Attitudes of UK based wound specialists towards the use of mobile applications in wound care delivery: a cross-sectional survey. Part 1: quantitative findings

KEY WORDS

- Digital
- Attitudes
- Barriers
- Enablers
- Wound healing

Introduction: This survey of wound care specialists in the UK aims to be the first study to establish the prevalence of mobile wound app use and the perceived barriers to their implementation in wound care. This article presents the quantitative findings of the study. **Method:** A cross-sectional survey of UK-based wound clinicians was undertaken to explore the current use of mobile applications in the field of wound care. A 40 question SurveyMonkey survey was used and distributed via closed Facebook groups for clinicians working in UK-based wound care services. Data analysis included calculation of Cronbach's alpha coefficient for attitude scales, summary statistics and thematic analysis of free text responses. Not reported in this paper The STROBE checklist was considered within the methodology of the study. **Results:** Overall, n=250 survey responses were received. Complete survey responses were received from n=153 wound clinicians. This included responses from 121 nurses and 29 podiatrists and from clinicians from all four devolved nations of the UK. Only 21–24% of clinicians reported using mobile applications for wound care at the time of this survey. Almost all (99.5%) of clinicians responding to the survey have access to a smartphone with most (58.7%) having both a personal and work smartphone **Conclusions:** It is evident that UK-based clinicians currently use mobile smartphones regularly, including within their clinical work, but do not currently use wound care focussed mobile applications. Barriers affecting the implementation of mobile applications in wound care services include a lack of interoperability between mobile applications and other IT infrastructure, poor Wi-Fi signal, negative attitudes towards technology, a lack of workforce diversity and bureaucratic obstructions. **Implications for practice:** Clinical leaders in wound care should consider the factors identified within this study when developing implementation strategies for new mobile application technologies into wound care services.

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In the context of wound care there are a growing number of mobile applications intended for use by healthcare professionals or patients receiving care. The functions available from these applications are numerous and include both advanced diagnostic capabilities such as the detection of infection, healing time estimates in addition to administrative functions such as product ordering and documentation of care (Shamloul et al, 2019). The integration of mobile application technology into routine wound care has the potential to improve the quality of care via the generation of big data on clinical outcomes, which are currently challenging to generate and/or analyse with the current use of paper records and heterogenous digital platforms (Dash et al, 2019). In addition to this, many wound applications contain functions allowing potentially more accurate and the faster assessment of wounds compared with traditional methods, which are associated with more effective treatment (Sigam and Denz, 2015, Yee et al, 2016, Wang et al, 2017, Foltynski, 2018, Budnevskiy et al, 2018).

There have been no studies to date investigating the prevalence of mobile application technology use in the UK, the attitudes towards or perceived barriers to the adoption of this technology. This cross-sectional survey of UK-based wound clinicians aims to establish the current use of this technological in UK wound services. In addition we want to assess attitudes towards mobile applications, potential barriers and enablers to implementation and identification of methodologies used for common clinical procedures that could be enhanced using mobile applications such as wound measurement, clinical documentation and photography. Understanding the current prevalence of use and attitudes towards the use of this technology may provide data to support the integration and further investigation of its value in clinical practice and how it can be best used to improve patient outcomes.

No major studies have evaluated barriers and enablers to the use of this technology within UK healthcare settings. This study sought to address these questions.

METHODS

A descriptive self-report cross-sectional survey design using a digital SurveyMonkey survey (premium version 2020, give software Momentive Inc) was used. Five-point Likert scale statements were used in addition to semi-open and free text option questions, the survey contained 41 questions in total.

Due to a lack of studies to date examining the current prevalence of the use of digital technologies in UK wound services cohort or case-control study designs may be of limited value when aiming to evaluate the barriers and enablers to the adoption of this technology. Without data indicating the prevalence of the use of mobile application technology in wound care services in this study it would not be possible to undertake a power calculation to design a robust case-control or cohort study (Jones et al, 2003).

