the SDoH (Yeoh et al, 2018; Kadu and Stolee, 2015; Si et al, 2008).

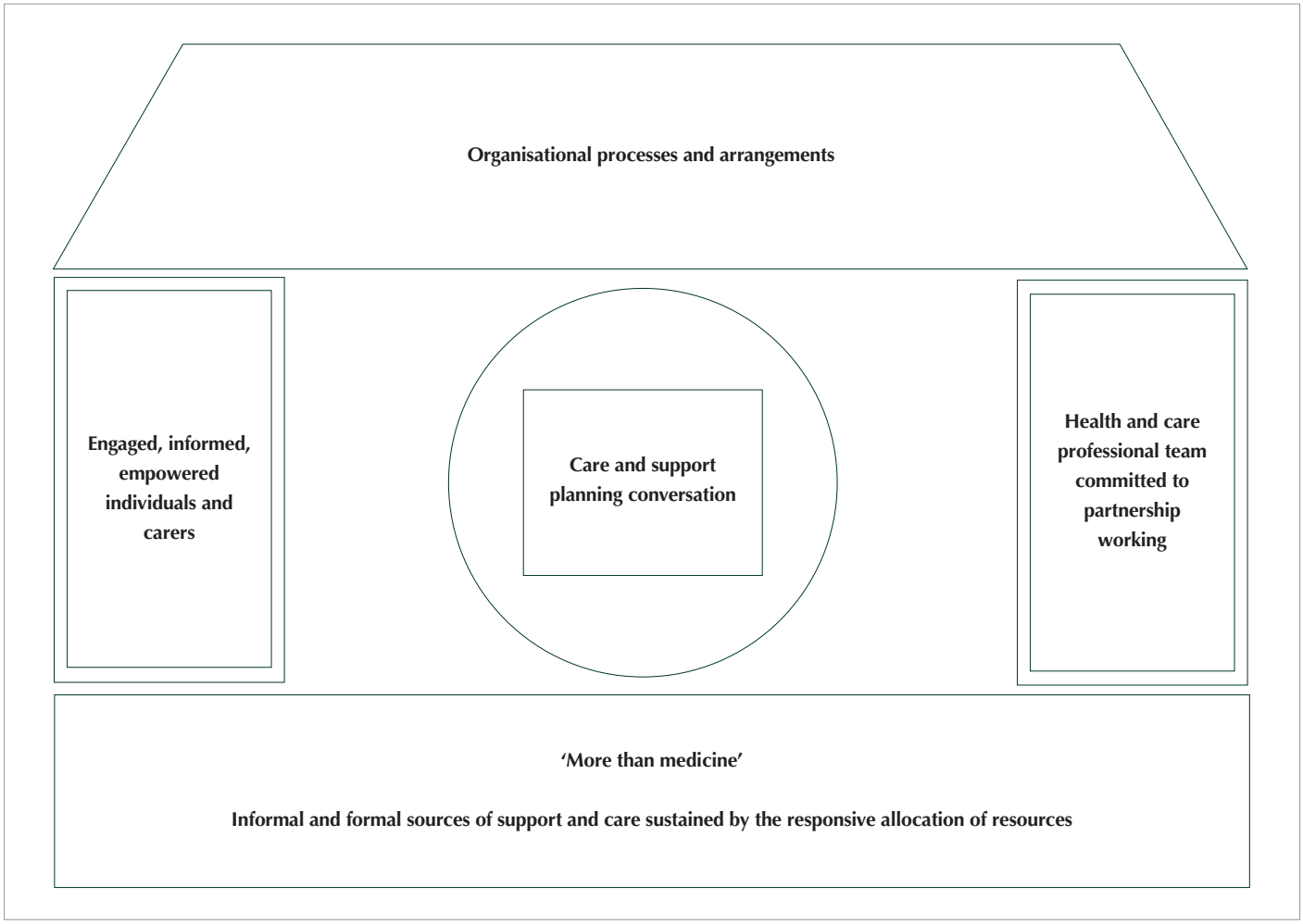

Figure 1. House of Care model (Alliance, 2023)

