THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

A massive open online course for type 2 diabetes self-management: adapting education in the COVID-19 era

OPEN ACCESS

A massive open online course for type 2 diabetes self-management: adapting education in the COVID-19 era

Scott C Mackenzie[1], Kirsten M Cumming[2], David Garrell[2], Doogie Brodie[2], Lyn Wilson[3], Salma Mehar [2,4], Scott G Cunningham[5], Alex Bickerton[6], Deborah J Wake[7,8]

1. Ninewells Hospital and Medical School. Dundee, Scotland. DD1 9SY.
2. MyWay Digital Health, Mackenzie Building, Kirsty Semple Way, Dundee, DD2 4BF.
3. NHS Lanarkshire, Scotland.
4. NHS North West London Collaboration of Clinical Commissioning Groups, Marylebone Road, London, NW1 5JD.
5. Population Health & Genomics, School of Medicine, University of Dundee.
6. Dept Diabetes & Endocrinology, Yeovil District Hospital NHS Foundation Trust, BA21 4AT.
7. Centre for Medical Informatics, Usher Institute, University of Edinburgh, EH16 4UX.
8. Edinburgh Centre for Endocrinology and Diabetes, NHS Lothian.

Corresponding author:
Scott C Mackenzie, Ninewells Hospital and Medical School. Dundee, Scotland. DD1 9SY.
Email: scm.123@hotmail.co.uk Telephone: (+44) 7453 270117. ORCID ID: 0000-0001-5823-4334.

Deborah J Wake ORCID ID: 0000-0003-4376-6973

Abstract word count: 282
Manuscript word count: 3247

Abstract

Introduction:
Type 2 diabetes self-management education is an essential component of type 2 diabetes care that is traditionally delivered in a face-to-face setting. In response to the recent COVID-19 pandemic, innovative solutions are urgently needed, allowing provision of self-management education that can be delivered in compliance with social distancing policies. Innovations that are self-service and can deliver education efficiently at low cost are particularly appealing to healthcare providers and commissioners.

Methods:
We aimed to evaluate user uptake, dropout, acceptability, satisfaction, perceived short-term knowledge gain and health benefits/behaviour changes in relation to a free massive open online course (MOOC) in diabetes self-management education, created and delivered during the COVID-19 pandemic. This course, focusing on addressing knowledge and self-management needs for people with type 2 diabetes, made use of online interactive content including expert and patient videos, quizzes, moderated discussion boards and live social media which encouraged personal reflection and goal setting. User expectations and experiences were explored via survey-based methods. Here, we present our experience of developing the course and describe users' experiences.

Results:
1991 users registered interest in the course over a 2-week period, with 976 users starting the course and 640 (65.6%) users completing the course in full. Users engaged well, finding the course educational, user-friendly and motivating, demonstrating high completion rates and user satisfaction. A statistically significant (p <0.001) increase in self-reported self-management ability and health knowledge was observed among participants with type 2 diabetes.

Discussion:
Massive open online courses in type 2 diabetes self-management education have great potential for delivering education efficiently at scale and low cost. Although engagement can be limited by digital literacy, benefits include flexible and remote access to up-to-date, evidence-based education delivered by a multidisciplinary team of healthcare professionals.

Keywords: COVID-19, type 2 diabetes, MOOC, self-management, structured education, social media, technology, health informatics, digital health

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has transformed the world in which we live, with global consequences yet to be fully realised. The response to COVID-19 has forced healthcare services to undergo rapid restructuring, significantly reducing face-to-face contact for non-urgent medical needs [1]. Routine follow-up and complications screening is being largely deferred, with a predicted impact on downstream complications occurrence. People with type 2 diabetes are at risk of poor health outcomes as a result of both COVID-19 infection [2, 3] and the consequent lockdown-related behavioural changes necessary to slow its spread [1, 4]. In order to comply with social distancing measures, face-to-face interaction between patient and healthcare professionals has been reduced. Type 2 diabetes self-management education (DSME) is recommended as part of national and international guidelines [5, 6] and can lead to clinically significant improvements in glycaemic control and diabetes outcomes [7], but face-to-face DSME during COVID-19 has largely ceased.

