Digital Solutions for the Marginalised in Society: A Review of Systems to Address Homelessness and Avenues for Further Research

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Abstract. The use of technology to access information and other services is increasingly seen as an integral element to enhance participation in society. Recent years have seen an increase in research focusing on information and communication technologies for marginalised groups such as those experiencing homelessness. With reports of increasing levels of homelessness in Europe and beyond, an understanding of the current literature exploring how information and communication technologies are used to address homelessness and how this may impact the well-being of the homeless is of relevance to policymakers and social service organisations. This research aims to address this by investigating the use of digital solutions to serve those experiencing homelessness. The study explored and synthesised peer-reviewed literature to understand the use of technology to address homelessness. Preliminary findings highlight perceptions and use of various technologies among homeless people and the communication patterns of the homeless. Overall, the research shows how technology enables the homeless to access information and services and why it is important for vulnerable groups to be socially and digitally connected.

Keywords: Marginalisation, Homelessness, Digital Inclusion, Information and Communication Technologies

1 Introduction

The marginalised are those whose position in the society is weak, are drawn towards the dark sides of society and are excluded from everyday societal interactions which limits their access to economic, social and political resources [1]. These could include the homeless, low-income communities, those living in underserved areas amongst others as outlined in the special issue discussing the role of information and communication technology (ICT) in addressing major societal challenges [2]. Those in marginalised situations face significant barriers and inequities in entitlement as they go through unfamiliar environments and situations in which they need to construct meaningful lives [3, 4]. Communication difficulties, low health literacy,

lack of social support and other forms of socioeconomic problems adversely affect the capacity of the marginalised to successfully navigate complex and changing health and social care systems [4]. The use of ICT by marginalised groups provides an opportunity to study how certain ICT-mediated activities can contribute to their social inclusion. Not being able to access, interpret, and use relevant informational resources may exclude them and push them further to the margins of society [3].

The advancement of ICT has led to a hyperconnected world characterized by immediate access to information, institutions, and people. The multi-modality of technology–the ability to combine text, image, audio and video–not only satisfies the communication needs of marginalised groups, but is also useful for establishing and promoting a sense of community [5, 6]. Digital solutions have become effective means to create opportunities for all, to further individual autonomy and individual ability to use technology to access public services. Digital solutions have the potential to improve people's lives and achieving a more inclusive information society is one of the key ambitions of information society policy. A society that is open, inclusive and accessible to all citizens [7, 8]. The central place of IT in this digital world creates a need to investigate the part IT plays in determining the extent to which people can participate in a hyperconnected society [5].

There is already sufficient confirmation of societal disparities, which could perhaps be ameliorated by the use of ICTs [1, 2, 9]. This requires the scientific community and other stakeholders to investigate ways to empower citizens by developing the tools and approaches to bridge the gap between civil society and decision-makers [8, 10]. Becoming empowered can be a big step for people who have been constantly devalued. Changing their state of affairs and fueling their willingness to act requires development of initiatives focused on promoting users' resources for participation [11].

This preliminary research aims to address this by investigating the use of digital solutions to address the needs of the homeless. There has been an increase in research focusing on homelessness and technology (see [12, 13]). And with the number of homeless increasing[1], there is a pressing need for more research on how housing policies supported by ICT can be used to address short and long-term challenges of homelessness. This research has the following underpinnings: the increasing problem of homelessness represents a unique, urgent, and poorly understood challenge with the potential for many technological solutions. There needs to be an in-depth understanding of the unique design challenges posed by those who are homeless [12]. Especially, as the information needs of the marginalised in society are multi-faceted, difficult to ascertain, and much more complex than assumed by stakeholders [14]. Therefore, the main research question is: *What kinds of digital solutions are used to address the challenges the homeless face?* This question seeks to understand the use of technology to address some of the challenges the homeless face in the context of information systems.

[1] Here's how Finland solved its homelessness problem

The rest of the paper is organized as follows. First, we present the theoretical background about the homeless and use of digital solutions for homelessness. Second, we outline the review process. Third, the results of the review are presented. Lastly, we present the conclusion and avenues for further research.

2 Background

2.1 Defining homelessness

How homelessness should be defined is a fundamental and persistent problem and it remains an enduring social issue which has been analysed and interpreted from a wide range of theoretical and practical disciplines [15, 16]. A robust definition of homelessness is necessary to produce meaningful statistics on the size and characteristics of homeless populations, which are of critical importance for informed policymaking. The definition is useful if it allows for accurate and reliable identification and classification of homeless people so that policies can be developed to respond to different manifestations of homelessness and monitor the effectiveness of such interventions [15].