STUDY AIM

To determine the prevalence of mobile application technology use among wound care clinicians working within the UK and identify enablers of and potential barriers to the implementation of this technology.

Objectives:

- Survey wound care clinicians working in the UK to establish the current use of mobile application technology in the delivery of wound care
- Determine wound specialists' attitudes towards the use of mobile wound application technology within wound care including the enablers and potential barriers to the implementation
- To determine what methods are currently used to achieve the most common three functions of contemporaneously available wound care mobile applications, specifically:
  - Documentation of wound care
  - Production and storage of clinical images
  - Measurement of wounds as part of assessment.

A pool of attitude statements and questions was generated to address the attitude objects identified via review of the literature. Reviews of similar web-based surveys on mobile applications in healthcare were also considered (Mayer et al, 2019; Singh and Alva, 2019) in addition to a review of the most recent 'Global diffusion of eHealth' survey by the World Health Organisation (2016) to help guide the development of questions. In addition, the authors' consensus on potentially relevant factors was included to generate the initial pilot survey following the principles of survey design described by Boynton and Greenhalgh (2004).

A pilot study involving n=10 participants identified using a convenience sample was conducted before the main study. Responses from the pilot study were not included in the analysis of the main study data. Data collection for the main study was obtained over an 8wweek period from April–May 2020.

Ethical considerations

A favourable ethical opinion was provided by the Cardiff School of Medicine ethics committee before the start of data collection. Participants were asked to read a participant information sheet and then consent digitally to take part in the study.

Sampling

A convenience sample of clinicians working mainly with wounds was used. There is currently no single organisation within the UK able to identify and/or contact clinicians in the UK currently working in wound care. Clinicians were therefore identified via

Table 1. Social media groups used to recruit participants	
Facebook Group	**Membership at time of survey distribution (April–May 2020)**
Tissue Viability Nurses UK	1100
Lower Limb Peripheral Arterial Disease Clinicians Network	2300
Journal of Community Nursing - JCN Group	4400
Lower Limb Clinicians Together (spelt 2gether on Facebook)	2700

membership of closed social media groups for wound care specialists including those listed in ***Table 1***.

These groups include clinicians working across multiple healthcare professions including specialist nurses, podiatrist and doctors.

Inclusion criteria:

- Registered health professional
- Working primarily within the field of wound care
- Responsible for the delivery of wound care within the UK.

Participants were invited to respond to the survey via posts within the Facebook groups, a follow-up post was posted after one week in all groups. Participants were screened against the inclusion/exclusion criteria via a series of questions within the survey. If the answers to these questions conflicted with the inclusion criteria, then the survey automatically ended. Repeat responses were prevented via use of the SurveyMonkey Internet Protocol (IP) address blocker which only allowed one-response per IP address.

Data analysis

Survey data were analysed using summary statistics. To indicate the reliability of the scales used to determine attitudes in the seven key domains, a Cronbach's alpha coefficient was calculated for each attitude scale using the Statistical Package for Social Sciences (SPSS, IBM Inc) version 26.0.

A SurveyMonkey filter was used when analysing data to exclude incomplete responses during the production of the summary statistics. Incomplete responses were automatically removed within analyses conducted using SPSS.

RESULTS

The final analysis included data obtained from 201 respondents. A full summary of respondent demographics can be seen in ***Table 2***. Of the 201 respondents who answered questions on demography, current ownership and use of mobile applications in wound care, only n=153 respondents responded to all Likert scale statements. There were no notable differences in the demographics between respondents who submitted partial responses and those who provided complete responses.

Only n=4 (2%) indicated that they do not have clinical roles. All but one respondent had personal access to a smartphone with the majority (n=118, 58.7%) having access to more than one smartphone.

Current use of mobile application technology in UK wound care services

A similar proportion of respondents from nursing (n=35; 21.9%) and podiatry (n=9; 23.7%) backgrounds reported that they are already using, or currently trialling, mobile applications in clinical practice. All respondents reported to use mobile applications in their wound care practice, indicating that mobile applications are already used ubiquitously in wound care even if the functions used are not directly related to the provision of wound care.

