SYSTEMATIC REVIEW

Co-creation methodology with Smart technologies in Health and well-being to enable communication between isolated and disperse small communities: a literature review [version 1; peer review: 2 approved with reservations]

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Abstract

Objective: The objective is to determine reported cases of co-creation methodology about the use of smart technologies in public spaces in order to create 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.
Methods: The literature published in the last 5 years (2016-2020) has been reviewed. Searches on Co-creation methodology and ICTs in Health and Biomedicine, on topics such as interaction among users, ICT and social behaviour, spatial analyses, planning methodologies and public involvement, on-line gaming, self-learning, and the prevention of risky habbits are made manually.
Results: Search strategies developed through electronic databases and manual search identified a total of 180 references, included in the supplementary material. They have been divided by the technologies used in the studies, co-creation methodology, and according to the type of socio-medical application. This research highlights the penetration of ICT in social and healthcare environments and clearly demonstrates the high number of publications that have come out over recent years and a lack of publications that evaluate co-creation methodology in this field.
Conclusions: Most of the papers included only partially cover the subject matter of ICT in Health and Biomedicine and how to use smart

Open Peer Review

Approval Status ✓ ?

	1	2
version 2 (revision) 25 Jul 2022	✓ view	? view
version 1 06 Jan 2022	? view	? view

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Any reports and responses or comments on the article can be found at the end of the article.

technologies to transform public spaces in small communities into people-friendly human environments. The research carried out for this paper clearly demonstrates the high number of publications concerning technology assessment. However, there is a distinct lack of publications that evaluate co-creation methodology.

Keywords
Co-creation, smart technologies, health, wellbeing, small communities, open-science

This article is included in the Health Sciences gateway.

This article is included in the Digital Health and Well-being collection.

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Author roles: RAMOS V: Conceptualization, Data Curation, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Resources, Supervision, Validation, Writing – Original Draft Preparation, Writing – Review & Editing; **de San Pedro I**: Conceptualization, Funding Acquisition, Project Administration, Supervision, Validation, Writing – Review & Editing; **Casado E**: Data Curation, Formal Analysis, Methodology, Supervision, Validation; **Santacruz E**: Data Curation, Formal Analysis, Methodology, Validation; **Hernández C**: Conceptualization, Formal Analysis, Methodology, Supervision; **Alcoceda JA**: Conceptualization, Formal Analysis, Methodology, Supervision; **de Tena-Davila MJ**: Data Curation, Formal Analysis, Supervision, Validation; **Burgos A**: Formal Analysis, Methodology, Software, Supervision; **Perez de la Camara S**: Formal Analysis, Resources, Software, Supervision; **Marina-Boillos P**: Data Curation, Methodology, Visualization, Writing – Review & Editing; **Pascual M**: Conceptualization, Data Curation, Methodology, Software, Supervision, Validation

Competing interests: No competing interests were disclosed.

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Plain language summary

In co-creative methodology, all teams are involved and have influence throughout the project lifecycle: from planning, to implementation, to dissemination in order to identify topics and players of interest and they can be involved in research activity to share their interests and values and generate new ideas, concepts, products, or projects. 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.

By means of this methodology are seeked to (1) obtain contributions by users, (2) produce a reference document with all these contributions. The aim of this review was to determine already reported cases of co-creation methodology about the use of smart technologies in public spaces, new forms of social interactions and practices, interactions and communication between isolated and disperse communities, and the existence of a digital divide.

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 "ICT in Health and Biomedicine and how to use smart technologies to transform public spaces in small communities into people-friendly human environments". 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 in order to promote healthy habits or to change high-risk behavior, using non-biased Information, maintaining anonymity and avoiding stigmatization

Introduction

In co-creative methodology, all teams are involved and have influence throughout the project lifecycle: from planning, to implementation, to dissemination in order to identify topics and players of interest and they can be involved in research activity to share their interests and values and generate new ideas, concepts, products, or projects within the wide group of members formed by government entities, funders, regulators, educators, charities, civil societies, patient groups and citizens.

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 Information and Communications Technologies (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. ICTs permeate our daily lives and 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 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, specially patients or patients' environments that use or form part of an ICT system[1].

