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Pedro Ramires

University of Évora, ramires.pedro@gmail.com

Sara Romeiro

University of Évora, sararomeiro91@gmail.com

Rui Quaresma

University of Évora, quaresma@uevora.pt

Paulo Resende da Silva

University of Évora, pfs@uevora.pt

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Contact Tracing Applications in the Context of COVID-19 Pandemic: Proposals for Acceptance of its Use

Pedro Ramires, University of Évora, Portugal, ramires.pedro@gmail.com

Sara Romeiro, University of Évora, Portugal, sararomeiro91@gmail.com

Rui Quaresma, University of Évora, Portugal, quaresma@uevora.pt

Paulo Resende da Silva, University of Évora, Portugal, pfs@uevora.pt

Abstract

COVID-19 has been the biggest threat humanity has faced since World War II. The rapidity of its spread generated a general feeling of uncertainty and fear. National governments had to adopt measures in a context of total ignorance of the threat. The development of contact tracing applications has emerged as the fastest option to contain the spread of the virus. However, its acceptance has been reduced. This study intends to understand the reasons for the resistance in the use of those applications and to identify proposals so that in future situations the use of applications of contact tracing can be generalized. This is a qualitative study using a literature review in accordance with the procedures. The literature review allowed us to identify, on the one hand, three dimensions in the approach to the theme: technical, legal, and political. In the particular case of COVID-19, the political dimension stood out compared to the others.

Keywords: Contact-tracing Applications; COVID-19 Pandemic Crisis; Privacy Surveillance Binomial; Literature Review.

1. INTRODUCTION

Contact tracing through mobile phone applications has been a useful tool for early detection and isolation of confirmed virus carrier contacts. With the COVID-19 pandemic, most national governments sought from telecommunications operators the creation of an application for smartphones (Leclercq-Vandelannoite & Aroles, 2020) that would allow, through the responsibility of those infected, to inform their contacts that they had a close contact with an infected person and to self-isolate. However, what happened was an almost generalized resistance from citizens to the use of these applications because of a growing collective awareness of the threat that the sharing of personal data represents to the privacy of each one (Rowe, Ngwenyama, & Richet, 2021).

In this period, between the beginning of the COVID-19 pandemic and the relaxation in government measures and the media attention given, there is an intense debate regarding the use of systems and information in combating a phenomenon with the characteristics of a pandemic

and the mass use of personal data to moderate the spread of the disease. The surveillance-privacy binomial has been at the center of this debate that goes far beyond the academic ring (Leclercq-Vandelannoitte, 2020; Prakash & Das, 2022; Kurtaliqui, Zaman & Shier, 2022).

It was this discussion that allowed the scientific community to emerge concepts that once deserved the attention of scholars, but which the inexorable passages of time sent to the annals. Through new approaches it was possible to recover the concept of a society of control and the dangers that this represents for the affirmation of a unique discourse.

This literature review fulfills a double objective, on the one hand, to understand the main reasons for the resistance in the adherence to contact tracing applications by citizens in a context of the pandemic threat of COVID-19, and, on the other hand, to identify proposed solutions to reduce resistance by citizens to the use of this technology. Therefore, this study seeks to answer the following research questions: What were the main reasons for widespread resistance to use of contact tracing applications? Are the dimensions of resistance to use of contact tracing applications political, technical, legal or are they all three? How, in a context of health crisis like the COVID-19 pandemic, can we encourage widespread adoption among citizens in the use of contact tracing applications? Other similar phenomena may occur, and digital contact tracing allows detecting, informing, and isolating potential disease transmission currents, constituting a quick and effective way of combating pandemics.

The article is structured in six parts that constitute the respective sections: introduction, theoretical framework, method, results, discussion, and conclusion and limitations.

2. THEORETICAL FRAMEWORK

When discussing contact tracing, it is inevitable not to consider the unified theory of acceptance and use of technology (Lin, Carter & Liu, 2021; Waal et al., 2022; Trakman, Popovic & Trakman; Venkatesh et al., 2003). This model identifies eight critical factors for the intention to accept and use technology, with trust and perception of values being the most common facilitators and moderators. Performance expectation, effort expectation, social influence and facilitating conditions contribute directly to intention, the remaining four have a moderating effect, namely: gender, age, experience, and willingness.

