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CO-CREATION: AN APPROACH TO DEVELOPING DIGITALIZED MENTAL HEALTHCARE

ABSTRACT

Mental health problems are increasing worldwide and a need for the development of digital mental health services has been noticed globally. A variety of novel technologies are currently being introduced in mental health services. The development process of health services should be done in collaboration with end-users and companies: it is crucial to develop health services with end-users and companies, because the resources of public healthcare are limited and the services are complex. A co-creation is a prominent facilitator of digital transformation, and it increases acceptability and user-friendliness. Especially, there are concrete benefits of co-creation models for stakeholders when developing needs-based products and services for healthcare. The aim of this article is to introduce the use of the co-creation process throughout the development of dynamic treatment monitoring solutions for mental health issues, and to present the preliminary results of a pilot test. Based on the results of the pilot test, the co-creation process improved the solution, and healthcare professionals were willing to use it. The solution increased the sensibleness of their work. In addition, digitalization enabled individual follow-up between care visits. Results tentatively point towards the usefulness and benefits of a data-driven monitoring system for mental health treatment.

INTRODUCTION

Mental health problems are increasing worldwide. Especially depression has become one of the most common causes of burden and disability [1]. Annually, 1.5% of Finnish people get a mental health illness, and approximately 5-7% of Finnish people have suffered depressive symptoms during their life [2]. In Finland, the national mental health strategy and programme for suicide prevention 2020-2030 refers to preventive and early interventions to promote mental health, and also suggests improving the accessibility of mental health services [3]. The current Covid-19 pandemic has increased psychiatric symptoms and disrupted mental health services [4]. A need for the development of digital mental health services has been noticed globally and, for example, in Europe, the European Commission has presented some guidelines to improve digital health and care [5]. In Finland, the development of digitalized mental health services is steered by the Ministry of Finance [6], and the need for low-entry and easy-to-use services and self-care interventions has been recognized [7].

During the past decade, digital health has become an important part of healthcare following the expanding use of information and communication technologies, sensors and wearable devices, robots and chatbots, and telehealth systems [8]. A variety of novel technologies are currently also being introduced in mental health services, like mHealth (refers to mobile health) applications and interventions [9], chatbots [10] and robots [11]. Recent studies have found that mHealth has a strong potential, for example, to increase the effectiveness of care among depressed older adults [12], decrease depressive symptoms among women with moderate to moderately severe post-partum depressive symptoms [13], increase the possibility of treatment response among adolescents with chronic illnesses [14] and support mood-monitoring among young people [15]. Although mHealth has become more popular, the evidence for its effectiveness is limited, and further research is needed to strengthen the evidence for mHealth [16].

Along with the rapid development of technology, the use of mobile applications and wearable technology has increased [17]. It has been evaluated that 30% of Finnish people have some kind of activity tracker [18] and, in comparison, every fifth American uses a smartwatch or activity tracker [19]. Patientgenerated health data refers to the data collected through mobile health applications and wearable devices [17, 20]. Studies have investigated patient-generated health data integration into electronic patient health records and suggested that integration may help to personalize the care [19, 20]. Personalized care can improve the quality and effectiveness of treatments [20]. Previous studies indicate that the use of patient-generated health data supports patient-clinician communication and health awareness, and furthermore, personalized and collaborative mental healthcare [20, 22, 23]. Patient-generated health data enables a more patient-centred approach to assessing symptoms and enhances the understanding of a patient's own experiences [21]. However, the utilization of patient-generated health data is scarce and needs more systematic development [21].

A co-creative framework in the healthcare digitalization development process enables different stakeholders to work towards shared goals, and results in better user experiences and improves services at organizational level [24]. In addition, in the field of healthcare, the development process of health services should be done in collaboration with end-users and companies: it is crucial to develop health services with end-users and companies, because the resources of public healthcare are limited and the services are complex [25]. Previous studies investigating digitalization in different kinds of healthcare contexts have suggested that co-creation is a prominent facilitator of digital transformation [26], and that co-creation increases acceptability and user-friendliness [25]. Especially, there are concrete benefits of co-creation models for stakeholders when developing needsbased products and services for healthcare [27]. It is worth noticing that in Finland, there are few organizations that aim to innovate, test and co-create digitalized solutions in the field of healthcare, like the OuluHealth Labs in Oulu and KYS Living Lab in Kuopio.