Long-term experiences and analysis do not yet exist. Due to the rapid development and application of new technologies there is a permanent need to monitor and support the work of ICT researchers, urban designers and social agents, and an assessment of usability is needed[2]. It is necessary to point out that the use of smart technologies in public spaces is increasingly creating new forms of social interactions and practices, as well as creating new socio-spatial relations that promote interactions and communication between isolated and disperse communities[3,4]. This result 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: living, caring, and acting[5–7].

The dialogue and connection between people (as users) with real and virtual worlds also open up new requirements in advanced knowledge, not only in new ways of gathering information, but also in how to interpret the data. Also, there is an additional need to manage and disseminate the acquired knowledge, analyse the current use and developments in electronics, information and telecommunications and the relevance they have on their daily lives, with almost every day something new being aggregated. This methodology seeks contributions by users, and produces a reference document with all these contributions. The aim of this review was to determine already reported cases of co-creation methodology about the use of smart technologies in public spaces in order to create 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.

Methods

Search strategy

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. To obtain effective results, the keywords used in searches were a combination of "co-creation"AND("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 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.

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 ICT system, (2) have an assessment of usability (3) be published in English (4) have Open Access. No restrictions were imposed on the quality of the study design. We have excluded editorials, letters, opinion papers, and studies that deal with questionaries, 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. In Table 1 are presented inclusion and exclusion criteria.

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 and discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias). Once this initial study was carried out, another filter was added 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, objectives, results, etc.) as is shown in Table 2.

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.

Annex 1 shows the papers that were included. The quality of the studies was assessed following the recommendations by the Spanish Healthcare Technology Evaluation Agency[8]. The evaluation was reached via a questionnaire specifically designed for this purpose, based on items such as the sample size, description and conditions of the study presented in Table 3. The choice of these items was based on quality studies found in other reviews and adapted to the current review.

Results

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, as is showed in Figure 1.

Characteristics of included studies

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.

Studies on technologies

The technology that is currently available and frequently used is presented in Figure 3. Technologies that provide useful help to patients, healthcare professionals, caregivers, men,

Table 1. Inclusion and exclusion criteria.

Variables	Inclusion criteria
Selected articles	Use of technologies in projects, activities and initiatives: That include aspects of interaction among users, ICT and social behaviour For spatial analyses, planning methodologies and public involvement On-lime games
Type	Scientific papers and reviews
Population	General population, patients, workers, young adults, adolescents, elderly people
Publications date	From 2016
Language	English
Variables	**Exclusion criteria**
Exclusion criteria	Not adjusted to inclusion criteria. Editorial, letters and opinion papers.
Different data base	Duplicates or previous study ampliation
Application	Hospital care or speciality care as well as those studies which deal with questioner, health management, data protection, ethical and legal aspects, only technical descriptions
Results	Questioner
Not obtained articles	Previous asking

Table 2. Check list to classify the studies.

REFERENCE OF THE STUDY (PMID, ISSN)
Authors Year of publication and journal
REFERENCE AND DESIGN OF THE STUDY
Objective Patients or patients' environments that use or form part of an ITC system Objective of the study
RESULTS ON APPLICATIONS AREAS IN TERMS OF ICT
Value measured Result
RESULTS ON USERS
Value measured Result
CONCLUSIONS OF THE AUTHORS
COMMENTS

Table 3. Checklist to evaluate the quality.

Sample
Is the sample size appropriate? Is a clear description of the tests specified? Is the sample representative?
Tests
Are the conditions of the study specified? In the case of social users, are the types of patient's environment specified, together with their importance? In case of technological applications, is it specified if there is temporary or permanent application? Are the conditions of the evaluation specified?
Results evaluation
Is there a correlation between the different studies classified in the same sections?

women, workers, general public, children, adolescents, in the studied environments.

Quality evaluation

On the whole, the evaluation of the methodological quality of studies has been a very difficult task because of the heterogeneity of the papers included in the review. This is due to the fact that there is a lack of published papers about co-creation methodology where most of the papers included only partially cover the subject matter, and in some of the cases, the sample size was not large enough.

Discussion

This research identifies relevant studies which highlight the penetration of ICT in social and healthcare environments. Most of the papers included only partially the items considered, in one hand the item "ICT in Health and Biomedicine" and in the other hand "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 are scarce.