There is a general consensus within the literature that being homeless is more than just being without a home. It is a consequence of a set of individual, systematic and structural factors that impact those affected [17, 18]. Homelessness can be characterized by marginalisation, social exclusion and a lack of opportunity for meaningful activity [18]. People who experience homelessness are profoundly impacted by social exclusion. Homelessness may be understood "*as a set of consequences that arise when social exclusion occurs in a context within which little or no assistance is given to those who experience it*" and individuals are left to fend for themselves in an environment that does little to support them [17]. Homelessness represents a lack of access to adequate housing and there are different degrees of homelessness, including rough sleeping (primary homelessness); living in temporary or transitional accommodation with uncertain tenancy (secondary homelessness); and marginal housing with poor amenities or over-crowding (tertiary homelessness) [18].

2.2 Digital Solutions for Homelessness

Within a context where our societies are increasingly and rapidly digitalised, access to services and goods will transform, thus affecting our societies[2]. As ICTs are seen as having the potential to alter how social, political, and economic relations are played out, they are a useful resource to promote participation in society [3, 9]. The concept of exclusion also features prominently in the information society discourse where access to and knowledge of ICTs are portrayed as either exacerbating exclusion or seen as a platform to create inclusiveness [9]. Access to digital resources can promote social inclusion, and digital inclusion for all is tasked with creating opportunities for

[2] FEANTSA – Digital Inclusion and Homelessness

everyone and enhancing individual autonomy and capability. The main objective is to remove obstacles in the widest sense for equitable participation in society [7, 8].

A growing body of work in information systems, human computer interaction and social sciences research is calling for an in-depth understanding of the needs of people who are homeless or at risk of becoming homeless (see the list of reviewed articles in Table 2). Recent research also suggests that the homeless are increasingly tech-savvy and technologies are becoming ubiquitous element in the lives of individuals experiencing homelessness [12, 13, 19].

In a study investigating mobile phone use among the homeless, Eyrich-Garg [19], found that a significant proportion of the sample they interviewed had a mobile phone. Mobile phones make communication and access to one's social support network easier for homeless individuals which could, in turn, lead to better health outcomes. Technology could also be used to enhance communication between the homeless and healthcare providers [19]. And the research by Eyrich-Garg [19] suggests that service providers and researchers should consider incorporating mobile phones into their prevention, intervention, aftercare, and data collection efforts as electronic connectivity could be important in addressing the challenges faced by this vulnerable population.

Sala and Mignone [19] found a positive relationship between ICT use among individuals experiencing homelessness and health outcomes. Greater access to information and social connectedness supposedly gained through ICTs may improve the health and social outcomes of individuals experiencing homelessness. However, the evidence was inconclusive, and little is known about the ways in which these populations utilise or leverage ICTs for their own benefit. In the analysis of users' perceptions of an application designed for the homeless, Burrows et al. [12], found seven themes relevant for the design of technology for those experiencing homelessness. These included: empowerment and control, hopefulness, assurance, cared for, identify and belonging, clarity and being unashamed. That is, the extent to which technology supported individuals to access critical services, to develop a sense of belonging, gain a sense of clarity, feel empowered, appreciated and independent [12]. These are similar to the main themes that emerged from Sala and Mignone's [19] review: social connectedness, identity management and instrumental purposes.

3 Research method

Using technology to access information and other services is increasingly seen as an integral element to enhance participation in society and to address social exclusion [3, 9]. As digital solutions have become increasingly ubiquitous mechanisms for maintaining and building social relationships, and for instrumental purposes, the relevance of ICTs and the benefits or potential harms of their use is a subject area of increasing interest [13]. Thus, the present article aims to investigate use of digital solutions to address the endemic problem of homelessness. The main question is: *What kinds of digital solutions are used to address the challenges the homeless face?*

To answer this question, the author undertook a search of peer reviewed literature to understand how ICT is being used to address these challenges.

Literature reviews are an appropriate method to systematically and critically assess the state of research on a particular topic and they help to understand the phenomenon as a whole, its meaning and its relationships [20]. The review process is driven by scholars' need to report progress in a particular area of research. There are reviews on mature topics and those on emerging issues that would benefit from exposure to new theoretical foundations to develop agendas for future research [21]. The present review focused on the latter. The study maps out and categorises existing literature about digital solutions to address homelessness [22].

Even though the search was broad, the focus was on studies that examined use of technology by the homeless themselves, those technologies that are/could be used by service providers to address the needs of the homeless and/or both. As in [13], no specific typologies of homelessness were examined in this study. Publications which only mentioned homeless as a term amongst others, often without context or relation to technology use, were excluded from further review. The review focused on primary studies that were published in peer-reviewed academic journals and conference proceedings, excluding, for example, editorials, reviews, white papers, books, (unpublished) dissertations, and working papers. This was done to ensure consistency between the studies.