In addition to lack of access to formal healthcare professional support, social distancing and lockdown may impact on individuals' lifestyle choices and ability to self-manage in several ways. For example, through reduced access to healthy food and exercise opportunities, reduced peer and family support and mental health deterioration through social isolation. These factors may impact on ability to self-manage and subsequent control of glycaemic and other risk factors (like weight, blood pressure and cholesterol). Although many of these factors cannot be altered by DSME, reduced DSME availability and accessibility in this period could additionally contribute to poor diabetes control.

DSME is traditionally delivered in a face-to-face individual or small group-based setting. Due to COVID-19, alternative mediums for DSME delivery are urgently required. Technological solutions to DSME may play a role in providing this service. Various digital DSME interventions are available including My Diabetes My Way [8], Oviva.com, ChangingHealth.com, Livongo.com and OmadaHealth.com. Digital DSME interventions have been studied previously, generally providing a smaller and more variable improvement in glycaemic control than to face-to-face equivalents, although data is limited as DSME evaluation has lagged behind technological development [9, 10]. The use of digital DSME in healthcare is currently limited and adoption has been slow due to lack of budgets, rigid procurement pathways and clinical inertia. Digital interventions have high variation in their cost due to varying degrees of reliance on human resource for online coaching, impacting on cost-effectiveness [11].

In recent years, massive open (free) online courses (MOOCs) have grown in popularity, traditionally used by academic institutions to offer a wide range of content for wider community consumption [12]. MOOCs are commonly used for continuing professional development (including healthcare professionals) [13]. Examples of MOOCs for direct engagement for people with diabetes or other chronic disease are however limited, and no recent evidence for their impact exists [9]. MOOCs could be a mechanism to supply a low-

cost, efficient and accessible solution to DSME that can be delivered in line with social distancing measures. In addition, MOOCs can provide a shared experience for many, facilitated through discussion boards and social media allowing real-time support from qualified healthcare professionals. This paper aims to share our experience of developing and delivering a MOOC for a non-homogenous learning cohort, and evaluate user experience including user uptake, dropout, satisfaction, acceptability and perceived short-term health benefits.

MATERIALS AND METHODS

Developing a MOOC for type 2 DSME

A MOOC, entitled *Understanding Type 2 Diabetes*, was delivered over the 28th and 29th of April 2020. The MOOC was developed by MyWay Digital Health Ltd. (MWDH) in collaboration with My Diabetes My Way [8], University of Dundee and The University of Edinburgh. The course was free and open-access, available to anyone provided they had technology and internet access.

For course structure, see box 1. The course curriculum was largely aligned with material normally delivered in existing QISMET accredited [14] structured DSME courses e.g. MWDH's *My Type 2 Diabetes* [15], and similar to existing accredited face-to-face offerings (e.g. Desmond [16] and X-PERT Health [17]). The MOOC provided general DSME as well as self-management education relevant to the COVID-19 pandemic. This aimed to improve user knowledge and help users make positive behaviour changes to meet their own diabetes goals. The course utilised several existing resources from MWDH products but developed a distinct narrative and layout to fit the purpose and timescale of a MOOC.

Box 1: MOOC Structure

Day 0: Hello and welcome to understanding type 2 diabetes
• What are we going to cover?
• Time to set a goal
o Pre-course survey
• Join in the conversation!
Day 1: Why managing diabetes matters
• Topic 1: What is type 2 diabetes?
• Topic 2: Why does managing diabetes matter?
• Topic 3: Diabetes and eyes
• Topic 4: Diabetes and feet
• Topic 5: Diabetes and kidneys
• Topic 6: Diabetes and mental wellbeing
• Quiz: Diabetes myth buster!
• Live social media question and answer session

