Ideas MELting pot for ICT and Health science for Citizens in small communities (MELTIC)

WP2: Analysis of state-of-the-art ICT
Deliverable D2: Literature review (M3)

May, 2020
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### 1. Version control

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2. Summary

2.1. General Objectives of MELTIC

The aim of this project is to make research activities in ICT in the area of Health and Biomedicine more open, transparent, and accessible in order to increase their social impact and thus contribute to improving the quality of life of European citizens in small communities. To support innovative and exciting initiatives that bring together different stakeholder groups to co-create research in ICT in Health and Biomedicine.

2.2. Specific Objectives

To come up with cooperative suitable research ideas in topics such as self-learning, discriminatory misinformation and addiction prevention (Compulsive gambling, gaming and betting). The leading issue is how to use smart technologies to transform public spaces in small communities into people-friendly humane environments.
3. Objectives

This document outlines the literature review for the “Ideas MELting pot for ITC and Health science for Citizens in small communities (MELTIC)”, a project funded by the ORION Open Science project’s call for new co-creation initiatives that will open up research in life sciences and biomedicine.

3.1. General Objectives of the literature review

The use of smart technologies in public spaces is increasingly creating new forms of social interactions and practices, which in turn creates new socio-spatial relations and promotes interactions and communication between isolated and disperse communities. This results in the need to re-think social practices and the use of public spaces which could also have an impact on the development of ICTs and their devices. The intertwining of real and virtual worlds also opens up new ways of advancing knowledge, gathering and interpreting data, and disseminating the acquired knowledge.

It is astounding how developments in electronics, information and telecommunications permeate our daily lives, and almost every day something new is aggregated. Throughout the MELTIC project, Information and Communications Technologies to improve the quality of life of European citizens in small communities connect with diverse European Policy challenges such as depopulation, health, active aging, education, youth and climate change, with the aim of identifying current and future problems. Research is carried out in ICTs in Health and Biomedicine, on topics such as self-learning, discriminatory misinformation and the prevention of compulsive gambling in order to innovate the use of existing public spaces and/or build new ones.

We are experiencing a digital era of real-time transmission of data and immense computing power. To set a comprehensive baseline for our project, a review of the state of art technologies used in projects, activities and initiatives has been developed focusing on:

a) Aspects of interaction among users, ICT and social behavior
b) Spatial analyses, planning methodologies and public involvement
c) On-line gaming
4. Material and Methods

A digitalized literature search was conducted on Medline, the Cochrane Library, WOS, SCOPUS, and other sources not included in PubMed: MDPI, IEEE Xplore and Google Scholar in order to identify relevant articles published between 2016 and 2020.

![Computerized literature search](image)

Figure 1. Computerized literature search. Data Base consulted

To obtain effective results, the keywords used in searches were a combination of (“telemedicine”OR“smartphone”OR“mobile application (app)”OR “Internet”OR“mHealth”OR “eHealth”OR“Internet of Things”OR“ IoT”)AND(“relapse prevention” OR “substances Use Disorder” OR “behavioural intervention” OR “rural treatment”OR “prevention”OR “rehabilitation”OR “harmful habits”OR “risk reduction behavior”). The keywords used to search articles were a combination of the previous ones. The systematic reviews that were found initially have then been used to identify additional relevant studies. The absence of homogeneous criteria among authors to choose keywords to describe their papers may have led to an unwanted consequence: that an indeterminate number of papers may have been omitted by search engines.

4.1. Inclusion and exclusion criteria

The criteria for inclusion required that the studies: (1) deal with patients or patients’ environments that use or form part of an ITC system, (2) have an assessment of usability (3) be published in English (4) have Open Access
We have excluded editorials, letters, opinion papers, and studies that deal with questionnaires, health management, data protection, ethical and legal aspects, or that only carry technical descriptions. We have also excluded those studies related to hospital or specialty care.

Table 2. Exclusion criteria

<table>
<thead>
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<td>Different Data Base</td>
<td>Duplicated or previous study ampliation</td>
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<td>Application</td>
<td>Hospital care or specialitycare as well as those studies which dealt with questionnaires, health management, data protection, ethical and legal aspects, only technical description</td>
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<td>Results</td>
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<td>Not obtained articles</td>
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4.2. Data synthesis

Two authors independently reviewed the selected papers by reading the abstracts in order to decide whether those papers should be read in their entirety. Once this initial study was carried out, another filter was added so as to avoid duplication or redundant material. For each study, a checklist was used to classify the type of paper, together with a form that included the main data or the study (reference, year, results, etc.).