To identify relevant academic sources, we conducted electronic searches for the years between 2006 and 2019 in several academic databases (ProQuest, EBSCOhost (Academic Search Ultimate), ACM, ScienceDirect, Springer and Web of Science). The search was conducted using combinations of the following search terms:

(*homeless*) AND (technolog* OR communication technolog*) OR ("digital inclusion" OR e-inclusion)*

Applying the criteria above, the search resulted in 198 articles. After removing duplicates, the author selected publications based on their relevance by reading the titles and abstract. This resulted in 32 articles presented in Table 1.

Table 1. Results of literature search

Database	Hits	Relevant	References
ProQuest	3	0	n/a
EBSCOhost	36	8	[23] – [30]
ACM	47	12	[31] – [43]
ScienceDirect	21	5	[44] – [49]
Springer	62	2	[50], [51]
Web of Science	29	5	[51] – [55]

4 Results

In the retrieved articles, digital solutions for homelessness were applied to different user groups and in different environments. The articles identified the widespread use of ICTs amongst homeless populations as in [13] and [19]. Overall, the articles analysed access to ICT, perceptions and use of various ICTs among homeless people, compared technology use between the homeless and other groups in the population and the communication patterns of the homeless (Table 2).

Table 2. Summary of analysed articles

Author(s), Objective	Method, Subjects	Findings
[23], Investigate the association between social media use and HIV risk behaviours among homeless youth	Survey conducted in 4 waves, N = 1,046	Reinforced earlier studies that found homeless youth actively use social media to communicate about a range of issues
[24], Empower women by engaging them into a self-learning model	Interviews and observations, women (16-60) at a shelter home	Access to the learning system shaped the participants' interests towards using computers
[25], Examine the potential of mHealth interventions among homeless youth to improve access to health information and services	Mixed method, Focus group, N=52, structured survey, N = 41	Mobile coverage was high, but many had challenges in maintaining connectivity. Mobile phones were useful in obtaining social support
[26], Explore the engagement of homeless drug users (HDUs) with ICT	Qualitative (Interviews) Longitudinal, Initial N=30, follow-up N=22	HDUs often had access to ICTs, used ICTs, and wanted to engage with them more.
[27], Improve outcomes for homeless individuals by producing research to enhance homeless services delivery	Case study of university-community partnership that implement a homeless management IS	The study demonstrates how partnerships, innovative technology delivery and social work research can reduce homelessness.
[28], Investigate the impact of including technology into operations for a program addressing chronic homelessness	Case study, Interviews, N=133	By adding technology enhancement, the program was also able to expand its ability to provide reliable and responsive support
[29], [30], [34], [35], [37], [45], [54], [55] Analyse access to and perceptions of technology and use of various ICTs among homeless people in Madrid [29] and youths in different cities in the United States.	Structured interview, N = 188 [29]. Retrospective interview, N=100 [30]. Participant observation, semi-structured interviews, N=39 [34]. Observation and interviews N=34 (Age 13 -25) [35]. Qualitative	Reinforce the importance of mobile phones when homeless. ICTs are used to varying degree among the homeless. Technology use is linked to collaborative practices, social connectedness, business purposes (job and housing search), and for leisure. Digital
[48], Compare technology use between college students		

Author(s), Objective	Method, Subjects	Findings
and young homeless adults. [52], Identify and reveal the digital communication patterns and experiences of the homeless	(photo elicitation interview, and Interviews), N=13 [37]. Interview, N=100 [45]. Survey, N=303, [48]. Mixed methods, N=65 [52]. Survey, N=201 [54]	divide has a negative impact on some marginalised populations, and it is important to bridge the gap between what people know and what they need to know.
[31], Investigate housing assignment among homeless youth. [33], to devise an optimal strategy to minimise violence among the youth	Develop and test an algorithm for assigning youth to housing programs. Develop a model to capture non-progressive diffusion of violence N = n/a	The algorithm was effective in assigning youth to housing and it can be deployed as a core algorithm for an intelligent agent, Studies indicated the strategy outperformed those based on centrality measures
[32], Investigate how the challenges associated with homelessness impact security and privacy practices and needs	Semi-structured interviews, N = 18	Based on themes from interviews, provided a framework to support the homeless and other marginalised groups.
[36], Examine challenges faced in deployment of two agents for social influence maximization, which assist service providers in maximizing HIV awareness in real-world homeless-youth social network	Pilot study (survey for analysis), N = 173	Instructive challenges and proposed solutions for assisting the deployment of agents to assist service providers in optimising their intervention strategies.
[38], Report on the adoption and use of a community resource manager for staff and residents at a shelter for homeless mothers	Qualitative (Focus groups, Interviews) and ethnographic observation, N=25	Innovative technologies can open new lines of communication between the homeless and their care providers, leading to more efficient and frequent communications, better coordination, and improved awareness of resources and needs.
[39], Explore issues of technology adoption and coordination in non-profit homeless outreach centres	Qualitative (observations = 53 hours, interviews), N = 15	Non-profit organisations that can develop better integration of ICTs and a strong community of practice are better positioned to provide coordinated care to some of the most vulnerable members of society.
[40], Study and compare the value expression in Tweets by the homeless. [43],	Quantitative content analysis, N=32 [40] Quantitative content	Values are expressed both implicitly and explicitly through opinions, judgments, and