AIM

The aim of this article is to introduce the use of the co-creation process throughout the development of dynamic treatment monitoring solutions for mental health issues, and to present the preliminary results of a pilot test.

CO-CREATION PROCESS

There are various models for co-creation [27]. The present work described here is "From need to solution", developed in the Co-created Health and Well-being project (CoHeWe). CoHeWe was a 6AIKA project (project code A74215) funded by the European Structural and Investment Funds -ERDF. In this "From need to solution" model, the process is managed by an orchestrator who launches the process, engages professionals and refines needs into a challenge. This co-creation process includes three main phases: 1) from need to challenge, 2) meeting the challenge, and 3) from challenge to solution [28].

During the first phase, the actual needs are identified by gathering ideas, needs and wishes related to services or a service system from healthcare professionals and clients. After this identification, the gathered data is analysed, and the orchestrator modifies the challenge. In the second phase, the challenge is made visible, and companies can present their proposals for solution challenges. The suitable solutions and partners for the co-creation process are selected through market dialogue. In the third phase, an agile pilot test is designed, conducted, evaluated and reported. The aim of the process is to generate valuable feedback for the company and help healthcare organizations find appropriate solutions with needed impact. [28.]

CASE MEDIFIED – DATA-DRIVEN SOLUTION FOR MENTAL HEALTH TREATMENT

The gathering of needs started in the city of Oulu at the end of 2018 with surveys targeted at citizens, and workshops targeted at healthcare professionals. Many needs were identified, and mental health care-related need was very extensive- to find a digital solution to support the mental health of mental health patients. About the same time in Tampere, the same need was identified, and they had found a company, Medified Solutions Ltd., which met the predetermined requirements for this challenge. Their data-driven solution includes a mobile application for patients and cloud-based software for healthcare professionals. The idea for the solution has arisen from healthcare practice needs. The solution aims to capture a dynamic overview of the individual mental health treatment process and enhance mental health recovery with a supportive mobile application with self-reflective features. Cumulative clinical information from the treatment process can be provided for healthcare professionals, who can utilize the treatment monitoring dashboard that includes data-driven insights in clinical decision making and personalized treatment planning. Patients can also use the application independently as self-treatment on a daily basis.

The co-creation process began early in 2020 when Medified's solution was selected to participate in a first agile pilot test conducted in Oulu and Tampere. The solution was launched in 2019 and the early-stage functional prototype was used as a pilot test version. A goal of the pilot was to help the company in their product development process, and further, to launch the mobile application. The results of the pilot test were promising, and the company has continued developing its solution. Notably, the mobile application was first called Mielipäiväkirja but renamed as Medified in May 2021.

In the spring of 2021, the developed version of the solution was piloted and co-created in one of the Finnish hospital districts for a period of five months. This pilot test was conducted in primary care, where patient participants were randomly selected from the general patient pool. Selection criteria included depressive symptoms, age over 18 years, owning a personal mobile device, and stable mental health conditions to exclude unstable, suicidal and psychotic patients. The healthcare professional participants were primarily psychiatric nurses working in a primary care unit. Selected professionals were remotely trained to recruit suitable patients, and to use the Medified solution. During the piloting phase, patients used the mobile application and healthcare professionals the cloud-based software. In addition, facilitated co-creation meetings were held with the professionals, biweekly to obtain qualitative and structured feedback along the implementation process. Continuous feedback from the healthcare professionals and patients, based on spontaneously aroused development needs, was used to co-create and iterate the solution. During the pilot, participating healthcare organizations, clinicians, startup company and the local test bed function identified a need for systematic project outcome and co-creation success factor assessment (including software usability, benefits and challenges).

METHODS

Stakeholders co-created an electronic feedback survey to obtain quantitative results on how predetermined goals were satisfied during the piloting phase. The survey was conducted for both professionals and patients as separate electronic surveys after the piloting phase, in May of 2021. The survey that targeted healthcare professionals included a total of 30 questions was divided into four main categories, which were: 1) solution's impact on improving the care processes, 2) solution's benefits for the psychiatric patients, 3) patient safety aspects, and 4) product development needs. The feedback survey mainly consisted of questions with a standardized 5-point Likert scale and some open answers. During the co-creation process, outcomes of the pilot project were defined by participating healthcare professionals and the organization's management. Part of the co-creation process was to identify the solution's development needs with quantitative and qualitative methods during the pilot project. These product development-related findings are not presented in this article. The co-creation process

was primarily done with healthcare professionals, and patient results are not presented here. All healthcare professionals gave their informed consent, and their feedback results are presented in this article.