As Figure 2 and Figure 3 shows, the number of papers does not seem to have increased significantly since 2016. The 180 papers finally included were classified into 4 categories taking into account linkage with IT means and social categories: 1. Behaviour (risk), 2. Substances (use and abuse of unhealthy), 3. Online gaming and 4. Education.

More than half of publications grouped under category 1. "Behaviour" refer to the use of technologies to promote healthy habits or how to change behaviour classified as risky.

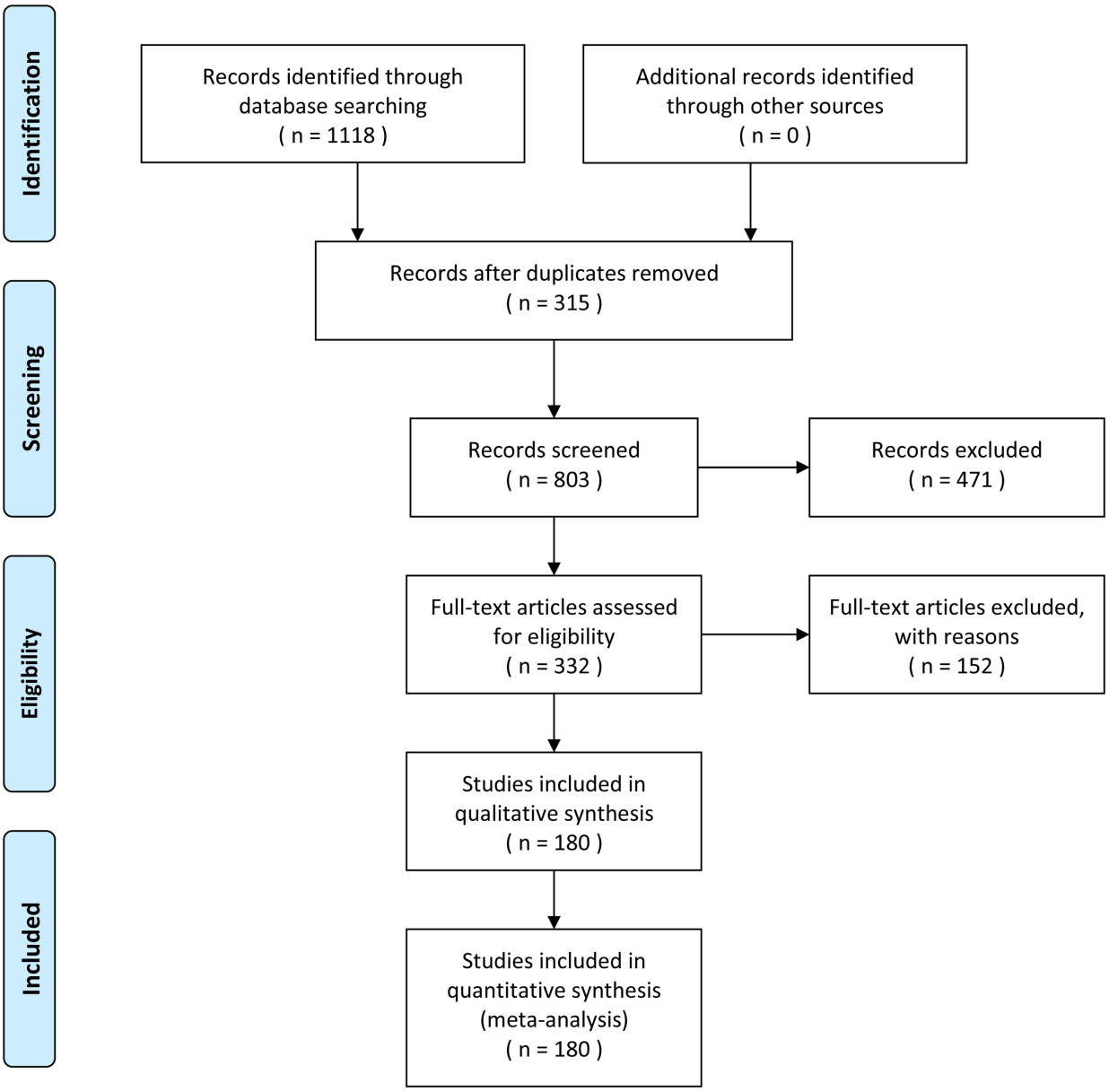

Figure 1. Study selection process.