Search strategies developed through electronic databases and manual searches identified a total of 803 references. After eliminating duplicates and other inaccurate results, 623 were excluded, leaving a total of 180 to consider. Other systematic reviews that had been previously carried out by different authors were also very useful in identifying and including relevant studies that had not been initially found by search engines. They have been divided by the technologies used in the studies, and according to the type of socio-medical application.

Articles and reviews were included in the study, however, Short Survey, Editorials, Letters, and Opinion Papers were excluded as well as those studies which dealt with protection data, ethical and legal aspects, questionnaires, health management, or only technical descriptions. We have also excluded those studies related to hospital or specialty care. No restrictions were imposed on the quality of the study design, as the studies are very heterogeneous. Annex 1 shows the papers that were included.

![Figure 2. Paper selected](image)
5. Results

Although most of the papers collected only partially cover the subject matter, the research carried out for this document clearly demonstrates the high number of publications that have come out over recent years. The last 5 years were chosen to obtain a more accurate view of the technology currently available and the frequency of its use.

As Figure 3 shows, the number of papers does not seem to have increased significantly since 2016. The 180 papers finally included in our review were classified into 4 categories taking into account linkage with IT means and social categories: (risk) behavior, (use and abuse of unhealthy) substances, online gaming and education.

![Figure 3. Papers in 4 categories](image)

Figure 3. Papers in 4 categories

Figure 4 illustrates the number of papers that mention the 4 aforementioned categories from 2016 to 2020 (Npapers: 180)

![Figure 4. Papers in 4 social categories 2016-2020 (Npapers: 180)](image)
The technology that is currently available and frequently used is presented in Diagram 5. Technologies that provide useful help to patients, healthcare professionals, caregivers, men, women, workers, general public, children, adolescents, ... in the studied environments.

![Diagram 5. Applications Areas in terms of ICT (Npapers: 180)](image)

In this work, the two categories which are of most interest to the authors are WEB platforms and Smartphone applications (APP), they are the most highly represented, appearing in 150 papers. The papers confirmed the consolidation of WEB platforms and Smartphones (APPs) in comparison to the other technological options over the last 5 years and reaffirms the technological options proposed in MELTIC.

Figure 6 shows the different technologies that can provide useful help to stakeholders in 29 social and healthcare environments. Figure 7 shows the different users from 2016 to 2020.

![Figure 6. Users (Npapers: 180)](image)
Figure 7. Users 2016-2020 (Npapers=180)
6. Discussion

This research identifies relevant studies which highlight the penetration of ICT in social and healthcare environments. Most of the papers included only partially cover the subject matter of ICT in Health and Biomedicine and how to use smart technologies to transform public spaces in small communities into people-friendly human environments, promoting interactions and communication between isolated and disperse communities.

The research carried out for this paper clearly demonstrates the high number of publications concerning technology assessment. However, in spite of the large number of studies that exist, there is a distinct lack of publications that evaluate co-creation methodology. These can only be observed in references [1] and [2], in relation to child obesity and heart disease. The number of articles focusing on rural populations or regions with a disperse population can only be found in references [3], [4] and [5]. This work highlights the studies carried out on minority populations or those living in marginal conditions or depressed areas [6] and on the existence of the digital divide presented in [7].

In Diagram 3 and Diagram 4, we observed that more than half of publications grouped under Behavior refer to the use of technologies to promote healthy habits or to change behavior classed as risky. Furthermore, participants in several works also expressed the importance of having non-judgmental Information and they highlighted the possibility of maintaining anonymity to avoid stigmatization. There is a great potential for health promotion practitioners to be involved in the development of apps for the purpose of promoting healthy behavior from the early years right up to old age, and indeed for healthcare in general. Another aspect that is described is the possibility of cultural adaptation to evidence-based Western therapies or behavior and this is an important step towards a better prevention and treatment of syndromes and illness in different communities through the use and support of smartphones.