PRELIMINARY RESULTS

The pilot study included eight healthcare professional participants, who were psychiatric nurses (n = 7) and a psychologist (n = 1). Five out of eight (63%) healthcare professionals answered the final feedback survey of the fivemonth pilot period. Two professionals opted out due to work-related changes. The median clinical working experience of the answering participants was 11-15 years (range 1-20 years).

Most of the professionals (80%) agreed or strongly agreed that the use of the solution promotes the implementation of patient-oriented care, and all agreed that the information in the solution helps in the treatment planning (*Figure 1*). Eighty per cent of the professionals strongly agreed and 20% agreed that the solution helped them with outpatient treatment monitoring, and most agreed (80%) that using the solution would promote patient recovery (*Figure 2*). None of the professionals disagreed or strongly disagreed with the benefits of using the solution. Evaluating patient safety and the effect on documentation were found to be difficult since many of the participating professionals gave neutral answers. All professionals agreed or strongly agreed that the information collected with the solution was reliable (*Figure 3*).



IMPROVEMENT OF THE CARE PROCESS (N=5)

Figure 1. Accumulated professional feedback on solution's effect on the care process on a 5-point Likert scale.



DIGITAL TREATMENT MONITORING PATIENT BENEFITS (N=5)

Figure 2. Accumulated professional feedback on digital mental health treatment monitoring patient benefits on a 5-point Likert scale.





Figure 3. Accumulated professional feedback on solution data reliability and patient safety aspects on a 5-point Likert scale.

DISCUSSION

These were preliminary results from a pilot test, and therefore the sample was small, indicating non-generalizable results. Nevertheless, the results are in line with previous feedback, and tentatively point towards the usefulness and benefits of a data-driven monitoring system for mental health treatment. This finding is in line with the results of the review by Rubeis [29], who summarized that the use of e-mental health applications has a positive influence on depressive symptoms. Also, Wahle et al. [30] found a reduction in self-reported depression symptom severity after the usage of a mobile application. In addition, the results of this pilot test indicate a problem-solution fit and good usability of the solution, since all the participating professionals were willing to continue the use of the solution after the pilot phase as an additional clinical tool in their treatment and care monitoring processes. The utilization of developed technology is improved when digitalized healthcare solutions meet the needs of the users: patients [31] as well as healthcare professionals [32].

The co-creation process requires motivation and commitment from not only healthcare professionals and organizations, but also from the company involved. Regardless, this approach should be considered when developing and implementing digitalized mental health services, because it is a reasonable way to develop solutions that are based on the actual needs of users [28]. Co-creation enables active participation not only for healthcare professionals but also for patients, and therefore it is important that organizational facilities and structures enable participation in the co-creation process [33]. And from an organizational perspective, managers of different levels have a remarkable role, because, agreeing with Garmann-Johnsen [33], they often are enablers for co-creation. Moreover, the digital transformation requires practical middle management strategies that enables co-creation [34]. In addition, it is important to consider the organizational and healthcare professional level attitudes and beliefs towards the development and use of technology, because these can either enhance or prevent the development and utilization of digitalized services [34, 35].

Based on the preliminary results, a more systematic and holistic evaluation of the usability and impact of the solution use in the clinical context is needed to co-develop the solution and to assess the product-market fit more thoroughly.

CONCLUSION

The co-creation process improved the solution, and healthcare professionals were willing to use it. The solution also increased the sensibleness of their work. In addition, digitalization enabled individual follow-up between care visits. Results of this cocreation pilot suggest that this kind of data-driven solution for mental health treatment could be a useful tool to be used in mental health services. Moreover, digitalized solutions can create value not only for the patient but also for healthcare professionals, and these solutions can improve mental health treatment. At organizational level, it is important to evaluate the effectiveness of digitalized solutions to support knowledgebased management. Digitalized solutions should be developed and validated carefully, and this kind of development requires systematic co-creation and collaboration between professionals, patients, companies and researchers, because it is crucial that solutions meet existing needs and fulfill requirements. Cocreation, and test bed and innovation activities are important links between companies and the field, and these kinds of activities should be utilized more effectively in the field of mental healthcare

Conflict of Interest

V.K. is a co-founder of Medified Solutions Ltd, owns a large share of stocks, and raises salary from the company. J.Ku. is a co-founder of Medified Solutions Oy, owns a large share of stocks, and raises salary from the company.