Author(s), Objective	Method, Subjects	Findings
Examine patterns of follow relationships on Twitter	analysis (cluster analysis and visualisation), N=476 [43]	sarcastic statements and a broad range of individuals used Twitter for self-advocacy and connectedness as they experienced homelessness
[41], Explores how to support the homeless and other marginalised communities to connect with each other and social services online.	Quantitative content analysis, N=32	Methods for identifying values and several implications for considering values in online communities as a first step in the design of ICTs.
[42], To reflect on fieldwork from case studies of severe life disruptions such as homelessness and share sketches that depict the lived reality of finding a "new normal"	Case studies	Extend existing understanding of technology use during the performance of daily living and show how technology can be used to mitigate the consequences of disruptive life events.
[44], Understand how technology may be used to better engage homeless youth in case management	4 Interviews (baseline, 1-week, 6-week, and 3-month follow-up), N = 97 (Age 18–21)	Technology holds promising implications for effectively engaging and retaining homeless youth in case management services.
[46] Report on the development and findings of a curriculum to develop homeless youth's life skills for technology and digital media	Descriptive case study, N > 75	Education in information technology and digital media can create an engaging setting for learning skills and building relationships useful for escaping homelessness.
[47], Investigate the feasibility of using cell phones to collect ecological momentary assessment (EMA) data with homeless crack cocaine-addicted adults treated in an intensive outpatient treatment program.	Quantitative (survey), N=30 Participants received automated calls daily for 14 consecutive days.	The usefulness of EMA as a potential intervention and suitability of mobile phones as a reliable survey tool.
[49], Investigate where sustainable financial resource for ICT programs can be obtained and address key elements affecting the adoption of the Internet by the homeless and underserved in Taiwan.	Descriptive case study	Practical solutions for financial problems and a foundation for comparative analyses of the relevance of organizational structures to integrate people at the bottom of the pyramid into e-society and reduce poverty.
[50], Understand the meaning, experience, and design of ICTs to improve the welfare of young homeless people.	Design research	Precautions and suggestions of how and when to intervene with ICT when addressing problems caused by homelessness.

Author(s), Objective	Method, Subjects	Findings
[51] Examine the implications for Australians experiencing homelessness of data use necessitated by large-scale digitisation of government services and other everyday interactions.	Multiple triangulation study	Digital inclusion approaches have not sufficiently addressed the digital harms that come about through digital participation, and there is a need to focus on exposing and countering these.
[53] To investigate how socio-technical systems help homeless young people to succeed broadly in employment	Value-sensitive design, focus groups, N=28	Barrier and possible solutions to employment for homeless young people. Design insights for a socio-technical system for job search.

The articles addressed how technology could support the concerns of homeless women [42], the youth [30, 54] those suffering from HIV [33, 36], and how algorithmns could be deployed to autonomously manage household assignments of youths subject to resource constraints [31] amongst other related topics addressing the challenges of homelessness.

Seven of the studies highlighted the importance of mobile communication and reported on the levels of mobile phone usage by the homeless. In the study by Massimi et al. [42] investigating the role of technology in life disruptions, they learned that a staff shelter for homeless mothers could extend their reach by providing facilities to encourage mobile communication as the shelter was only open at night. The homeless mothers were already coping with information overload and helping them restore order and timing to the information they received would help them make better use of resources [42]. Dependence on smartphones for access to information and communication when homeless, in combination with the design and regulation of urban spaces, structures the mobilities of homeless young people, resulting in distinctive connectivity needs and barriers [51]. The research by Humphry [51] revealed how those experiencing homelessness are resourceful at getting their digital needs meet.

Le Dantec et al. [37] reported 76% of participants owned a mobile phone in their study investigating the use of a system that integrated a shared display, the Web and mobile phones to help the residents and staff at a shelter stay connected. The system became a stable medium for sharing information that helped the staff be more effective and helped the residents feel more connected. As a summary regarding the use of mobile technologies among the homeless, they are an essential means for maintaining contact with peers and they open up new lines of communication with their care providers leading to more efficient and frequent communications, better coordination, and improved awareness of resources and needs [38].