After reviewing the different works, it can be stated that smartphone-based interventions in social and health care settings play a key role in fostering the ubiquitous and proactive health oversight and healthcare services of the future, whilst having the potential to reach a high level of the population, complementing what is available on the Internet. Six ICT Technologies for tracking and monitoring have been found and these are reflected in Diagram5. These include the use of WEB access and the use of Smartphones (APPs). Nevertheless, few papers show that access through apps guarantees their usage, or indeed assess whether using a smartphone application is effective in decreasing substance use. Thus, the secondary research question is: “Is the use of a smartphone application that targets the use of harmful substances effective in reducing their consumption?”

Analyzed papers confirm the consolidation of WEB platforms and Smartphones (APPs) in comparison to other technological options over the last 5 years and reaffirms the technological options proposed in MELTIC.

This review has found significant efforts dedicated to the dissemination of Internet-based interventions for prevention, treatment, and management of different disorders. The effects
that different recruitment channels and access routes may have on the composition of the sample and on the use of the intervention should also be considered.

Regarding the **general population** and the smartphone, in relation to the focus given to the new care models that tend to be addressed in mHealth, in general today we are witnessing:

a) an increasing interest in the health of young subjects: in particular, recently, special attention has been focused to the new forms of addiction that have been caused by mobile phone technologies

b) the creation of Apps for a remote asynchronous self-therapy based on virtual reality (VR) and augmented reality (AR)

c) the creation of Apps for self-awareness and empowerment with regards to the correct use of the smartphone, for instance, Apps that provide information on the time spent using different smartphone applications and

d) an increasing interest in the design and assessment of care models with a high technological content and that provide psychological therapy to young subjects using the technologies and tools with which they are familiar with.

An aspect that appears in some works is a social evaluation of the “digital divide”, something that conditions significantly interventions based on mobile, computer and Internet use in depressed areas [6] and [7]. Possible reasons include the fact that it is not practical to deliver those interventions to the community *en masse* due to limited health care resources and the limited availability of evidence-based interventions and practicing clinicians, especially in rural areas.

In relation to Internet gaming disorders, an evaluation study of the program was carried out in order to assess the social impact of the program in mitigating symptoms of Internet gaming disorders and risky mobile or online behavior, and in bolstering emotional well-being. Disorders regarding high risk online behavior were studied in a similar way to other high risk behaviors. Given the high level of diffusion of ICTs among young people and adolescents, interventions are also proposed that can be applicable to them but that focus on their parents substance abuse or mental health issues.

Finally, a peculiar study is the one that suggested that an online prevention and early intervention program could facilitate access to conventional healthcare.
7. Conclusions

This research identifies relevant studies which exemplify the penetration of ICT in social and healthcare environments in real workflows. Most of the papers included only partially cover the subject matter of ICT in Health and Biomedicine and how to use smart technologies to transform public spaces in small communities into people-friendly human environments, promoting interactions and communication between isolated and disperse communities.

After reviewing the different studies, it can be stated that ICT in social and healthcare settings will play a key role in fostering ubiquitous and proactive health and healthcare services in the future.

It is likely that future ICT in Health and Biomedicine are likely to require an even greater amount of data derived from a multitude of different sources. The algorithms deployed in these applications will become computationally more complex, resulting in a higher processing effort. Also, depending on their use, different applications put higher demands on Internet and Mobile communications. At the same time, new social and health care environments should incorporate the use of technologies to promote healthy habits or to change high risk behavior, whilst also using non-biased Information, maintaining anonymity and avoiding stigmatization. It is here that you can see the great potential for health promotion practitioners in the area of app development in order to promote healthy behavior through all stages of life, with the possibility of cultural adaptation, as well as helping to fight against depopulation in rural areas.

The fact that the most studied technologies are WEB platforms and Smartphone (APPs), as shown in Diagram 5, and that the percentage of studies dedicated to the assessment of the other four technologies is low, confirms the consolidation of WEB platforms and Smartphones (APPs) in comparison with the other technological options over the last 5 years and reaffirms the technological option proposed in MELTIC.

The use of ICT in social and healthcare environments provide a lot of benefits and an important advance in the transformation of public spaces, whilst also promoting interaction and communication between isolated and disperse communities, improving the efficiency, quality, equity, interactions and communication between isolated and disperse communities.