Participants in several works also expressed the importance of having non-judgmental information and the possibility of maintaining anonymity to avoid stigmatization [38], [76], [81], [97], [126], [171]. There is a great potential of co-creation methodology involving in the development of apps from the early years right up to old age [20], [22], [23], [27]-[30], [32], [34], [36], [45], [52] - [54], [57], [60], [62] - [65], [68] - [71], [73], [74], [76], [77] by means of smartphone and by means of Web Platform [104] - [110], [113], [117], [120], [124], [128], [131], [135], [137], [138], [140], [149], [151], [154], [155], [158], [161], [167], [178], [180], [185]. Another described aspect is the possibility of cultural adaptation to evidence-based Western behaviour therapies towards a better prevention and treatment of syndromes and illness in different communities through the use and support of smartphones [31], [33], [47], [50], [57], [76], [79], and also support by means

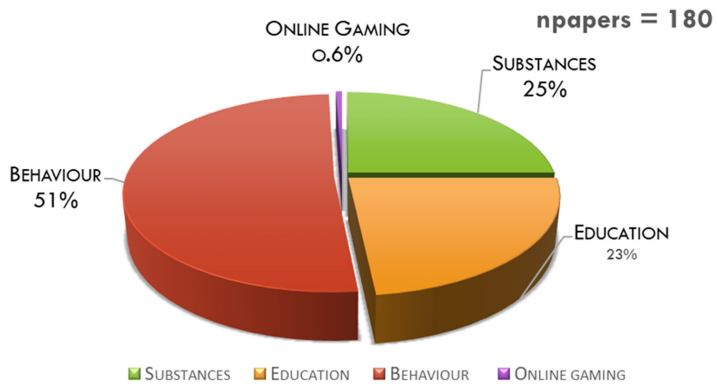

Figure 2. Papers that mention 4 social categories from 2016 to 2020 (Npapers: 180).

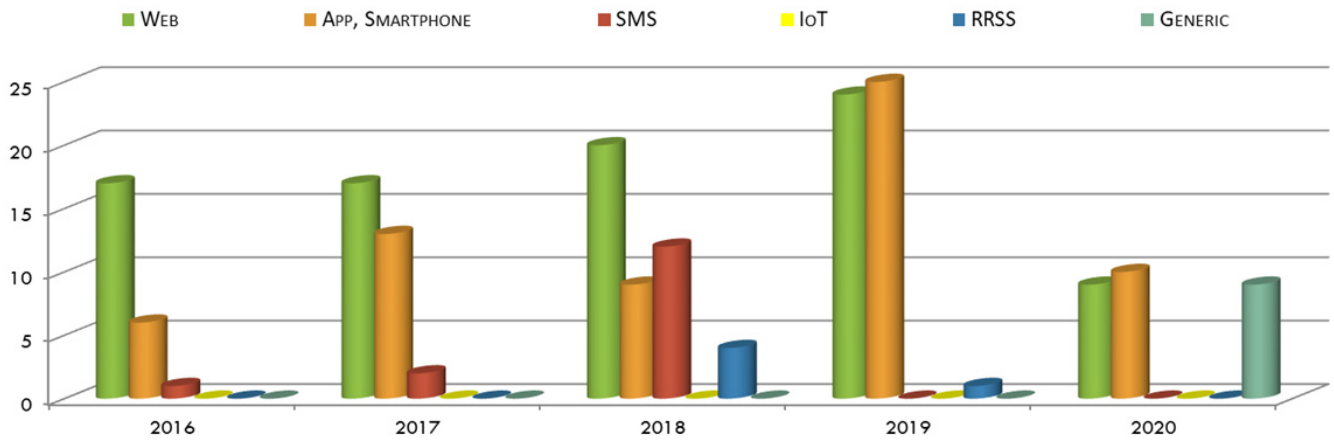

Figure 3. Applications Areas in terms of ICT (Npapers: 180).

of Web platform [102], [107], [109], [114], [117], [123], [139], [145], [147], [149], [155], [159].