In this framework, contextual factors and social benefits and risks (Abramova et al., 2022; Ye et al., 2022) are particularly relevant in the discussion around contact tracing applications launched by national governments. Although exceptions have been registered regarding their adherence, Lin, Carter and Liu (2021) have sought the reasons for such resistance. Most point out the distrust of users regarding the sharing of data that threatens their privacy. This situation reignited the

discussion around the dichotomous binomial *surveillance – privacy*, which goes beyond the boundaries of academia and extends to society. Nowadays, public awareness regarding privacy is very pressing, although users easily enter contradiction by making too much data available on the internet without knowing the reasons (Leclercq-Vandelannoite & Aroles, 2020).

Although the threat of COVID-19 is unparalleled in recent history and governments and their health authorities have been slow to act effectively, even this general picture has not disposed people to adhere to the tracking applications developed by national governments. Even in the face of the social risk that the threat to public health represented, it did not allow people to become aware of the social benefit that downloading the contact tracing application would entail (Abramova, Wagner, Olt, & Buxmann, 2022). Individual privacy prevails in the cost-benefit relationship between joining an application and preserving data privacy.

Abramova *et al.* (2022) state that in addition to trust in technology, trust in the government is crucial for adherence to tracking applications. This political dimension of the privacy issue is in line with the proposal of Rowe *et al.* (2021) in which they highlight the need for greater community engagement through campaigns (Zhang, Kreps, McMurry, & McCain, 2020) but also emphasize the benefits that the use of these digital tools represents for the peace of mind of the public and for their future.

Some authors (Trkman, Popovic, & Trkman, 2023) mention that issues related to trust in technology must be ensured, such as more restrictive permissions (accessing only the information necessary for tracking), more sophisticated systems and cryptography, namely for data storage, developing decentralized tracking applications (in that the control of shared information is on the user's side) and increase the level of information contained in the privacy policy (Azad *et al.*, 2021; Xu *et al.*, 2021; Simko *et al.*, 2022).

This theme has deserved by the authors clear concerns with the practical contribution. They have not only explained the phenomenon, but also sought to contribute with proposals that make it possible to mitigate the effects of users' lack of confidence in joining this type of application. However, trust in technology is downstream of trust in governments. This aspect becomes clear with the contribution of Kurtaliq, Zaman and Shoier (2022) in the analysis they made of the contact tracing application – *STOPCOVID* – developed by the French government under the auspices of the alienation that the authors defined as knowledge, design, and implementation, that is, a failure across the board. In view of the poor adherence, researchers call for a collaborative and less imposing policy so that such a decision will be accepted by citizens in the future. Still according to this line of thought, Wal *et al.*, (2022) propose an integrative model that relates aspects of the unified theory of acceptance and use of technology, belief in health and context

factors. Only with this combination will it be possible to gain greater acceptance of tracking applications.

3. METHOD

The approach of this investigation is of a qualitative nature and consists of reviewing publications of scientific articles that deal with digital contact tracing in the context of combating the COVID-19 pandemic and that highlight the problem of the privacy-surveillance binomial, namely with proposals for mitigating its effects on users' perception.

After defining the problem and research objectives, the literature review is the next phase in the process of building a research article. There are three types of literature review (Okoli & Schabram, 2010): that which derives from a theoretical framework in a larger body of text, that which appears as a chapter of a thesis/dissertation and, finally, that which results from an “autonomous” review of the literature, in which the data obtained does not result from primary sources. This means that the first two are the starting point for an empirical study and the last one is an autonomous piece with an end in itself (Xiao & Watson, 2019). Autonomous literature reviews seek to make sense of a dispersed body of theory through aggregation, interpretation, explanation, or integration. Taking into account their objective, these can aim to describe, test, extend and criticize.

In the elaboration of a literature review, still according to Okoli and Schabram (2010), the fulfillment of a set of steps that make it sufficiently robust must be ensured, namely: (i) identification of the objective; (ii) protocol planning, with a clear definition of the procedures to be followed; (iii) practical selection or inclusive selection and studies to consider in the review and reason why they were included; (iv) bibliographic research; (v) collection of the most relevant data from the selected studies; (vi) quality assessment and definition of criteria; (vii) synthesis of studies and interrelate them; and, (viii) writing of the review.