Other articles investigated the expression of values through opinions, judgements and sarcastic comments and self-identity in online social networks [40, 41, 55]. This research highlighted the range of homelessness characteristics displayed in online biographies and the perception of users on helpfulness (as it relates to social connectedness [19]) and wealth. Although these studies focused on online social

environments, they resulted in similar themes as those in [12, 13] which studied user values and emotions. The studies also highlighted the importance of online social networks as avenues for social participation for the homeless that helps them to develop and maintain social ties and stave away their sense of alienation from society [55].

The nature of ICT utilization by individuals experiencing homelessness is often dependent on individual factors such as mental health, addiction histories, pre-existing social factors, and time spent homeless ([13, 35, 37]. Although mostly beneficial, increasingly digitalized societies also bare challenges and can negatively affect people's lives. Digital engagement brings both a cost and responsibility shift to citizens, especially those already on the fringes of society, who face unique, urgent and poorly understood problems that some do not have the resources or skills to address [56, 57]. Some of these challenges, associated with financial security, can limit the inclusivity of technology design [32]. Therefore, developers of technology need to understand that digital inclusion of the vulnerable may take time and prioritize the issues that can limit inclusion [32].

5 Conclusions and Further Research

The use of technology to tackle societal challenges has been receiving increased attention, however, there is still a need for research on how technology can be used to benefit different marginalised groups. The concrete measures that effectively promote social inclusion and what the marginalised are actually able to do and achieve with ICTs [3, 6]. To this end, the author reviewed the literature to understand the research on digital inclusion for those experiencing homelessness.

Due to its preliminary nature, this research has a few limitations. First, forward, and backward searches were not conducted, thereby limiting the scope of the research. It also lacks the synthesis and analysis of a structured review [22]. Second, the review results are only up to date as of December 2019. Third, more information systems literature on digital and social inclusion and ICT4D should be covered in more detail. However, this might be challenging due to the multidisciplinary research question posed in the current study and the multidisciplinary nature of information systems [21]. There are plans to carry out more in-depth reviews of literature that covers the key goals of ICT, stakeholder requirements, outcomes of interventions and the effectiveness of ICT in supporting integration processes, which the retrieved articles did not adequately address.

Additional research is also needed to identify and compare the effects and outcomes ICT tools may have in bridging the gap for digital and social inclusion among homeless people and other vulnerable groups[3]. There are further plans to conduct surveys and interviews to better understand stakeholders' concerns and their perceptions of digital solutions for inclusion.

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After getting a clearer understanding of the stakeholders' needs, existing digital interventions and defining the key goals of these interventions, the research will propose concrete solutions for implementing digital solutions to serve the needs of the homeless and other marginalised groups. The proposed solutions will highlight the following issues:

1. That the addressed problems apply to the marginalised
2. Development of the intervention(s) involves the marginalised
3. The marginalised have the capabilities to use these interventions and
4. The interventions have a beneficial effect on the livelihoods of the marginalised

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References

1. Sam, S.: Exploring Mobile Internet Use Among Marginalised Young People in Post-Conflict Sierra Leone. The Electronic Journal of Information Systems in Developing Countries. 66, 1–20 (2015). https://doi.org/10.1002/j.1681-4835.2015.tb00475.x.
2. Majchrzark, A., Markus, M.L., Wareham, J.: Designing for Digital Transformation: Lessons for Information Systems Research From the Study of ICT and Societal Challenges. MIS Quarterly. 40, 267–278 (2016). https://doi.org/Article.
3. Andrade, A.D., Doolin, B.: Information and Communication Technology and the Social Inclusion of Refugees. MIS Q. 40, 405–416 (2016). https://doi.org/10.25300/MISQ/2016/40.2.06.
4. O'Donnell, C.A., Burns, N., Mair, F.S., Dowrick, C., Clissmann, C., van den Muijsenbergh, M., van Weel-Baumgarten, E., Lionis, C., Papadakaki, M., Saridaki, A., de Brun, T., MacFarlane, A.: Reducing the health care burden for marginalised migrants: The potential role for primary care in Europe. Health Policy. 120, 495–508 (2016). https://doi.org/10.1016/j.healthpol.2016.03.012.
5. Carter, M., Armstrong, D.J., Lee, A.S., Loiacono, E.T., Thatcher, J.B.: Social inclusion in a hyperconnected world. 19th Americas Conference on Information Systems, AMCIS 2013 - Hyperconnected World: Anything, Anywhere, Anytime. 4, 3011–3013 (2013).
6. AbuJarour, S., Krasnova, H.: Understanding the role of ICTs in promoting social inclusion: The case of syrian refugees in Germany. Proceedings of the 25th European Conference on Information Systems, ECIS 2017. 1792–1806 (2017).
7. Almuwil, A., Weerakkody, V., El-Haddadeh, R.: A conceptaul study of the factors influencing e-inclusion. Proceedings of the European, Mediterranean and Middle Eastern Conference on Information Systems - Informing Responsible Management: Sustainability in Emerging Economies, EMCIS 2011. 2011, 198–209 (2011).
8. Weerakkody, V., Dwivedi, Y.K., El-Haddadeh, R., Almuwil, A., Ghoneim, A.: Conceptualizing E-Inclusion in Europe: An Explanatory Study. Information Systems Management. 29, 305–320 (2012). https://doi.org/10.1080/10580530.2012.716992.