But these successful factors may be accompanied by drawbacks in the assessment of co-creation methodology. It has been considered interesting to highlight rural populations or regions with a disperse population, marginal conditions, depressed areas and the existence of a digital divide. The study of these critical factors can guide not only promotion, but also prevention in social and healthcare applications.
8. Strength and Limitation of review

8.1. Strength

- Systematic review from 2016 for the previous 5 years
- WEB platform and Smartphones (APPs) Technologies seem to be consolidated without large variations during these 5 years
- Great diversity of potential users

8.2. Limitations

- The evaluation of the methodological quality of the study has not been an easy task due to the heterogeneity of the papers included in the review.
- Most of the papers included only partially cover the subject matter.
- Limitation or confusion regarding eHealth terminology, Telemedicine, mHealth. For example, mHealth is sometimes referred to as e-mail, sometimes as mobile phone....
- Difference between the user recruitment process and adherence to the study as well as the results obtained
- An indeterminate number of papers may have been omitted by search engines due to the absence of homogeneous criteria to choose keywords to describe their papers.
9. References

[1] Giorgi Rossi, Paolo Ferrari, Francesca Amarri, Sergio Bassi, Andrea Bonvicini, Laura Dall’Aglio, Luca Della Giustina, Claudia Fabbri, Alessandra Ferrari, Anna Maria Ferrari, Elena Fontana, Marta Foracchia, Marco Gallelli, Teresa Ganugi, Giuliaiari, Barbara Lo Scocco, Sara Maestri, Gianluca Moretti, Veronica Panza, Costantino Pinotti, Mirco Prandini, Riccardo Storani, Simone Street, Maria Elisabeth Tamelli, Marco Trowbridge, Hayely Venturelli, Francesco Volta, Alessandro Davoli, Anna Maria “Using Cocreation to Define Contents and Functions of a Smartphone App for Obesity Prevention in Childhood: Mixed Method Study Describing the Process”. JMIR Mhealth Uhealth. 2020 Feb 21. PMID: 32357123 DOI: 10.2196/16165

[2] Linda Mansson; Maria Wiklund; Fredrik Öhberg; Karin Danielsson; Marlene Sandlund “Cocreation with older adults to improve user experience of a smartphone self-test application to assess balance function” Int. J. Environ. Res. Public Health 2020, 17(11), 3768; https://doi.org/10.3390/ijerph17113768 (registering DOI)


10. **Tables and Figures**

Table 1. Inclusion criteria  
Table 2. Exclusion criteria  

Figure 1. Computerized literature search. Data Base consulted  
Figure 2. Paper selected  
Figure 3. Papers in 4 categories  
Figure 4. Papers in 4 social categories 2016-2020 (Npapers: 180)  
Figure 5. Applications Areas in terms of ICT (Npapers: 180)  
Figure 6. Users (Npapers: 180)  
Figure 7. Users 2016-2020 (Npapers=180)
11. **ANNEX 1. Papers included.**