> **Day 2: Taking control of type 2 diabetes**
> - Topic 1: Why weight matters
> - Topic 2: Eating right
> - Topic 3: Let's get physical
> - Topic 4: Smoking and alcohol advice
> - Topic 5: Diabetes medications
> - Topic 6: Treatment targets
> - Quiz: Taking control of type 2 diabetes
> - Topic 7: Thanks for joining us!
>   - Post-course survey
> - Live social media question and answer session

Technical aspects

To participate and gain access to the MOOC, users were required to register an account with a username and password. This allowed users' progress through the course to be tracked. The MOOC was developed using the LearnDash WordPress LMS plugin software which also allowed user tracking and personalised certificates to be issued [18]. The MOOC was developed in line with online accessibility guidelines (WCAG AA [19]). Content was structured in topics and was available to users in a stepwise manner ensuring progression through each topic before access to subsequent topics was granted. The programme tracked completed and incomplete sections. Users had access to the MOOC introduction (day 0) 4 days prior to the scheduled launch of day 1 and day 2 content, allowing completion of introductory steps, familiarity with the user interface and troubleshooting of any technical difficulties. Day 1 and day 2 content were released at 00:00 on each day respectively. The course stayed live for an additional 2 days after the official end date to allow course completion.

Advertisement of the course occurred via social media and email lists. Once registered, users could access functionality including viewing interactive content clustered by topic, reading and leaving comments in the moderated discussion boards, completing goal setting and free text reflections, completing pre- and post-course surveys and taking part in quizzes. Registration also allowed summary course emails to be received. On day 1 and day 2 of the course a two-hour question and answer livestream was hosted via social media (Facebook and Twitter) where user questions were answered by experienced diabetes healthcare professionals. Conversation was encouraged among participants and facilitated via discussion boards on each course page, thorough a commentary on the live Facebook feed and through use of #understandingtype2 on social media. A personalised certificate was available to users on completion of the course.

Evaluating a MOOC for DSME

Users who expressed interest in the course provided consent for ongoing contact related to the course. When users registered with the platform, they accepted the terms and conditions and privacy policy for use of the site which permits that user information may be used for "research and development… and anonymised data may be used for regional and national quality reporting". Following completion of the post-course survey, users were asked if they consented to ongoing contact via email to assess the impact of the course on self-reported diabetes outcomes. Formal ethical approval was not required for evaluation of the MOOC as data was collected for the purpose of service improvement.

Milestones for user progress tracking were initial registration, completion of day 1 of the MOOC and completion of day 1 and day 2 of the course. Completion rates were calculated using these milestones.

As there is an absence of published evidence relating to MOOCs for DSME, this evaluation aimed to assess user uptake, engagement, user experience and to assess the MOOC method of DSME delivery (through analysis of user satisfaction, self-reported short term benefits and free text comments) to aid future improvements. This was achieved through a pre- and post-course survey (see Appendix 1 for survey questions). Users were presented with the pre-course survey during the course introduction. Course progression was restricted so that users only had access to the post-course survey after completing all prior steps of the course. Completion of the pre- or post-course surveys was optional and non-essential for course progression or completion. Survey data was exported from GravityForms [20] into Microsoft Excel.

Data analysis

Data were anonymised prior to analysis and aggregate data is presented. Free text responses were independently coded by 2 coders to mutually agreed themes identified after initial review of user responses. Where coding differed between coders, consensus was reached by discussion. Coding results are expressed as descriptive statistics. Descriptive statistics were calculated, and figures produced using Microsoft Excel.

A pseudonymised identification number was generated for each user and this was used to pair responses between the pre- and post-course surveys. This was relevant for 2 statements that users were asked to state their agreeableness to: '*I know enough about my health*' and '*I manage my diabetes well*'. Response options were *strongly agree*, *agree*, *neutral*, *disagree* and *strongly disagree* and these were scored 1 to 5 respectively. Data were tested for normality and as the data were not normally distributed based on a Shapiro-Wilk test ($p < 0.05$), non-parametric tests were used. Pre- and post-course responses were analysed using a Wilcoxon Signed-Rank sum test to determine if the response differed between pre- and post-course scores. Statistical tests were performed using IBM SPSS Statistics 25.0.