The most used functions of mobile applications included wound photography and documentation of care. Notably, many respondents reported the use of mobile applications for non-wound specific tasks such as making video calls, receiving referrals, managing expenses and maintaining a work diary ***(Figure 1)***.

LIKERT SCALE RESPONSES

Funding

Most respondents agreed or strongly agreed that funding is a barrier to using mobile application (n=109; 71.3%). A minority of respondents felt that they have sufficient funding to support the integration of mobile application technology into wound care practice (n=40; 26.3%). However, a third

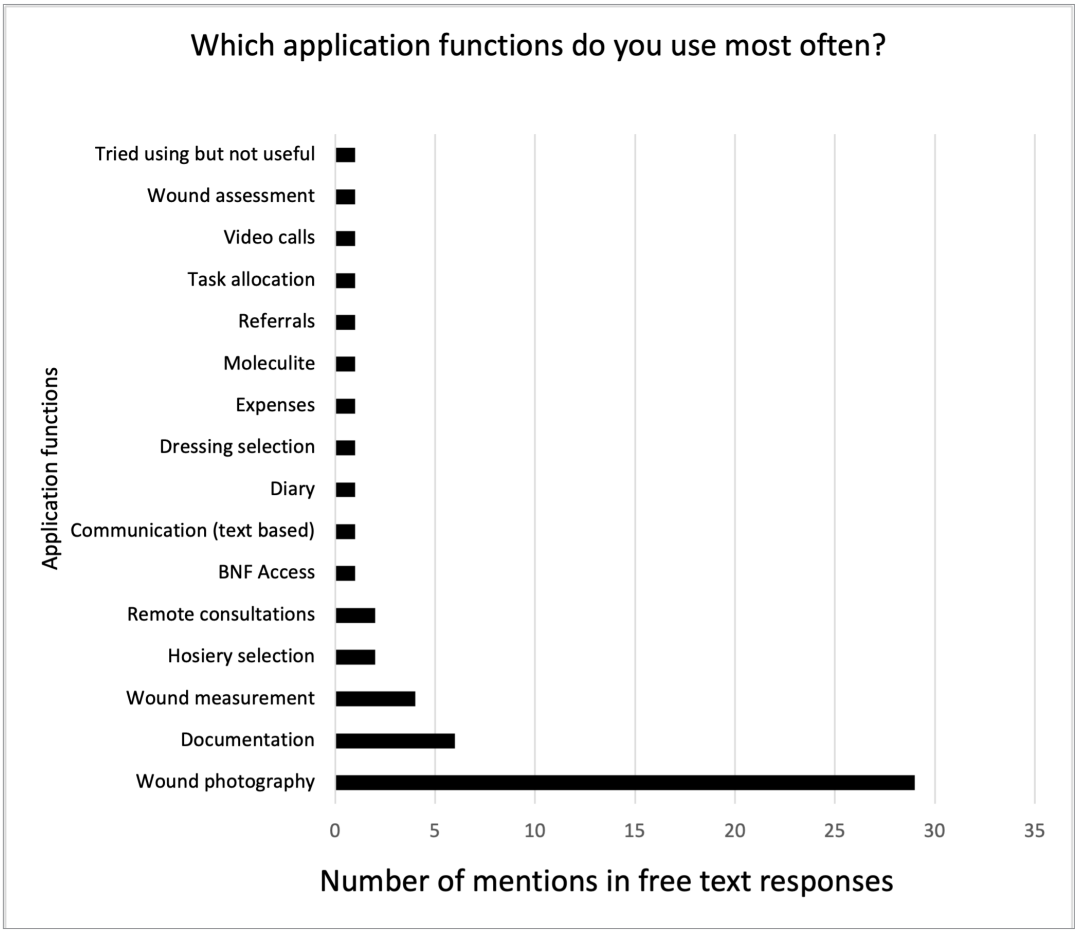
Table 2. Respondent demographics		
Demographics	**Included in analysis for objective 1 n(%)**	**Included in final analysis for all three objectives n**
Professional group		
Tissue Viability Nurse	106 (53.5%)	n=83
Community Nurse	36 (18.2%)	n=28
Podiatrist	36 (18.2%)	n=28
Leg Ulcer Nurse	6 (3%)	n=4
Nurse (unclear role)	5 (2.5%)	n=4
Vascular Nurse	2 (1%)	n=1
Lymphoedema Nurse	2 (1%)	n=1
Clinical Lead (podiatrist)	2 (1%)	n=2
Wound Care Nurse	1 (0.5%)	n=0
Clinical director (nurse)	1 (0.5%)	n=1
Clinical Lead (nurse)	1 (0.5%)	n=1
Academic (nurse)	2 (1%)	n=0
Nurse (total)	160 (80.8%)	n=121
Podiatrist (total)	38 (19.2%)	n=29
Missing data	3 (1.5%)	n=3
Location		
England	152 (80.9%)	n=112
Scotland	22 (11.7%)	n=16
Wales	9 (4.8%)	n=8
Northern Ireland	5 (2.7%)	n=4
Missing data	n=13 (6.5%)	n=13
Professional experience		
0–5 years	50 (24.9%)	n=33
6–10 years	43 (21.4%)	n=38
11–15 years	41 (20.4%)	n=34
16–20 years	33 (16.4%)	n=24
21+ years	34 (16.9%)	n=25
Smartphone access		
0–5 years	50 (24.9%)	n=33
I own a personal smartphone	79 (39.3%)	n=58
I have a smartphone provided by my employer	3 (1.49%)	n=3
I have both a personal and a work smartphone	118 (58.7%)	n=92
I do not own a smartphone	1 (0.5%)	n=0
Total	**201**	**153**