Yeoh et al (2018) identified eight studies that measured the effects of chronic care models on foot exam interventions; of the papers available, they demonstrated a mean increase in foot examination of 33.2% (20–57%); however, these results may not be transferable to other populations (Siminerio et al, 2005; Caruso et al, 2007; Barceló et al, 2010; DiPiero et al, 2008; Yu and Beresford, 2010; Page et al, 2015).

The HoC model was developed by the Year of Care Partnerships in the early 2000s, initially for PWD, but growing to include many long-term conditions. It was recognised that each person managing a long-term condition spends only a few hours each year with various HCPs and then are left to manage the condition themselves. A supportive, productive conversation is scheduled which both 'experts' (the person with the condition and the HCP) prepare for before attending; leading to an agreed plan of action in a process called 'care and support planning' (Roberts et al, 2019). This change in practice may be intimidating for some who might be unwilling to alter from the traditional paternalistic biomedical patient/doctor model; furthermore, time pressures and unfamiliarity can make adopting new healthcare practices challenging (Eaton et al, 2015). Eaton et al (2015) also highlighted that people with health literacy challenges from SD areas may require additional support for care planning; nevertheless, this increased input often facilitates the biggest gains.

The foundation on which the HoC model is built on is 'informal and formal sources of support and care' (*Figure 1*). This can only be achieved by engagement with robustly measured local and community involvement or 'community assets' (Coulter et al, 2016). A good knowledge of locally available groups and services to support

individuals and carers is key to social prescribing or community signposting; unfortunately, this is often lacking in many HCPs knowledge base (Coulter et al, 2016).

In partnership with the Scottish Government, the Health and Social Care Alliance Scotland (Alliance) is a third sector intermediary for more than 3,000 health and social care organisations. An important Alliance project for community development is A Local Information System for Scotland (ALISS), a digital platform providing information on resources, groups and services to support local communities to manage long-term conditions and provide other social support (Health and Social Care Alliance Scotland, 2023). However, using digital resources does require a level of digital ability that has been shown to be lacking in some areas of society (Scheerder et al, 2017).

Following the publishing of the Diabetes Improvement Plan by the Scottish Government (2021), Alliance and Diabetes Scotland partnered to facilitate a diabetes network to ensure PWD are included in influencing the improvement of support services. These service users' voices were published in a report summarising their experiences of accessing services for diabetes in Scotland (Health and Social Care Alliance Scotland, 2022). They utilised online surveys, community focus groups and a workshop in partnership with Networking Key Services, a multicultural support group helping women and their families. Despite the involvement of a multicultural group, 85.9% of the 199 respondents to the survey or focus groups and were white and surprisingly, no socio-economic details were gathered. Given that data from 2021 reports white ethnicity as 82.2% and 72.3% of people with type 1 and type 2 diabetes respectively, this is not a true reflection of the community, highlighting issues with partnership working (Scottish Diabetes Group, 2021; Scriven, 2012). The Allaince report does highlight the need for flexibility in accessing support structures available and making the services equitable by providing a variety of multiple and accessible services.

The benefits and desire for peer support have been stressed, alongside calls for increased access to emotional support for mental health and wellbeing (Health and Social Care Alliance Scotland, 2022). No reference is made to the prevention or management of DFD within the Alliance report; however, it does celebrate My Diabetes My Way; an important development in eHealth that is being used to support PWD in Scotland.