RESULTS

Course progress and completion rates

1991 registered interest in the MOOC and 976 users started the MOOC by registering on the platform. Of these users, 75.7% (n=739) completed day 1 and 65.6% (n=640) completed day 1 and day 2 (data collected by LearnDash). Based on data collected in the pre- and post- course survey, the dropout rate was highest at 50.0% among family members and carers of people with diabetes, followed by 47.5% among healthcare professionals, 34.0% among people with type 2 diabetes and 31.0% among people at risk of type 2 diabetes. On an introductory step of the course users were encouraged to introduce themselves in the comment section. The audience was comprised of UK-based and international users.

Pre-course survey

636 users completed the pre-course survey. 66.5% (n=423) of users self-identified as having type 2 diabetes, 2.6% (n=29) users self-identified as being at risk of developing type 2 diabetes, 5.3% (n=34) self-identified as a family member or carer of a person with type 2 diabetes and 28.8% (n=183) self-identified as a healthcare professional.

Users were asked *'What would you like the course to help you achieve?'* to which n=367 people with type 2 diabetes left a free-text response. See Table 1 for summary of responses from people with type 2 diabetes. Among healthcare professionals who left a free text response (n=150), 85.3% (n=128) aimed to improve their understanding of diabetes and its management for professional development purposes and 13.3% (n=20) aimed to increase their understanding of DSME available to patients online. The most common theme among those who left a free text response and self-identified as at risk of type 2 diabetes (n=23) was reducing risk of developing type 2 diabetes (n=10). The most common theme among those who left a free text response and self-identified a family member or carer of someone with diabetes (n=29) was to help support someone with diabetes (n=12).

When users were asked to rank their confidence in achieving their pre-set goals, 65.8% (n=239/363) of users with type 2 diabetes, 90.4% (n=132/146) of healthcare professionals, 65.2% (n=15/23) of those at risk of type 2 diabetes and 96.4% (n=27/28) of family member or carer of someone with diabetes were either confident or very confident in doing so.

Table 1: What did people with type 2 diabetes want to achieve from the MOOC?

Response theme	Responses (%)
Improve glycaemic control	50
General understanding of diabetes	42
Dietary advice	24
Diabetes remission	12
Latest information/knowledge update	11

Diabetes complications	10
Weight loss advice	8
Improve self-management motivation	7
Reducing/avoiding medication	6
Improve self-management confidence	4

Based on n=367 free-text responses from people with type 2 diabetes to the question '*What would you like the course to help you achieve?*' in pre-course survey. All responses underwent coding by two independent coders. When coding was inconsistent, consensus was reached by discussion. The ten most frequently referenced themes are presented. Results presented as percentage of user responses that made references to individual themes.

Post-course survey

401 users completed the post-course survey. Course satisfaction was very high, with the majority of people responding that the course was easy to use and in agreement that it had improved their knowledge, motivation, confidence, health and wellbeing and ability to self-manage their diabetes (Figure 1). Sub-group analysis of this data did not find any noteworthy differences in agreeableness between groups, aside from an 19.5% increased proportion of healthcare professionals compared to people with diabetes being in agreement to the statement 'My learning was enhanced by sharing information and hearing stories from other people with diabetes'.

203 pre- and post-course survey paired responses were available for the statement '*I manage my diabetes well*' and 224 pre- and post-course survey paired responses were available for '*I know enough about my health*'. For both statements, users were more agreeable following completion of the course with the median response changing from *neutral* in the pre-course survey to *agree* in the post-course survey (statistically significant for both statements at p <0.001).