In this paper, a systematic literature review was chosen, which Okoli and Schabram (2010) described as “autonomous” literature review.

Remote digital sensing is an indispensable tool in contact tracing to mitigate the spread of disease among the community. In the face of the COVID-19 emergency, mobile phone applications were developed that allowed contact tracing. Despite the evident effectiveness of this technology, there was resistance to its use. This literature review aims, on the one hand, to understand the reasons for the resistance in the adoption of applications for digital remote sensing mobile phones and, on the other hand, to identify the proposals that impact on user confidence and mitigate the effects of the binomial privacy-surveillance in contact tracing applications.

The research design was defined according to the proposed objectives and had as its first task the construction of a summary table for systematization of all the collected studies, which included the following information: authors, study title, objective, method, main results, and model. Based on these data, the approach strategy was outlined, and the objective defined. Next, the platforms to carry out the bibliographic research were established, as well as the keywords with which this research would be carried out. We started by resorting to *google scholar* and the chosen keywords were: “*digital contact tracing*”, “*apps*”, “*covid-19*”, “*privacy*” and “*surveillance*”. Subsequently, the same search was carried out but on *B-On*, using the same keywords for the purpose. For the next phase, the construction of a table-results was established in which an attempt was made to present all the studies included in this review in a systematic way. Another inclusion criterion considered were the publication dates of the articles, since the study phenomenon originated in 2019, the collected articles are located between 2020 and 2023. The Figure 1 illustrates the steps followed in constructing the literature review.

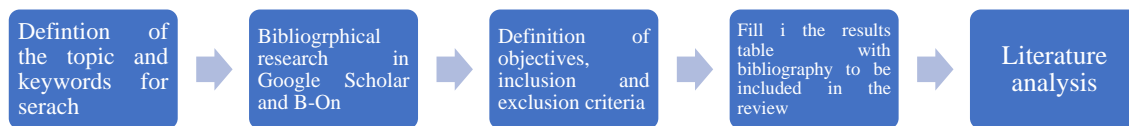


Figure 1 – Literature review process

The articles included in the literature review were selected according to the keywords in the title or *abstract*, and that reflect the objective of the study and the research focused only on texts in English. The studies concerned only contact tracing mobile applications in the context of combating COVID-19 pandemic, which is why the period between 2020 and 2023 was defined. The research was restricted to journals around information systems, using the *Scimago Journal & Country Rank* for this nomination, the search restricted redounded in a sample of 15 articles from the *IEEE Internet of Things Journal*, *European Journal of Information Systems*, *International Journal of Information Management*, *Ethics and Information Technology*, *European Journal of Information Systems*.

4. RESULTS

The studies covered by this review are systematized in Table 1. The analysis criterion was established from the reading of the 15 papers included in this article, in which it was possible to identify three groups of proposals to minimize resistance to the use of tracking applications: technical, legal, and political. These three approaches were clearly identified although the political dimension is the most prevalent.

Authors	Analysis dimension	Suggestions/proposals
Leclercq-Vandelannighte & Aroles (2020)	Political	Control society: continuous control through instantaneous communication and codification of individuals. Paradox of privacy and conformation with the system of domination (affirmation of the single discourse).
Rowe (2020)	Political	Surveillance Society - Biopower (Foucault). Health consequences/exclusion/discrimination. Blind acceptance of technology as a solution to social problems in exchange for freedom. The privacy paradox has little research on apps and location data. Ethics of digital governance , reinforcement of the ethical component in IS studies. More community involvement for solutions to combat covid-19. Address the values dilemmas and less the technical problems.
Xu et al. (2020)	Technical	<i>Beep Trace</i> : more accessible and secure. The intermediate solution between Health Code (centralizer) and Bluetooth (mobile phone consumption)
Zhang et al. (2020)	Technical/political	Local data storage. Public perceptions are a barrier to the widespread use of digital tracking apps. Public campaign to encourage use. Part of a public health strategy.
Azad et al. (2021)	Technical	Encryption systems for storing data and strengthening the authentication mechanism . Apps with a decentralized operation (user side). Easily understandable privacy policy and create a mechanism for post-pandemic data destruction . Reduce permissions. Enable the user to use a pseudonym. Simple interface and design.
Hatamian et al. (2021)	Legal	An app should only request and access permissions that are relevant to its operation. Privacy Policy that provides information on how the provider collects, uses, discloses and manages user data. EU General Data Protection Regulation (2016)
Lin, Carter & Liu (2021)	Political	The privacy paradox was reinforced in adopting the COVIDsafe application, because the perception of risk did not reduce its use.
Rowe, Ngwenyama & Richet (2021)	Political	Alienation of knowledge, design and implementation. It generated distrust and increased the belief in the ineffectiveness of the <i>Stop Covid app</i> in France. More collaboration and less coercion. The negative effect of acceleration.