Community development and other means to improve outcomes

In line with the Scottish Government's (2022) *Care in the Digital Age: Delivery Plan 2022-23*, My Diabetes My Way is an online self-management platform and app for PWD with approximately 60,000 registered and 22,665 active users (Conway et al, 2019; Shields et al, 2023). The platform launched in 2010 and is linked to SCI-DC for real-time access to key diabetes indicators and targeted educational materials; for example, foot care advice is specifically tailored to the risk stratification previously recorded for the individual (Cunningham et al, 2019). Although funded by the Scottish Government, arguably it is community driven, as its users are periodically surveyed for feedback on the platform. This has resulted in improvements in functionality, such as the uploading of data from activity trackers, for example, Fitbit and Apple Watch (Conway et al, 2019; Shields et al, 2023).

Patient and public involvement can be used to develop technology supporting DFD and is expected in modern health research (Sproson et al, 2022; Biddle et al, 2019), yet there is no patient and public involvement reported by the My Diabetes My Way team. Despite positive user experiences and facilitation of self-management, reported weaknesses include a relatively low uptake (13%) by PWD in Scotland and reduced access from the most deprived SIMD quintiles; however, the My Diabetes My Way team group give no suggestions as how to address these issues, although it should be noted that these are is not unique to My Diabetes My Way (Conway et al, 2021; Ross et al, 2023).

The 'Fixing Dad' story is an example of the empowerment of one family in improving the health outcomes of a loved one, leading to a movement of supporting others to do the same. Frustrated by the negative language and attitudes

of HCPs regarding their father's type 2 diabetes and actioned by the sudden deterioration of his foot health, his sons took ownership of their father's lifestyle and diet and reversed his type 2 diabetes in 12 months (Whitington, 2017). After a film documenting this journey, the Fixing Us team have been involved in developing media content, virtual forums and events to inspire health engagement in communities worldwide; however, the impressive statistics displayed on https://www.fixingus.com do not appear to be backed up with measurable research.

"Art and science working together can change the world" is the tag line from Seven Thousand Feet, an award-winning art and science collaboration exploring a creative response to diabetes. The artist curated 22 pieces of artwork (five relating to DFD) that highlight different aspects of having a lived experience of diabetes, showcasing them at the Manchester Science Festival in 2018. The festival seeks to attract harder to reach groups, but acknowledges that the majority of the 113,350 public visitors had a high level of science capital and cultural engagement; the project has since been shown in various spaces (Manchester Science Festival, 2019). The eponymous artwork relates to a display of 7,000 single socks gathered from donations (some from people with amputations) to illustrate the number of lower-limb diabetes-related amputations in the UK each year. Many of the socks have a lost property tag with a quote from a person who has undergone an amputation.

There is strong evidence to support the use of the arts in influencing health prevention and promotion regarding the SDoH; furthermore, the improved management and treatment of conditions such as diabetes have also been reported (Fancourt and Finn, 2019).

As part of the #PuttingFeetFirst campaign, Diabetes UK published a video showing the public's response to selling off single shoes of people who had undergone a diabetes-related amputation (Diabetes UK, 2016).

The use of fear in health promotion is debated (Green et al, 2019). Fairchild et al (2018) argue that fear-based messages cannot be an assault to SDoH as they do not change conditions that cause disease; conversely, others believe that a fear-based message is unethical as it may lead to devalued, rejected and stigmatised individuals (Chapman, 2018).

These many and varied types of public engagement aim to connect with PWD from all walks of life and inspire motivation for change in their foot health.

Conclusion

In this paper, the global and local extent of diabetes-related foot disease have been highlighted and the catastrophic consequences to individuals, carers and society have been touched upon. The effects of SDoH on DFU have been presented both within the UK and further afield. Evidence of the influence of socio-economic status, built environment, educational attainment, quality and access to healthcare and food agency have been critiqued and presented. The methodology of addressing this in Scotland has been introduced and the origins of the chosen model discussed, highlighting that this cannot be achieved by governance and healthcare services alone. The potential involvement of partnership working, community assets, social action and health promotion in the enormous task of the prevention of diabetes-related foot disease has been identified so that diabetes-related ulceration, amputation and early death can be avoided. ■

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