Free text responses to '*Is there anything you found particularly enjoyable or useful in the course?*' were highly variable and hence not formally coded. Generalised themes included users enjoying refreshing their knowledge or learning new things about type 2 diabetes and its management, the multimedia delivery of the course content (videos, text, quizzes) and hearing stories from other people with diabetes. Free text responses to '*Is there anything you feel would have improved the course?*' tended to focus on users seeking more detailed information on aspects of diabetes management. Users were asked if they had any difficulty accessing the site or resources, to which 89.0% (n=357) of users reported no specific issues. Other identified issues included video playback issues (3.5%), unfamiliarity with social media channels used (2.5%), login/registration issues (2.0%) and course navigation issues (0.7%). 244 people with diabetes provided consent to be contacted in future to allow the course's impact on diabetes outcomes to be assessed.

[Figure 1]

DISCUSSION

This MOOC had high retention and completion rates with 65.6% of registered users completing the course and appears to be highly appreciated by registrants. Online DSME offers increased flexibility compared to face-to-face alternatives regarding where and when users progress through course materials which may influence engagement. Remote access to DMSE is of clear benefit during the COVID-19 pandemic, allowing users to develop skills in self-management whilst social distancing in line with current public health guidelines. In addition, some users may simply prefer remote access to DSME with the reduced time commitment and travel costs associated with traditional DSME.

Restrictions were in place around when users could complete the course (2-day period, with additional 2 days to allow completion), in part due to limited availability of healthcare professionals for moderation of social spaces such as comment sections and social media questions. However, narrowing the access period also created more of an impetus, focus and a sense of community and excitement around the event. It also ensured a critical number of users interacting concurrently enabling social media, discussion forums and live events to work well, adding to the success of the programme. The COVID-19 pandemic has emphasised the risk of misinformation online, particularly via social media [21]. The risk of diabetes self-management misinformation will grow as both the online diabetes community expands and more people turn to online advice for self-management [22]. There are many reputable patient-facing information sources available in DSME, however information in diabetes-focused social communities can be of variable quality and safety [23]. A MOOC in DSME mitigates misinformation risk through provision of professional endorsed materials and enabling healthcare professional moderation of live comments/individual questions in line with accepted, evidence-based practice.

A significant proportion of users participating in the MOOC were not people with diabetes. This included healthcare professionals, people at risk of type 2 diabetes and family members or carers of people with diabetes. Bringing these groups together provides a novel vibrant learning environment. These groups are typically not invited to traditional DSME due to space limitation or concerns around patient confidentiality. An online MOOC allows an opportunity for a larger community to develop a wider understanding of type 2 diabetes in a way relevant to their personal or professional life. There is a scarcity of literature evaluating large scale social learning environments in chronic disease self-management. MOOCs aimed at patient education are available via platforms such as FutureLearn.com or Coursera.org, yet often are developed for healthcare professional consumption. Some authors have found when evaluating MOOCs aimed at healthcare professionals that patients contribute a large proportion of their audience [24], suggesting patients are interested in this medium of education delivery.

The pre-course survey was useful in establishing what users hoped to achieve through participating in the MOOC. The responses were broadly in line with the content of the course itself. The most common themes identified among users with type 2 diabetes were improving

glycaemic control, followed by developing general diabetes-related understanding, dietary advice and diabetes remission. User evaluation supplied in the post-course survey was highly positive, with most users finding the MOOC a useful, easy to follow learning experience that improved self-management motivation and confidence. Pre- and post-course surveys found that user self-reported health knowledge and diabetes management improved significantly. In addition, completion rates in this MOOC (65.6%) were significantly higher than typical MOOC completion rates of 5–10% [25].

A limitation of this initial evaluation is that it assesses only user self-reported experiences in the short-term. Although participants were asked to respond to the statement '*I manage my diabetes well*' before and after the course, it is clear that many aspects of the diabetes self-management may not yet have changed. Ideally, interventions such as this should be further assessed in terms of their impact on longer-term diabetes outcomes such as glycaemic control (HbA_{1c}), blood pressure, body mass index (BMI) and diabetes complications (e.g. retinopathy or foot disease). Access and collation of such data from this widely dispersed user group is challenging. A key advantage of this MOOC is its scalability, and although just under 1000 users took part, we believe this number was restricted due a limited sphere of influence in advertising and a short time period (~2 weeks) between initial advertisements and MOOC launch. This MOOC focused on type 2 DSME and future work aims to develop a similar course for type 1 DSME. Experience in delivering a MOOC affords many learning opportunities, both software and content related, which will allow for streamlined development of future MOOCs, aiming for improved accessibility and user experience.