of respondents (33.6%) neither agreed nor disagreed that funding is an issue. Majorities agreed that they would adopt wound applications if they had sufficient funding (n=128; 83.7%).

Legal Regulation

Reponses to statements about legal regulation initially indicated that most respondents did not hold strong feelings about legal regulation with only n=18 (11.76%) indicating that they felt that legal regulation was a barrier to using mobile applications. Nearly half (n=73; 48.03%) of respondents neither agreed nor disagreed that there is already sufficient legal regulation of mobile

Figure 1. Features of mobile applications currently used in clinical wound care



applications. Despite this, most respondents (n=94; 60.79%) felt that if there was more robust legal regulation that they would adopt the technology into their practice.

Demand for technology

Reponses to statements related to the demand for mobile application technology among wound care clinicians demonstrate an overwhelming positive attitude towards its use. Most respondents (n=126; 82.35%) agreed that the functions available on mobile applications for wound care are useful. Similarly, there was majority agreement that there is a demand for the functions available on mobile applications (n=122; 79.74%). A smaller majority agreed that mobile applications are the future of wound care (n=101; 66.02%).

Healthcare IT infrastructure

There was majority agreement (n=109; 70.58%) that IT infrastructure is a barrier to the implementation of mobile applications. A minority felt that current infrastructure is sufficient to support the use of mobile applications in wound care (n=55; 36.19%). Most respondents felt that if there was more robust IT infrastructure, they would be more likely to adopt mobile applications in their practice (n=109; 70.58%)

Clinical effectiveness of mobile application functions

The scale indicating attitudes towards the clinical effectiveness of mobile applications showed poor reliability (α=0.35) indicating low consistency in attitudes reported in each question. This was the least statistically reliable attitude scale used in this survey.