Studies on co-creation

The research carried out for this paper clearly demonstrates the high number of publications concerning technology assessment. However, there is a distinct lack of publications that evaluate co-creation methodology. These can be specially observed in references 1 and 2, in relation with child obesity and heart diseases.

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.

Studies on technologies

Figure 3 shows that the two categories, WEB platforms and Smartphone applications (APP), are most highly represented categories appear in 146 papers. The papers confirmed the consolidation of WEB platforms and Smartphones (APPs) in comparison to the other technological options over the last 5 years.

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 Figure 3. 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.

This review founded 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 use of smartphone, related to the focus given to the new care models that tend to be addressed in m-Health, 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 that are familiar with.

Some works study the social evaluation of the "digital divide", also revealed in the current COVID-19 pandemic, an aspect that conditions significantly interventions based on mobile, computer and Internet use in depressed areas [6] and [7] and also in [65], [96], [108], Possible reasons are that it is not practical to deliver those interventions to the community "*en masse"* due to limited health care resources and availability of evidence-based interventions and practicing clinicians, especially in rural areas.

An evaluation study of gaming disorders, carried out in order to mitigate symptoms of Internet gaming disorders and risky mobile or online behaviour, and in bolstering emotional well-being. Given the high level of diffusion of ICTs among young people and adolescents, interventions are also proposed to them but also focus on their parents with substance abuse or mental health issues.

Conclusion

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 "ICT in Health and Biomedicine and how to use smart technologies to transform public spaces in small communities into people-friendly human environments". There is a distinct lack of publications that evaluate co-creation methodology, that is only observed in references 1 and 2, in relation to child obesity and heart disease.

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.

Future of ICT in Health and Biomedicine are likely to require an even greater amount of data derived from a multitude of different sources and a higher processing effort. 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, using non-biased information, maintaining anonymity and avoiding stigmatization. There is 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 Figure 3, 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.

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.

However, 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.

Data availability

Underlying data

All data underlying the results are available as part of the article and no additional source data are required.

Reporting guidelines

Repisalud: PRISMA checklist, https://doi.org/10.4321/repisalud.13489.

Acknowledgments

The authors would like to thank the Stakeholders participants for having understood the interest of this study. An earlier version of this article can be found on MELTIC project Website.

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PubMed Abstract | **Publisher Full Text** | **Free Full Text**

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PubMed Abstract | **Publisher Full Text** | **Free Full Text**

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PubMed Abstract | **Publisher Full Text**

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Reference Source

Open Peer Review

Current Peer Review Status: ? ?

Version 1

Reviewer Report 20 June 2022

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Victor Alfonso Florez-Garcia
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General feedback:
- There are many “and” connections in several sentences, so I highly suggest being simple in sentences for transmitting the ideas.

Summary:
- The last part of the aim is wordy, so I highly recommend checking the grammar. Also, methods and results should be improved in the same way.
- Clarify the meaning of ICTs.

Introduction:
- Some sentences need to have references that support the statement. Also, several of them are unclear (e.g.: ..This results in the need to re-think social practices and the use of public spaces,...)
- The sentence “Long-term experiences and analysis do not yet exist” is not clear. Are you talking about the ICT?
- To mention “their devices” is always confusing.
- The aim of this work is not precise; it seems like you are going to account for the number of cases (I'm not sure if it's referring to studies, technologies, etc).

Methods:
- How can we connect the research strategy's second part with this paper's objective?. The terms (“relapse prevention” OR “substances Use Disorder” OR “behavioural intervention” OR “rural treatment”OR “prevention”OR “rehabilitation”OR “harmful habits”OR “risk reduction behavior”) seem to like are outside of the scope of this review. Also, I know you are trying to evaluate something regarding the behavior, but these terms are spread.