Authors	Analysis dimension	Suggestions/proposals
Abramova <i>et al.</i> (2022)	Political	Prevalence of the calculation of individual privacy , but with greater weight in the social risks of controlling mass surveillance. Social risks mechanism underlying personal privacy risks in the use of apps.
Kurtaliqui , Zaman & Shier (2022)	Political	The strong link between perceived value and trust in the government, well-being and confidence in the future (effects of tranquility in a pandemic context). utility, status and risk perception. Relate the use of the app with the fight against covid-19 and a better future. Reassure through concrete actions such as contact tracing apps.
Prakash & Das (2022)	Political	Privacy, distrust, difficulties in use and value (benefit) barriers.
Simko <i>et al.</i> (2022)	Technical	User training. Users value transparency and consent. Usage relies on security and privacy.
Wall <i>et al.</i> (2022)	Political	Integrative model (acceptance of technology and belief in health) is the best answer. Context variables such as fear related to the use of apps. Context factors contribute to greater acceptance of tracking apps.
Trkman, Popvic & Trkman (2023)	Political	The unified theory of acceptance and use of technology has a significant impact. Privacy has a direct impact. Trust in government and trust in technology have a direct impact.

Table 1 – Summary of literature review

The articles were ordered chronologically and classified according to the identified dimension of analysis. The defined dimensions - Political, Technological and Legal - relate to the subject of each author's proposal/strategy for facilitating the use of remote sensing technology in public health crisis contexts such as COVID-19 pandemic.

5. DISCUSSION

From the research carried out, it was noticed that the authors present technical solutions to minimize the effects of trust in the use of contact tracing applications, but these are downstream of the need for a political framework to a problem that is interrelated with trust in the government. Leclercq-Vandelannoitte and Aroles (2020) warn of the dangers of a society of control based on the instant communications of data and coding of individuals, entangling them in a web that call the privacy paradox. Privacy is the value most appreciated by citizens whenever data sharing is at stake, especially when the perceived value is not understandable (Parkash & Das, 2022) as was evident in the COVID-19 pandemic crisis, in which the perception of risk did not reduce

resistance to the use of contact tracing applications (Lin, Carter & Liu, 2021). The same was possible to prove with the contribution of Rowe, Ngwenyama and Richet (2021) through which the acceleration effect for decision making imposed the option of a tracking application – *StopCOVID* – but which ended up generating distrust and had a very low rate of accession. Rowe (2020) suggests more community involvement and that governments adopt an ethical model in digital governance. In this way, the author believes it is possible to address value dilemmas, relegating technical issues to the background, which mitigate the effect of the privacy paradox. This is reinforced by Kurtaliqui, Zaman and Shier (2021) when they establish causal link between perceived value and trust in the government through concrete actions integrated into a public health strategy (Zhang et al., 2020). Restoring citizens trust with contact tracing applications necessarily involves trusting governments (Trkaman, Popvic & Trkman, 2023), particularly when facing a worldwide phenomenon such as the COVID-19 pandemic that may predispose citizens to accept the use of contact tracing applications as suggested Wall et al. (2022). Abromova *et al.* (2022) state that despite the social benefits of adhering to a technology that allows detecting, informing, and isolating in the event of transmission of an infectious disease, citizens are at risk and prefer to safeguard their individual privacy. For users of contact tracing applications, it is necessary to understand its usefulness, the status it confers and the perception of risk so that adherence is effective and reinforces the link between perceived value and trust in the government.