Most respondents (n=99; 44.71%) neither agreed nor disagreed that the functions currently available on mobile applications are supported by robust studies. Majorities did agree however, that if there were more robust studies evaluating mobile applications, they would be more likely to adopt them in clinical practice (n=116; 75.82%) and

that mobile applications could improve clinical practice in wound care (n=139; 90.85%). Notably, a minority of respondents (n=20; 13.16%) indicated they were either unsure (n=9) or disagreed (n=11) to the statement that they would 'allow a relative to have their wound assessed using a mobile application.'

Impact on health inequalities

The majority disagreed that the use of mobile applications may have a negative impact on health inequalities (n=81; 52.94%). Despite this, the majority agreed that patients who could monitor their own wounds using a smartphone might receive better care than those who cannot (n=79; 51.62%). Most respondents agreed that if mobile technology were more readily available, they would be more likely to use functions requiring patients' use of the technology (n=115, 75.17%).

Acceptability of mobile applications by clinicians

There was no clear consensus on the impact of the difficulty of using mobile applications on adoption of the technology, with roughly equal numbers of respondents agreeing that it may be a barrier (n=58; 38.16%) as those disagreeing (n=61; 40.13%). However, majority agreed that smartphone applications are easy to use (n=105; 68.63%), if more training was available related to the use of mobile applications, they would be more likely to adopt the technology (n=112; 73.2%). Notably, almost all respondents reported that they use mobile applications unrelated to wound care without difficulty (n=135; 88.24%).

Documentation of wound care, imaging and wound measurement

Respondents indicated that they currently use a variety of methods to document care. The majority indicated that they use a combination of digital methods to document care, such as using a mobile application or applications in combination with other electronic records (n=123; 54.3%). A minority indicated they use only paper records (n=21; 13.7%) (***Table 3***).

For obtaining images of wounds over half of respondents indicated that they use a smartphone (n=78; 50.35%). A minority of staff reported using dedicated medical illustrations staff or dedicated cameras (n=54; 34.8%). Of 18 free-text responses n=9 (50%) indicated that health professionals use combinations of methods to obtain images.

DISCUSSION

Table 3. Current wound care documentation, imaging and wound measurement practices

How do you currently document the wound care you deliver?	**n (%)**
Paper records	21 (13.7%)
Electronically using a computer	70 (45.8%)
Electronically using a mobile application	8 (5.2%)
Combination of paper and electronic records	48 (31.4%)
Combination of mobile application and electronic records	5 (3.3%)
How do you currently obtain and store clinical images of wounds?	**n (%)**
Using dedicated medical illustrations staff	25 (16.1%)
Clinician using a dedicated camera	29 (18.7%)
Clinician using a smartphone	78 (50.35%)
Using a tablet (e.g. iPad)	18 (11.6%)
Images taken on smartphone then transferred to computer	4 (2.6%)
Patients own photos	1 (0.65%)
How do you currently obtain and store clinical images of wounds?	**n (%)**
Ruler (e.g. tape measure / Q-tip method)	144 (93.5%)
Digital planimetry	1 (0.65%)
Using a mobile application	4 (2.6%)
Tracing method	5 (3.3%)

Responses to the survey broadly supported the initial hypotheses that the seven domains, explored via Likert scale statements, identified as potential enablers or barriers to the adoption of mobile application technology are potentially important factors influencing the adoption of this technology in wound care practice in the UK. The only exception to this were responses to questions about the demand for mobile application technology in wound care, which indicated there was consensus that there is demand for this technology in UK wound care services.

At present there is little data indicating challenges associated with the acquisition of new technologies by wound care teams and notably, the costs of technology are not included in the most recent burden of wounds study (Guest et al, 2020). This could indicate a lack of data demonstrating how much money is currently being spent on technologies to support the delivery of wound care. Alternatively, it is possible that budgets currently do not account for these costs or there may be challenges associated with justifying the cost of largely untested new technologies for use in NHS services. If it is not currently reported, the costs of technologies used by wound care clinicians and patients should be included in future economic analyses of wound care services. This would allow a more robust understanding of the costs of these technologies to be established and budgets adapted accordingly. It is possible that the reported perceived funding inadequacies reflect challenges in the process of obtain funds rather than the lack of monies available currently in the UK for implementing technology. More in-depth analysis of the abilities for wound care professionals to access funding or support in accessing funding to implement mobile application technologies is required.