- I suggest changing the word patients to subjects or individuals because this is not clinical-based research.
- The title for table 3 is incomplete.
- I'm not sure if annex means supplemental material.
- There is no information regarding how the authors analyzed the results.
- I recommend checking the spelling in the search terms (e.g, behavioral is incorrect)

Results:

- In figure 1, you mentioned that a meta-analysis was done, but it is not true.
- Figures must be entitled according to appearing order. Thus, current figure 3 actually is figure 2. Otherwise, please describe the figure 2 in the results before the current figure 3.
- I highly recommend improving the results. You included 180 papers to extract more information about the entire profile and even grouped papers (e.g., type of technologies, devices used, areas for use, etc.). Also, I highly recommend changing the visualization style in the figures.
- You have 180 articles included, but it is not clear to know exactly which articles you included because they are not even in references. Thus, I recommend a) including all the articles in the references and 2) improving the visualization of all of these in the results section (could be in tables instead to mentioned them in brackets)

Discussion:

- I just realized that this section included several results than an analysis. I would recommend to re-locate the information.
- I highly recommend improving this section by comparing, contrasting, providing hypotheses, etc. A more significant number of references in this section will demonstrate that the authors know the state of the art of this research and analysis itself.

Are the rationale for, and objectives of, the Systematic Review clearly stated?

Partly

Are sufficient details of the methods and analysis provided to allow replication by others?

Partly

Is the statistical analysis and its interpretation appropriate?

Not applicable

Are the conclusions drawn adequately supported by the results presented in the review?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Epidemiology, Public Health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 06 Jul 2022

Victoria RAMOS, Instituto de Salud Carlos III, Madrid, Spain

Thank you very much for your contributions, which have mostly been included in the new version. The language review has been done by a native English speaker. Some clarifications have been included, tables and order of figures have been revised taking into account your comments.

Competing Interests: No competing interests were disclosed.

Reviewer Report 20 June 2022

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Department of Computer Science and Artificial Intelligence, School of Technology and Telecommunications Eng
University of Granada, Granada, Spain

Key words
The authors could add ‘telemedicine’ to the key words, because it is an important element and they have used it in the search strategy.

Introduction
A better and concise definition of co-creative methodology is needed.

“The intertwining of real and virtual worlds also opens up new ways of advancing knowledge, gathering and interpreting data, and disseminating the adquired knowledge”

At this point, the authors could review the recent development of the concept ‘metaverse’.

Results.
The following sentence in the quality evaluation paragraph is not clear enough:
‘This is due to the fact that there is a lack of published papers about co-creation methodology where most of the papers included only partially cover the subject matter, and in some of the cases, the sample size was not large enough.'

Tables
Table 1. The ending publications date must be specified.

Table 1. Questioner or questionnaire?

Annex 1.
The annex one is missing. It should be provided by the authors.

General comments
The English writing needs slight improvements. Example, in the abstract: 'prevention of risky habbits are made manually'; better, ' prevention of risky **habits were** made manually'. In the introduction, ' This result in the need to': 'this **results** in the need to'. Table one, 'on lime games': on **line** games.
'In one hand': **on the** one hand.

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 that **they** are familiar with.

Conclusion
This paper aims to review published cases of co-creation methodology on the use of smart technologies in public spaces, new forms of social interactions, practices, and communication between isolated and dispersed communities, and the existence of a digital divide. This article is somehow too ambitious because its scope includes behaviour, abuse of substances, online gaming and education. Even so, it is interesting for professionals working in these areas and searching to learn about the possibilities of new technologies in health promotion. More studies in those specific areas are needed.

Are the rationale for, and objectives of, the Systematic Review clearly stated?
Yes

Are sufficient details of the methods and analysis provided to allow replication by others?
Yes

Is the statistical analysis and its interpretation appropriate?
Yes

Are the conclusions drawn adequately supported by the results presented in the review?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Health care quality assurance. Research and innovation planning and management. e-Health. Preventive medicine and public health.

I confirm that I have read this submission and believe that I have an appropriate level of

expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 06 Jul 2022

Victoria RAMOS, Instituto de Salud Carlos III, Madrid, Spain

Thank you very much for your contributions, which have mostly been included in the new version. The language review has been done by a native English speaker. Some clarifications have been included, tables and order of figures have been revised taking into account your comments.

Competing Interests: No competing interests were disclosed.

Reviewer Response 25 Jul 2022

Juan Fernández Martín, University of Granada, Granada, Spain

Thank you very much, Victoria. Your article is very interesting. Congratulations. Best regards. Juan Fernández

Competing Interests: No competing interests were disclosed.