9. Trauth, E.M., Howcroft, D.: Social inclusion and the information systems field: Why now? IFIP International Federation for Information Processing. 208, 3–12 (2006). https://doi.org/10.1007/0-387-34588-4_1.
10. Wolske, M., Williams, N.S., Johnson, E.O., Noble, S.U., Duple, R.Y.: Effective ICT Use for Social Inclusion. iConference 2010. (2010).
11. de Freitas, C., Martin, G.: Inclusive public participation in health: Policy, practice and theoretical contributions to promote the involvement of marginalised groups in healthcare. Social Science & Medicine. 135, 31–39 (2015). https://doi.org/10.1016/j.socscimed.2015.04.019.
12. Burrows, R., Mendoza, A., Sterling, L., Miller, T., Pedell, S.: Evaluating Ask Izzy: A Mobile Web App for People Experiencing Homelessness. In: Proceedings of the 17th European Conference on Computer-Supported Cooperative Work: The International Venue on Practice-centred Computing and the Design of Cooperation Technologies - Exploratory Papers, Reports of the European Society for Socially Embedde (2019). https://doi.org/10.18420/ecscw2019_ep17.
13. Sala, A., Mignone, J.: The benefits of information communication technology use by the homeless: a narrative synthesis review. Journal of Social Distress and the Homeless. 23, 51–67 (2014). https://doi.org/10.1179/1573658x14y.0000000006.
14. Mervyn, K., Simon, A., Allen, D.K.: Digital inclusion and social inclusion: a tale of two cities. Information, Communication & Society. 17, 1086–1104 (2014). https://doi.org/10.1080/1369118X.2013.877952.
15. Amore, K., Baker, M., Howden-Chapman, P.: The ETHOS Definition and Classification of Homelessness: An Analysis. European Journal of Homelessness. 5, 19–37 (2011).
16. Anderson, I., Filipovič Hrast, M., Finnerty, J.: Researching homelessness: Challenging exclusion? Social Inclusion. 4, 1–4 (2016). https://doi.org/10.17645/si.v4i4.774.
17. Pauly, B., Wallace, B., Perkin, K.: Approaches to evaluation of homelessness interventions. Housing, Care and Support. 17, 177–187 (2014). https://doi.org/10.1108/HCS-07-2014-0017.
18. Neale, K., Buultjens, J., Evans, T.: Integrating service delivery in a regional homelessness service system. Australian Journal of Social Issues. 47, 243–261 (2012). https://doi.org/10.1002/j.1839-4655.2012.tb00245.x.
19. Eyrich-Garg, K.M.: Mobile phone technology: A new paradigm for the prevention, treatment, and research of the non-sheltered “street” homeless? Journal of Urban Health. 87, 365–380 (2010). https://doi.org/10.1007/s11524-010-9456-2.
20. Rowe, F.: What literature review is not: diversity, boundaries and recommendations. Eur J Inf Syst. 23, 241–255 (2014).
21. Webster, J., Watson, R.T.: Analyzing the Past to Prepare for the Future: Writing a Literature Review. MIS Q. 26, xiii--xxiii (2002).
22. Grant, M.J., Booth, A.: A typology of reviews: an analysis of 14 review types and associated methodologies. Health Info Libr J. 26, 91–108 (2009). https://doi.org/10.1111/j.1471-1842.2009.00848.x.
23. Barman-Adhikari, A., Rice, E., Bender, K., Lengnick-Hall, R., Yoshioka-Maxwell, A., Rhoades, H.: Social Networking Technology Use and Engagement in HIV-Related Risk and Protective Behaviors Among Homeless Youth. Journal of Health Communication. 21, 809–817 (2016). https://doi.org/10.1080/10810730.2016.1177139.
24. Dangwal, R., Sharma, K.: Impact of HiWEL learning stations on women living in shelter homes. British Journal of Educational Technology. 44, 26–31 (2013). https://doi.org/10.1111/j.1467-8535.2012.01353.x.