- Kwon, Myung SoonYu, Jeong Soon “Development and Effect of a Smartphone Overdependence Prevention Program for University Students Based on Self-Determination Theory” 2020
- Delisle Nystrom, Christine Sandin, Sven Henriksson, Pontus Henriksson, Hanna Maddison, Ralph Lof, Marie “A 12-month follow-up of a mobile-based (mHealth) obesity prevention intervention in pre-school children: the MINISTOP randomized controlled trial” 2020
- Emily T Hébert; Chaelin K Ra; Adam C Alexander; Angela Helt; Rachel Moisiuc; Darla E Kendzor; Damon J Vidrine; Rachel K Funk-Lawler; Michael S Businelle “A Mobile Just-in-Time Adaptive Intervention for Smoking Cessation: Pilot Randomized Controlled Trial” 2020
- Bardus, M., Hamadeh, G., Hayek, B., Al Kherfan, R “A self-directed mobile intervention (WaznApp) to promote weight control among employees at a lebanese university: Protocol for a feasibility pilot randomized controlled trial” 2020
- Winskell, K., Sabben, G.e, Akelo, V.a, Ondeng’E, K.a, Obong’O, C.b, Stephenson, R.c, Warhol, D.d, Mudhune, V.a “A smartphone game-based intervention (Tumaini) to prevent HIV among young Africans: Pilot randomized controlled trial” 2020
- Sun, M., Tang, S., Chen, J., Li, Y., Bai, W., Plummer, V., Lam, L., Qin, C., Cross, W.M “A study protocol of mobile phone app-based cognitive behaviour training for the prevention of postpartum depression among high-risk mothers” 2020
- Kirkman, J.J.L., Leo, B., Moore, J.C “Alcohol consumption reduction among a web-based supportive community using the hello sunday morning blog platform: Observational study” 2020
- Bonn, S.E., Löf, M., Östenson, C.-G., Trolle Lagerros, Y “App-technology to improve lifestyle behaviors among working adults - The Health Integrator study, a randomized controlled trial” 2020
- Stavropoulos, V., Mastrotheodoros, S., Burleigh, T.L., Papadopoulos, N., Gomez, R. “Avoidant romantic attachment in adolescence: Gender, excessive internet use and romantic relationship engagement effects” 2020
- Taki, Sarah; Russell, Catherine; GWen, Li M; Laws, Rachel; A Campbell; Karen Xu, HuilanDenney-Wilson, Elizabeth “Consumer Engagement in Mobile Application (App) Interventions Focused on Supporting Infant Feeding Practices for Early Prevention of Childhood Obesity” 2020
- Patel, Unnati;Sobowale, Kunmi; Fan, Jingyi; Liu, Nina; Kuwabara, Sachiko; Lei, Zhang; Sherer, Renslow; Van Voorhees, Benjamin “Cultural considerations for the adaptation of an Internet-based intervention for depression prevention in Mainland China” 2020
- Barbera, Mariagnese; Mangialasche, Francesca; Jongstra, Susan; Guillemont, Juliette; Ngandu, Tiia; Beishuizen, Cathrien; Coley, Nicola; Brayne, Carol; Andrieu, Sandrine; Richard, Edo; Soininen, Hilka; Kivipelto, Miia. “CAHATICE study group. Designing an Internet-Based Multidomain Intervention for the Prevention of Cardiovascular Disease and Cognitive Impairment in Older Adults: The HATICE Trial” 2020
- Ponum, M., Hasan, O., Khan, S. “Easy detect disease: an android app for early symptom detection and prevention of childhood infectious diseases” 2020
- Moessner, Markus; Minarik, Carla; Ozer, Fikret; Bauer, Stephanie “Effectiveness and Cost-effectiveness of School-based Dissemination Strategies of an Internet-based Program for the Prevention and Early Intervention in Eating Disorders: A Randomized Trial”. 2020
- Leif Boß;, Dirk Lehr; Michael Patrick Schaub; Raquel Paz Castro; Heleen Riper; Matthias Berking; David Daniel Ebert “Efficacy of a web-based intervention with and without guidance for employees with risky drinking: results of a three-arm randomized controlled trial” 2020
- Pedrò Gami to; Jorge Oliveira; Paulo Lopes; Rodrigo Brito; Diogo Morais; Diana Silva; Ana Silva; Sara Rebelo; Marta Bastos; Alberto Deus “Executive Functioning in Alcoholics Following an mHealth Cognitive Stimulation Program: Randomized Controlled Trial” 2020
- Ming-Yuan Chih “Exploring the use patterns of a mobile health application for alcohol addiction before the initial lapse after detoxification” 2020
- Paige, Samantha RStellelfson, MichaelChaney, Beth HChaney, J DonAlber, Julia MChappell, Chelsea Barry, Adam E “Examining the Relationship between Online Social Capital and eHealth Literacy: Implications for Instagram Use for Chronic Disease Prevention among College Students”. 2020