Responses to both Likert scale statements, and open questions indicated that IT infrastructure is a barrier to the implementation of mobile applications in wound care. Notably, multiple respondents indicated that the use of this technology actually increased the burden on health professionals due to having to either convert digital documentation back into paper formats or to provide services to teams who did not yet use the technology. It is evident that implementation of mobile applications is unlikely to be successful if it is implemented unilaterally without consideration of the broader digital infrastructure involved in patient care or that of neighbouring services. Other barriers associated with IT infrastructure included poor Wi-Fi signal. This was particularly problematic in rural community settings. A study by Chen et al (2017) investigating the use of mobile applications in dietetic practice, in Australia, New Zealand and Britain, reported that access to Wi-Fi and to smartphones were the most commonly reported barriers to implementing the technology. It is unlikely that access to smartphones remains a significant barrier in the UK and this was not reported within this cross sectional survey. The proportion of adults owing smartphones has increased consistently since 2008 from 17% to 78% of the general population including 95% of 16–24-year-olds in 2018 (Ofcom, 2018). Notably, 99.5% of respondents indicated that they have access to a smartphone with 58.7% having access to both a work and a personal smartphone.

Measuring the acceptability of mobile applications by wound care clinicians was limited as only 25% of respondents reported to have used mobile applications in wound care. This was reflected in a lack of consensus over whether this represented a significant barrier. It was, however, clear that most respondents (n=135; 88.2%) own and use smartphone applications unrelated to wound care regularly and without difficulty with a small minority (n=7; 4.5%) reporting to have difficulty operating smartphone applications. Further studies are required to establish the technology acceptability associated with operating specific functions in specific circumstances. For example, applications used by patients for monitoring surgical site incisions or podiatrists using an application for measuring wounds and documenting care.

STUDY LIMITATIONS

The study was limited by an insufficiently robust pilot study. This involved only n=10 participants who were all nurses. Issues unique to podiatrists were therefore unidentified and not explored in the main study, creating a bias towards barriers and enablers reported by nurses.

A power calculation was not possible to

determine a sample size required to create a representative sample. Response rates could not be determined due to the recruitment strategy used for the study which relied on clinicians who are members of closed Facebook groups responding via a shared link. In addition, it was notable that the majority of respondents were from the tissue viability population. As there is no agreed upon definition on what constitutes a 'wound specialist' a broad inclusion criteria was necessary to avoid exclusion of potentially valuable data. This may however, limit comparability of the findings of this study with those using alternative definitions or focussing on specific job roles or titles. Given that the survey was shared via social media, the survey may be biased in favour of clinicians who are already familiar with mobile technology.

CONCLUSION

This cross-sectional survey has highlighted that mobile application technology for wound care is not used widely within UK wound care services, with between 21–24% of nurses and podiatrists reportedly using mobile applications currently. Despite this, wound photography is predominantly obtained using a mobile device such as a smartphone or iPad. Almost all (99.5%) of clinicians responding to the survey have access to a smartphone with most (58.7%) having both a personal and work smartphone. UK-based clinicians currently use mobile smartphones regularly, including within their clinical work, but do not currently use wound care focussed mobile applications. The most used functions of mobile applications in wound care currently include wound photography and documentation of care, with notable non-use of higher functions such as wound area measurement or tissue type analysis. Most respondents reported using manual planimetry to measure wounds.

It is unclear how important issues related to legal regulation of mobile applications, clinical effectiveness of application functions, technology acceptability or impact on health inequalities are in influencing the adoption of mobile applications in wound care services. Overall, overwhelmingly positive attitudes towards the potential benefits of integrating mobile applications into wound care were expressed by respondents. WUK

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