25. Jennings, L., Lee, N., Shore, D., Strohminger, N., Allison, B., Conserve, D.F., Cheskin, L.J.: U.S. Minority Homeless Youth's Access to and Use of Mobile Phones: Implications for mHealth Intervention Design. Journal of Health Communication. 21, 725–733 (2016). https://doi.org/10.1080/10810730.2015.1103331.
26. Neale, J., Stevenson, C.: Homeless drug users and information technology: A qualitative study with potential implications for recovery from drug dependence. Substance Use and Misuse. 49, 1465–1472 (2014). https://doi.org/10.3109/10826084.2014.912231.
27. Patterson, D.A., Cronley, C., West, S., Lantz, J.: Social justice manifest: A university-community partnership to promote the individual right to housing. Journal of Social Work Education. 50, 234–246 (2014). https://doi.org/10.1080/10437797.2014.885244.
28. Stefancic, A., Henwood, B.F., Melton, H., Shin, S.M., Lawrence-Gomez, R., Tsemberis, S.: Implementing Housing First in rural areas: Pathways Vermont. American Journal of Public Health. 103, 206–210 (2013). https://doi.org/10.2105/AJPH.2013.301606.
29. Vázquez, J.J., Panadero, S., Martín, R., del Val Diaz-Pescador, M.: Access to new information and communication technologies among homeless people in madrid (spain). Journal of Community Psychology. 43, 338–347 (2015). https://doi.org/10.1002/jcop.21682.
30. Pollio, D.E., Batey, D.S., Bender, K., Ferguson, K., Thompson, S.: Technology use among emerging adult homeless in two U.S. cities. Social Work (United States). 58, 173–175 (2013). https://doi.org/10.1093/sw/swt006.
31. Chan, H., Tran-Thanh, L., Wilder, B., Rice, E., Vayanos, P., Tambe, M.: Utilizing Housing Resources for Homeless Youth Through the Lens of Multiple Multi-Dimensional Knapsacks. AIES 2018 - Proceedings of the 2018 AAAI/ACM Conference on AI, Ethics, and Society. 41–47 (2018). https://doi.org/10.1145/3278721.3278757.
32. Sleeper, M., Matthews, T., O'Leary, K., Turner, A., Woelfer, J.P., Shelton, M., Oplinger, A., Schou, A., Consolvo, S.: Tough Times at Transitional Homeless Shelters: Considering the Impact of Financial Insecurity on Digital Security and Privacy. In: Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA (2019). https://doi.org/10.1145/3290605.3300319.
33. Srivastava, A., Petering, R., Kannan, R., Rice, E., Prasanna, V.K.: How to stop violence among homeless: Extension of voter model and intervention strategies. Proceedings of the 2018 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining, ASONAM 2018. 83–86 (2018). https://doi.org/10.1109/ASONAM.2018.8508641.
34. Roberson, J., Nardi, B.: Survival Needs and Social Inclusion: Technology Use among the Homeless. In: Proceedings of the 2010 ACM Conference on Computer Supported Cooperative Work. pp. 445–448. Association for Computing Machinery, New York, NY, USA (2010). https://doi.org/10.1145/1718918.1718993.
35. Woelfer, J.P., Hendry, D.G.: Homeless young people's experiences with information systems: Life and work in a community technology center. Conference on Human Factors in Computing Systems - Proceedings. 2, 1291–1300 (2010). https://doi.org/10.1145/1753326.1753520.
36. Yadav, A., Wilder, B., Rice, E., Petering, R., Craddock, J., Yoshioka-Maxwell, A., Hemler, M., Onasch-Vera, L., Tambe, M., Woo, D.: Influence maximization in the field: The arduous journey from emerging to deployed application. Proceedings of the International Joint Conference on Autonomous Agents and Multiagent Systems, AAMAS. 1, 150–158 (2017). https://doi.org/10.1017/9781108669016.005.
37. Le Dantec, C.A., Edwards, W.K.: Designs on Dignity: Perceptions of Technology among the Homeless. In: Proceedings of the SIGCHI Conference on Human Factors in