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References

1. WHO. Mental disorders [Internet]. Available from: https://www.who.int/news-room/fact-sheets/detail/mental-disorders, 2019.

2. Duodecim. Depressio. National Care Guidelines [Internet]. Available from: https://www.kaypahoito.fi/hoi50023, 2021.

3. Ministry of Social Affairs and Health. *National Mental Health Strategy and Programme for Suicide Prevention* 2020–2030 [Internet]. Available from: https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/162053/STM_2020_6. pdf?sequence=4&isAllowed=y, 2021.

4. WHO, *Mental health & COVID-19* [Internet]. Available from: https://www.who.int/teams/mental-health-and-substance-use/ covid-19, 2021.

5. European Commission. Digital health and care [Internet]. Available from: https://ec.europa.eu/health/ ehealth/home_en, 2020.

6. Ministry of Finance. *Digitalisaation edistämisen ohjelma 2020-2023* [Internet]. Available from: https://vm.fi/ documents/10623/1464506/Digitalisaation+edist%C3%A4misen+ohjelman +toimintasuunnitelma/5cd124e3-ec59-2fcb-79e0a501f7ec404c/Digitalisaation+edist%C3%A4misen+ohjelman+toimintasuunnitelma.pdf, 2020.

7. Ministry of Social affairs and health. *Government to improve access to low-threshold mental health services* [Internet]. Available from: https://stm.fi/en/-/matalan-kynnyksen-mielenterveyspalveluiden-saatavuutta-parannetaan, 2020

8. Meskó B, Drobni Z, Bényei E, Gergely B, Györff, Z. *Digital health is a cultural transformation of traditional healthcare*. mHealth. 2017, 3, 38.

9. Ali EE, Chew L, Yap KY. *Evolution and current status of mHealth research: a systematic review*. BMJ Innovations. 2016, 2(1), 33-40.

10. Abd-Alrazaq AA, Rababeh A, Alajlani M, Bewick BM, Househ M. *Effectiveness and safety of using chatbots to improve mental health: Systematic review and meta-analysis.* J Med Internet Res. 2020, 22(7), e16021. doi:10.2196/16021

11. Riek LD. *Robotics technology in mental health care*. In D.D. Luxton (Ed.), Artificial intelligence in behavioral and mental health care (185–203). Elsevier Academic Press. 2015. doi:10.1016/B978-0-12-420248-1.00008-8

12. Grossman JT, Frumkin MR, Rodebaugh TL, Lenze EJ. *MHealth Assessment and Intervention of Depression and Anxiety in Older Adults*. Harvard Review of Psychiatry. 2020, 28(3)1, 203-214.

13. Avalos LA, Aghaee S, Kurtovich E, Quesenberrt C, Nkemere L, McGinnis MK. *A mobile health mindfulness intervention for women with moderate to moderately severe postpartum depressive symptoms: Feasibility study.* JMIR Mental Health. 2020. 7(1), e17405.

14. Lau N, Waldbaum S, Parigoris R, O'Daffer A, Walsh C, Colt SE, Yi-Fracier JP, Palermo TM, McCauley E, Rosenberg AR. *eHealth and mHealth psychosocial interventions for youths with chronic illnesses: Systematic review.* JMIR Pediatrics and Parenting. 2020. 3(2), e22329.

15. Dubad M, Winsper C, Meyer C, Livanou M, Marwaha S. *A systematic review of the psychometric properties, usability and clinical impacts of mobile mood-monitoring applications in young people*. Psychological Medicine. 2018. 48(2), 208-228.

16. Won JH, Ju SH, Mi JK. *Research Trends on Mobile Mental Health Application for General Population: A Scoping Review*. Int. J. Environ. Res. Public Health. 2021. 18(5):2459.

17. Cortez A, HSii P, Mitchell E, Riehl V, Smith P. *Conceptualizing a Data Infrastructure for the Capture, Use, and Sharing of Patient-Generated Health Data in Care Delivery and Research through 2024*. Office of the National Coordinator for Health Information. 2018.

18. Statista. Share of people, who used an activity tracker or a sports or smartwatch that measures movement, calorie consumption and the quality of sleep in Finland in 2016, by type of activity [Internet]. Available from: https://www.statista.com/statistics/557967/ activity-tracker-usage-in-finland-by-activity-type/, 2016.