- Pedro Gamito; Jorge Oliveira; Paulo Lopes; Rodrigo Brito; Diogo Morais; Diana Silva; Ana Silva; Sara Rebelo; Marta Bastos; Alberto Deus “Executive Functioning in Alcoholics Following an mHealth Cognitive Stimulation Program: Randomized Controlled Trial” 2020
- Chau, Chor-LamTsui, Yvonne Yin-Yau Cheng, Cecilia “Gamification for Internet Gaming Disorder Prevention: Evaluation of a Wise IT-Use (WIT) Program for Hong Kong Primary Students” 2020
- Damasceno, É.B., Cortez, L.C.A., Ferreira, F.S., Silva, M.F.S, de Melo, L.P. “Something that is so simple to experience and control, yet difficult to share and defend: HIV/Aids, secrets and sociability in an on-line social network” 2019
- Ribeiro, Nuno; Moreira, Luis; Barros, Ana; Almeida, Ana; MargaridaSantos; Silva, Filipe “Guidelines for a cancer prevention smartphone application: A mixed-methods study” 2020
- Frederick Muench; Katherine van Stolk-Cooke; Alexis Kuerbis; Gertraud Studler; Amit Baumel; Sijing Shao; James R. McKay; Jon Morgenstern “A Randomized Controlled Pilot Trial
of Different Mobile Messaging Interventions for Problem Drinking Compared to Weekly Drink Tracking” 2019
- Nugroho, A.a, Erasmus, V.a, Zomer, T.P.b, Wu, Q.a, Richardus, J.H.a “Behavioral interventions to reduce HIV risk behavior for MSM and transwomen in Southeast Asia: a systematic review” 2019
- Linda Mansson; Maria Wiklund; Fredrik Öhberg; Karin Danielsson; Marlene Sandlund “Co-creation with older adults to improve user experience of a smartphone self-test application to assess balance function” 2019
- Heayon Lee; Yu Rang Park; Hae-Reong Kim; Na Young Kang; Gahee Oh; Il-Young Jang; Eunju Lee “Discrepancies in Demand of Internet of Things Services Among Older People and People With Disabilities, Their Caregivers, and Health Care Providers: Face-to-Face Survey Study” 2019
- Ip, PatrickChim, DavidChan, Ko LingLi, Tim M HHo, Frederick Ka WingVan Voorhees, Benjamin WTiwari, AgnesTsang, AnitaChan, Charlie Wai LeungHo, MatthewTso, WinnieWong, Wilfred Hing Sang “Effectiveness of a culturally attuned Internet-based depression prevention program for Chinese adolescents: A randomized controlled trial” 2019
- MacPherson, M.M., Merry, K.J., Locke, S.R., Jung, M.E “Effects of mobile health prompts on self-monitoring and exercise behaviours following a diabetes prevention program: Secondary analysis from a randomized controlled trial” 2019
- Poppe, L., De Bourdeaudhuij, I., Verloigne, M., Shadid, S., Van Cauwenberg, J., Compernolle, S., Crombez, G “Efficacy of a self-regulation-based electronic and mobile health intervention targeting an active lifestyle in adults having type 2 diabetes and in adults aged 50 years or older: Two randomized controlled trials” 2019
- Stormshak, Elizabeth ASeeley, John RCaruthers, Allison SCardenas, LuciaMoore, Kevin JTyler, Milagra SFleming, Christopher MGau, JeffDanaher, Brian “Evaluating the efficacy of the Family Check-Up Online: A school-based, eHealth model for the prevention of problem behavior during the middle school years” 2019
- James R. McKay; Deborah Van Horn; David Oslin; Megan Ivey; Michelle Drapkin; Donna Coviello; Qin Yu; Kevin G. Lynch “Extended Telephone-Based Continuing Care for Alcohol Dependence: 24 Month Outcomes and Subgroup Analyses” 2019
- Paul, E., Mergl, R., Hegerl, U “Has information on suicide methods provided via the Internet negatively impacted suicide rates?” 2019
- Smail-Crevier, R., Powers, G., Noel, C., Wang, J. “Health-related internet usage and design feature preference for e-mental health programs among men and women” 2019
- Kobra Etminani; Arianna Tao Engström; Carina Göransson; Anita Sant’Anna; Sławomir Nowaczyk “How Behavior Change Strategies are Used to Design Digital Interventions to Improve Medication Adherence and Blood Pressure Among Patients With Hypertension: Systematic Review” 2019
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- Luis Marco-Ruiz; Rolf Wynn; Sunday Oluwafemi Oyeyemi; Andrius Budrionis; Kassaye Yitbarek Yigzaw; Johan Gustav Bellika “Impact of Illness on Electronic Health Use (The Seventh Tromsø Study - Part 2): Population-Based Questionnaire Study” 2019
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- Hennemann, Severin Farnsteiner, Sylvia Sander, Lasse “Internet- and mobile-based aftercare and relapse prevention in mental disorders: A systematic review and recommendations for future research” 2019
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