Despite the weight assumed by the political dimension, the technical solution proposals identified in the literature are heading towards greater user responsibility, through a decentralized operation in which the user has control of the data he shares, the storage of this data takes place in a context of encryption and the privacy policy provides all the information regarding the collection, processing and storage of data (Azad *et al.*, 2021; Xu *et al.*, 2020; Ye *et al.*, 2022; Kurtaliqui, Zaman & Shier, 2022). Still about user trust in both government and technology, data protection regulations must be considered and applied, transposing what is contained in the General Data Protection Regulation of the European Union (Hatemian *et al.*, 2021).

These three dimensions of analysis of proposals to minimize the effects of mistrust in the use of contact tracing applications lead to an integrated solution in which the political, legal and technical dimensions intersect in order to generate in citizens the confidence necessary for the use of this type of technology safely.

In the Figure 2 it is possible to see the interdependence of the approaches in the definition of proposals to minimize the distrust of the citizens. This interdependence illustrates the need for an integrated solution that reassures public opinion and allows governments and their respective health authorities to contain the transmission of a contagious disease through collaboration and

accountability to citizens. The intervention must therefore be political, legal and technological at the same time, so that there is a double trust of citizens in the use of this kind of tracking technology - trust in governments (political and legal) and trust in technology.

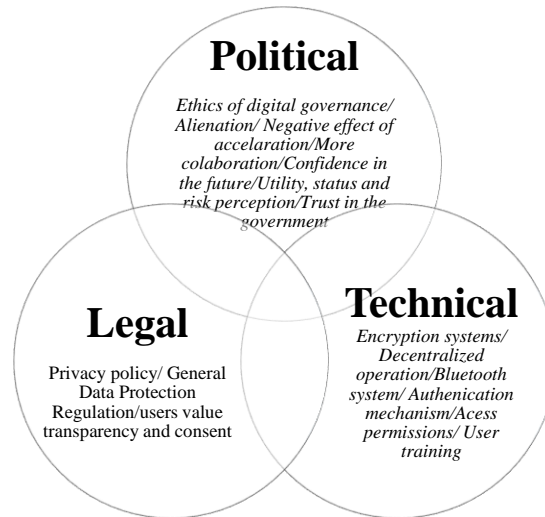


Figure 2 – Suggested model

6. CONCLUSION AND LIMITATIONS

The surveillance-privacy binomial has been the center of an intense public debate marked by overwhelming technological advances that have imposed new dynamics on the daily lives of contemporary societies characterized by the constant presence of technological devices that make everything just a click away. Despite the recognized value contributed by technology and information systems in all areas of life and knowledge, the truth is that pockets of resistance and in times of crisis, such as the COVID-19 pandemic, this resistance can cost many human lives and jeopardize public health. Understanding and identifying the reasons for resistance or mistrust generated by voluntarily joining a mobile contact tracing application is of vital importance. This objective was achieved by this literature review. It was also possible to identify the main proposals for minimizing distrust in relation to these applications. The acceleration effect (Rowe et al., 2021) that some national governments imposed determined the distrust of citizens in joining the application. There is a collective perception of invasion of privacy that results from the ever-increasing collection of data that we are all subject to in our day-to-day lives when we interact with a machine. In addition to all this, there was a perception of data vulnerability in the face of the threat of cyber-attacks.

The political role of national governments must be strengthened, particularly in an emergency, fulfilling the role of agent of trust by adopting measures that convey peace of mind to citizens.

The solution must also include technical proposals, which are within the reach of programmers, and effective regulation that contributes to the desired environment of trust.

This review has, however, some limitations, since the articles included in this study only come from journals around information systems field, excluding, for example, the contribution to the theme of journals in the medical specialty. Another limitation that can be identified is because contact tracing applications are only related to the control of the COVID-19 pandemic when there are other examples with different results and context.

However, it would be interesting to approach the use of these contact tracing applications through the perception of value that the medical community attributes to them, since the patient-doctor trust relationship remained unbreakable during the COVID-19 pandemic crisis. It would also be interesting to explore the relationship between the level of democratic deepening and resistance to the use of these contact tracing applications. There are two possible leads for future investigations.

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