19. Pew Research Center. *About one-in-five Americans use a smart watch or fitness tracker* [Internet]. Available from: https://www. pewresearch.org/fact-tank/2020/01/09/about-one-in-five-americans-use-a-smart-watch-or-fitness-tracker/, 2020.

20. Wu, DTY, Hin C, Bindhu S, Xu C, Sachdeva J, Brown J, Jung H. *Clinician Perspectives and Design Implications in Using Patient-Generated Health Data to Improve Mental Health Practices: Mixed Methods Study.* JMIR Formative research. 2020. 4(8):e18123.

21. Austin E, Lee JR, Amtmann D, Bloch R, Lawrence SO, McCall D, Munson S, and Lavallee DC. Use of patient-generated health data across healthcare settings: implications for health systems. JAMIA Open. 2020. 3(1):70-76.

22. Lordon RJ, Mikles SP, Kneale L, Evans HL, Munson SA, Backonja U, Lober WB. *How patient-generated health data and patient-reported outcomes affect patient–clinician relationships: A systematic review.* Health Informatics Journal. 2020. 26(4):2689-2706.

23. Lavallee DC, Lee RJ, Austin E, Bloch R, Lawrence SO, McCall D, Munson SA, Ney-Hurwit MB, Amtmann D. *mHealth and patient generated health data: stakeholder perspectives on opportunities and barriers for transforming healthcare*. MHealth. 2020. 6:8.

24. Sjödin D, Parida V, Kohtamäki M, Wincent J. An agile co-creation process for digital servitization: A micro-service innovation approach. Journal of Business Research. 2020. 112:478-491.

25. Ricciardi W, Pita Barros P, Bourek A, Brouwer W, Kelsey T, Lehtonen L. *How to govern the digital transformation of health services*. European Journal of Public Health. 2019. 29:7-12.

26. Dugstad J, Eide T, Nilsen ER, Eide H. *Towards successful digital transformation through co-creation: a longitudinal study of a four-year implementation of digital monitoring technology in residential care for persons with dementia.* BMC Health Service Research. 2019. 19:366.

27. Haukipuro L, Väinämö S, Hyrkäs P. *Innovation instruments to co-create needs-based solutions in a Living Lab*. Technology Innovation Management Review. 2018. 8(5):22-35.

28. Kauppinen S, Kesäniemi E, Luojus S, Lange P, Lönn N. *From need to solutions. Co-creation handbook for social welfare and health care* [Internet]. Available from: http://urn.fi/URN:ISBN:978-952-331-876-2

29. Rubeis, G. *E-mental health applications for depression: an evidence-based ethical analysis*. European Archives of Psychiatry and Clinical Neuroscience. 2020. 271:549–555.

30. Wahle F, Kowatsch T, Fleisch E, Rufer M, Weidt S. *Mobile sensing and support for people with depression: a pilot trial in the wild.* JMIR Mhealth AND Uhealth. 4(3):e111.

31. Pateel S, Akhtar A, Malins S, Wright N, Rowley E, Young E, Sampson S, Morriss R. *The acceptability and usability of digital health interventions for adults with depression, anxiety, and somatoform disorders: qualitative systematic review and meta-synthesis.* JMIR. 22(7):e16228

32. Stawarz K, Preis C, Tallon D, Wiles N, Coyle D. *User experience of cognitive behavioral therapy apps for depression: an analysis of app functionality and user reviews.* JMIR. 2018. 20(6):e10120.

33. Garmann-Johnsen NF, Helmersen M, Eikebrokk TR. *Employee-driven digitalization in healthcare: codesigning services that deliver*. Health Policy and Technology. 2020. 9(2):247-254.

34. Gjellebaek C, Svensson A, Bjørkquist C, Fladeby N, Grunden K. *Management challenges for future digitalization of healthcare services*. Futures. 2020. 124:102636.

35. Konttila J, Siira H, Kyngäs H, Lahtinen M, Elo S, Kääriäinen M, Kaakinen P, Oikarinen A, Yamakawa M, Fukui S, Utsumi M, Higami Y, Higuchi A, Mikkonen K. *Healthcare professionals' competence in digitalisation: A systematic review.* Journal of Clinical Nursing. 2019. 28(5-6):745-716.