Computing Systems. pp. 627–636. Association for Computing Machinery, New York, NY, USA (2008). https://doi.org/10.1145/1357054.1357155.
38. Le Dantec, C.A., Farrell, R.G., Christensen, J.E., Bailey, M., Ellis, J.B., Kellogg, W.A., Edwards, W.K.: Publics in practice: Ubiquitous computing at a shelter for homeless mothers. Conference on Human Factors in Computing Systems - Proceedings. 1687–1696 (2011). https://doi.org/10.1145/1978942.1979189.
39. Le Dantec, C.A., Edwards, W.K.: The view from the trenches: Organization, power, and technology at two nonprofit homeless outreach centers. Proceedings of the ACM Conference on Computer Supported Cooperative Work, CSCW. 589–598 (2008). https://doi.org/10.1145/1460563.1460656.
40. Koepfler, J.A., Fleischmann, K.R.: Studying the values of hard-to-reach populations: Content analysis of tweets by the 21st century homeless. ACM International Conference Proceeding Series. 48–55 (2012). https://doi.org/10.1145/2132176.2132183.
41. Koepfler, J.A., Shilton, K., Fleischmann, K.R.: A stake in the issue of homelessness: Identifying values of interest for design in online communities. ACM International Conference Proceeding Series. 36–45 (2013). https://doi.org/10.1145/2482991.2482994.
42. Massimi, M., Dimond, J.P., Le Dantec, C.A.: Finding a new normal: The role of technology in life disruptions. Proceedings of the ACM Conference on Computer Supported Cooperative Work, CSCW. 719–728 (2012). https://doi.org/10.1145/2145204.2145314.
43. Koepfler, J.A., Hansen, D.L.: We Are Visible: Technology-Mediated Social Participation in a Twitter Network for the Homeless. In: Proceedings of the 2012 IConference. pp. 492–493. Association for Computing Machinery, New York, NY, USA (2012). https://doi.org/10.1145/2132176.2132261.
44. Bender, K., Schau, N., Begun, S., Haffejee, B., Barman-Adhikari, A., Hathaway, J.: Electronic case management with homeless youth. Evaluation and Program Planning. 50, 36–42 (2015). https://doi.org/10.1016/j.evalprogplan.2015.02.002.
45. Eyrich-Garg, K.M.: Sheltered in cyberspace? Computer use among the unsheltered 'street' homeless. Computers in Human Behavior. 27, 296–303 (2011). https://doi.org/10.1016/j.chb.2010.08.007.
46. Hendry, D.G., Woelfer, J.P., Harper, R., Bauer, T., Fitzer, B., Champagne, M.: How to integrate digital media into a drop-in for homeless young people for deepening relationships between youth and adults. Children and Youth Services Review. 33, 774–782 (2011). https://doi.org/10.1016/j.childyouth.2010.11.024.
47. Freedman, M.J., Lester, K.M., McNamara, C., Milby, J.B., Schumacher, J.E.: Cell phones for ecological momentary assessment with cocaine-addicted homeless patients in treatment. Journal of Substance Abuse Treatment. 30, 105–111 (2006). https://doi.org/10.1016/j.jsat.2005.10.005.
48. Guadagno, R.E., Muscanell, N.L., Pollio, D.E.: The homeless use Facebook?! Similarities of social network use between college students and homeless young adults. Computers in Human Behavior. 29, 86–89 (2013). https://doi.org/10.1016/j.chb.2012.07.019.
49. Huang, S.C., Cox, J.L.: Establishing a social entrepreneurial system to bridge the digital divide for the poor: a case study for Taiwan. Universal Access in the Information Society. 15, 219–236 (2016). https://doi.org/10.1007/s10209-014-0379-7.
50. Woelfer, J.P., Hendry, D.G.: Designing ubiquitous information systems for a community of homeless young people: Precaution and a way forward. Personal and Ubiquitous Computing. 15, 565–573 (2011). https://doi.org/10.1007/s00779-010-0341-5.

51. Humphry, J.: ‘Digital First’: homelessness and data use in an online service environment. Communication Research and Practice. 5, 172–187 (2019). https://doi.org/10.1080/22041451.2019.1601418.
52. Humphry, J.: Looking for Wi-Fi: youth homelessness and mobile connectivity in the city. Information, Communication & Society. (2019). https://doi.org/10.1080/1369118X.2019.1670227.
53. Hendry, D.G., Woelfer, J.P., Duong, T.: U-District Job Co-op: constructing a future vision for homeless young people and employment. INFORMATION TECHNOLOGY & PEOPLE. 30, 602–628 (2017). https://doi.org/10.1108/ITP-05-2015-0117.
54. Rice, E., Barman-Adhikari, A.: Internet and Social Media Use as a Resource Among Homeless Youth. JOURNAL OF COMPUTER-MEDIATED COMMUNICATION. 19, 232–247 (2014). https://doi.org/10.1111/jcc4.12038.
55. Taylor, P.-F., Narayan, B.: #Homeless but at home in cyberspace. INFORMATION RESEARCH-AN INTERNATIONAL ELECTRONIC JOURNAL. 21, (2016).
56. Foster, C., Heeks, R.: Conceptualising Inclusive Innovation: Modifying Systems of Innovation Frameworks to Understand Diffusion of New Technology to Low-Income Consumers. The European Journal of Development Research. 25, 333–355 (2013). https://doi.org/10.1057/ejdr.2013.7.
57. McLean, R., Cushman, M.: Exclusion, inclusion and changing the face of information systems research. Information Technology & People. 21, 213–221 (2008). https://doi.org/10.1108/09593840810895993.