Although the potential impact of this MOOC on glycaemic control is unclear, if this MOOC had a similar impact to other type 2 DSME programmes it may deliver a reduction in HbA_{1C} of approximately 9 mmol/mol at two years [10]. For a conservative estimate of the cost impact a UK prospective diabetes study outcomes model was used which applied an average HbA_{1C} reduction of approximately 4 mmol/mol. This results in an estimated total saving of approximately £28,000 over 2 years secondary to a reduction in events associated with diabetes and delivers an approximate return on investment of 6:1 [26]. Whilst DSME has previously been shown to be cost effective, it is unusual to demonstrate cost savings [27]. It is emphasised that these figures are estimated and serve mainly to illustrate potential cost savings associated with a high-volume, low-cost mechanism of DSME delivery. We aim to gathered self-reported outcomes in the 244 people with diabetes who have consented for recontact at 3 months, which may give some indication of medium-term impact.

Most users found the MOOC easy to use and did not report technical difficulties, although it is likely that this self-selected group have a high level of digital literacy. Digital alternatives to traditional DSME rely on technology, internet access and internet skills which are not universal [28]. Awareness of this digital inequality is important, particularly if digital solutions to DSME are to displace face-to-face interventions in future.

CONCLUSION

Online DSME shows great promise and MOOCs have potential to provide social learning in a structured, accessible and engaging manner. MOOCs are highly efficient and likely cost-effective, with low healthcare resource requirements per user, enabling release of staff for front line duties. Further understanding of the impact of a MOOC on diabetes outcomes is warranted. However, the highly positive user feedback and completion suggests that high quality DSME need not be sacrificed in the COVID-19 era.

References

1. Wake DJ, Gibb FW, Kar P et al. Endocrinology in the time of COVID-19: Remodelling Diabetes Services and Promoting Innovation. *Eur J Endocrinol*. 2020 Jun 5;1.
2. Fang L, Karakiulakis G, Roth M. Are patients with hypertension and diabetes mellitus at increased risk for COVID-19 infection?. *Lancet*. Respiratory Medicine. 2020 Apr 1.
3. Williamson EJ, Walker AJ, Bhaskaran K et al. OpenSAFELY: factors associated with COVID-19 death in 17 million patients. *Nature*. 2020 Jul 8:1-1.
4. Xue T, Li Q, Zhang Q, Lin W et al. Blood glucose levels in elderly subjects with type 2 diabetes during COVID-19 outbreak: a retrospective study in a single center. Available at SSRN 3566198. 2020 Mar 31.
5. National Institute for Health and Care Excellence. Type 2 diabetes in adults: management (2019). https://www.nice.org.uk/guidance/ng28/ (accessed 10th May 2020)
6. Davies MJ, D'Alessio DA, Fradkin J et al. Management of hyperglycaemia in type 2 diabetes, 2018. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetologia*. 2018 Dec 1;61(12):2461-98.
7. Chrvala CA, Sherr D, Lipman RD. Diabetes self-management education for adults with type 2 diabetes mellitus: a systematic review of the effect on glycemic control. *Patient Educ Couns*. 2016 Jun 1;99(6):926-43.
8. Cunningham SG, Wake DJ, Waller A et al. My Diabetes My Way: an electronic personal health record for diabetes. *Br J of Diabetes Vasc Dis*. 2013 May;13(3):143-9.
9. Greenwood DA, Gee PM, Fatkin KJ, Peeples M. A systematic review of reviews evaluating technology-enabled diabetes self-management education and support. J Diabetes Sci Technol. 2017 Sep;11(5):1015-27.
10. Steinsbekk A, Rygg L, Lisulo M et al. Group based diabetes self-management education compared to routine treatment for people with type 2 diabetes mellitus. A systematic review with meta-analysis. *BMC Health Serv Res*. 2012 Dec 1;12(1):213.
11. McNamee P, Murray E, Kelly MP et al. Designing and undertaking a health economics study of digital health interventions. *Am J of Prev Med*. 2016 Nov 1;51(5):852-60.
12. Breslow L, Pritchard DE, DeBoer J et al. Studying learning in the worldwide classroom research into edX's first MOOC. *Research & Practice in Assessment*. 2013;8:13-25.
13. Liyanagunawardena TR, Williams SA. Massive open online courses on health and medicine. *Journal of Medical Internet Research*. 2014;16(8):e191.
14. QISMET. (2020) Available online: https://www.qismet.org.uk/ (accessed 16th May 2020)
15. MyWay Digital Health. My Type 2 Diabetes. (2020) Available online: https://elearning.mydiabetes.com/courses/my-type-2-diabetes/ (accessed 16th May 2020)
16. Desmond. (2020) Available online: https://www.desmond-project.org.uk/ (accessed 16th May 2020)
17. X-PERT Health. (2020) Available online: https://www.xperthealth.org.uk/ (accessed 16th May 2020)

18. LearnDash. (2020) Available online: https://www.learndash.com/ (accessed May 9th, 2020)
19. WC3. Web Content Accessibility Guidelines (WCAG) Overview. (2020) Available online: https://www.w3.org/WAI/standards-guidelines/wcag/. (accessed 16th May 2020)
20. Gravity Forms. (2020) Available online: https://www.gravityforms.com/ (accessed May 9th, 2020)
21. Kouzy R, Abi Jaoude J, Kraitem A et al. Coronavirus goes viral: quantifying the COVID-19 misinformation epidemic on Twitter. *Cureus*. 2020 Mar;12(3).
22. Hilliard ME, Sparling KM, Hitchcock J et al. The emerging diabetes online community. *Curr Diabetes Rev*. 2015 Dec 1;11(4):261-72.
23. Litchman ML, Walker HR, Ng AH et al. State of the science: a scoping review and gap analysis of diabetes online communities. *J Diabetes Sci Technol*. 2019 May;13(3):466-92.
24. Wake DJ. The future of diabetes education. *Practi Diabetes Int*. 2019 Nov;36(6):196-200.
25. Davis D, Jivet I, Kizilcec RF et al. Follow the successful crowd: raising MOOC completion rates through social comparison at scale. In Proceedings of the seventh international learning analytics & knowledge conference 2017 Mar 13 (pp. 454-463).
26. Cunningham SG, Stoddart A, Wild SH et al. Cost-effectiveness of an online education platform and diabetes personal health record: analysis over 10 years. Poster presented at the International Diabetes Federation Conference; Korea; 2019 Dec 2–6.
27. Boren SA, Fitzner KA, Panhalkar PS et al. Costs and benefits associated with diabetes education a review of the literature. *Diabetes Educ*. 2009 Jan;35(1):72-96.
28. Hargittai E, Piper AM, Morris MR. From internet access to internet skills: digital inequality among older adults. *Univers Access Inf Soc*. 2019 Nov 1;18(4):881-90.

Legend

Figure 1: Post-course survey results summary
Each question is based on n=271–393 responses. Response options were a 5-point Likert-type scale including *strongly agree, agree, neutral, disagree* and *strongly disagree*. Users who self-identified as only healthcare professionals were excluded from responding to statements not relevant to them. The following statements were only analysed among participants with type 2 diabetes: 'The course helped me set my own diabetes goals', 'The course motivated me to manage my diabetes', 'The course will help me achieve my diabetes goals', 'The course will improve my confidence around managing diabetes' and 'I will change the way I manage diabetes as a result of this course'. The following statement was only analysed among people with or at risk of type 2 diabetes: 'The course has improved my overall health and wellbeing'.