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Implementation of Tracing System for Covid-19: A Literature Review

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COVID19 virus spreads very fast and can result in death. COVID19 incident has also impacted all sectors of life. Governments in many countries made various efforts to control the rate of transmission including developing and implementing contact tracing for COVID19. Contact tracing or tracing systems is a priority effort to contain the spread of the coronavirus and reduce mortality due to covid19. This paper aims to analyze the implementation covid-19 tracing system as an effort to restrain the covid-19 outbreak. The following bibliographic databases were searched to identify potentially relevant documents: SCOPUS, EBSCOHost, EMERALD, ScienceDirect, and PubMed. The search strategy was developed by the first author and further refined through team discussions. The final search results are exported to EndNote, and duplicates are removed automatically and manually. Then for the report format, follow PRISMA. 12 articles were included in the review. We found several things in analyzing the implementation of contact tracing such as the impact of implementing contact tracing, contact tracing management, and obstacles to implementing contact tracing in controlling covid19 outbreak. Contact tracing or tracing systems have a positive impact on reducing and controlling the transmission and spread of the COVID19 disease.

Penerapan Sistem Tracing Covid-19: Tinjauan Pustaka

Kata kunci:

Pelacakan kontak
Sistem pelacakan
Covid-19
Penularan
Pemulihan

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A B S T R A K

Virus COVID19 menyebar sangat cepat dan dapat mengakibatkan kematian. Wabah COVID19 juga berdampak pada semua sektor kehidupan. Pemerintah di banyak negara melakukan berbagai upaya untuk mengendalikan laju penularan termasuk mengembangkan dan menerapkan pelacakan kontak COVID19. Pelacakan kontak atau sistem pelacakan merupakan upaya prioritas menahan laju penularan virus corona dan mengurangi angka kematian akibat covid-19. Makalah ini bertujuan untuk menganalisis penerapan sistem pelacakan covid19 sebagai upaya pengendalian wabah covid-19. Basis data bibliografi berikut dicari untuk mengidentifikasi dokumen relevan yang potensial: SCOPUS, EBSCOHost, EMERALD, ScienceDirect, dan PubMed. Strategi pencarian dikembangkan oleh penulis pertama dan disempurnakan lebih lanjut melalui diskusi tim. Hasil pencarian akhir diekspor ke End Note, dan duplikatnya dihapus secara otomatis dan manual. Kemudian untuk format laporan, mengikuti PRISMA. 12 artikel dimasukkan dalam review. Kami menemukan beberapa hal dalam menganalisa pelaksanaan contact tracing seperti dampak penerapan pelcakan kontak, manajemen pelcakan kontak, dan kendala penerapan pelcakan kontak dalam pengendalian wabah covid19. Pelacakan kontak atau sistem pelacakan berdampak positif dalam mengurangi dan mengendalikan penularan dan penyebaran penyakit COVID19.

INTRODUCTION

Covid19 was originally known as the coronavirus where staff from the WHO office located in China reported the case at the end of 2019. This case spread very quickly to other countries until it became a pandemic (Mitra et al., 2020). Covid19 can spread quickly through droplets, sneezing, coughing, secretions and contact with contaminated person/object/surface. The high transmission of this virus can cause symptoms ranging from mild, severe, to end in death (Chakrabarti et al., 2020).

Covid19 incident has also had an impact on all sectors of life. So the government made various efforts to control the rate of transmission and speed up the recovery process. One of the government programs in the health sector is to carry out a tracing system for covid-19 cases. Contact tracing or tracing systems are a priority effort to contain the spread of the coronavirus and reducing mortality due to covid19 (Organization, 2021).

Many countries have implemented tracing system as an effort to restrain the COVID19 outbreak. Contact tracing and quarantine measures are intervention measures to control pandemic of covid-19. This can be effective, if there is cooperation and health promotion in reaching and monitoring all contacts that have been properly identified (Hellewell et al., 2020). Generally, many countries apply only regional and national quarantine policies, which are not sufficient to restrain the spread of covid19 (Dewi et al., 2020).

Contact tracing is part of epidemiological investigations related to infectious diseases such as Covid-19, where active surveillance is needed to identify contacts and follow-up of these contacts (Arakpogun et al., 2020).

Implementation of contact tracing requires involvement of health workers, the community, the government, researchers, and communication network providers (Mbunge, 2020). Initially the application of contact tracing was carried out traditionally or manually, where local public health officers interviewed confirmation case of covid-19, then identified contacts and contacted contacts to self-isolate, reporting symptoms to get follow-up (Kleinman & Merkel, 2020). Traditional contact tracing begins when receiving a notification from the local community health center that a confirmed case is found living in certain area and informing the contact (Anglemyer et al., 2020). Because spread of covid-19 is so fast that the application of traditional or manual of contact tracing alone cannot be completely overcome. Thus, a faster and more efficient tracking action is needed, and includes individuals on a large scale (Ferretti et al., 2021). Therefore, currently there is a new method of contact tracing tool known as digital contact tracing (Salathé et al., 2020). This tool is intended to enhance the traditional tracing system that was already implemented (Barrat et al., 2021).

This article aims to analyze the implementation tracing system of covid-19 as an effort to restrain covid-19 outbreak.

METHODS

The following bibliographic databases were searched to identify potential relevant documents: SCOPUS, EBSCOHost, EMERALD, ScienceDirect, and PubMed. The search strategy was developed by the first author and further refined through team discussions. The final search results are exported to EndNote, and duplicates are removed automatically or manually. Then for the report format, follow PRISMA (Page et al., 2021).

Then a gray literature search strategy was carried out to index literature related to research on automatic search engines on the Google Scholar and ProQuest websites.

This article was screened based on inclusion and exclusion criteria. Articles in English and are original articles that can be opened in full text for free, as well as publications in 2019-2021 where the participants are humans, are included in the inclusion criteria. Those that are not included in the inclusion criteria will be excluded, as will articles that are not relevant to the purpose of this paper.

The keywords used in the article search are Contact tracing OR Tracing system AND Covid-19 OR Coronavirus AND Transmission AND Recovery OR Treatment.

RESULT AND DISCUSSION

Based on a search of the 5 databases used, 934 articles were obtained. Both of authors jointly screened titles and abstracts using Endnote20, obtaining 57 full text articles, which were then being screened with eligibility for 24 articles with 12 articles entering the criteria.

From 12 articles were extracted, 2 articles were mixed methods, 3 qualitative research articles, 3 retrospective cohort articles, 3 cross sectional articles, and 1 quasi-experimental article. From the 12 extracted articles, we found several things in analyzing the implementation of contacts tracing such as the impact of implementing contacts tracing, contact tracing management, and obstacles to implementing contacts tracing in controlling covid-19 outbreak.

Impact of Implementing Contacts Tracing

Investigation strategies by combining the discovery of active cases and contact tracking based on systematic testing on close contacts either light and severe, with a follow-up of monitoring for 14 days and case insulation, it is possible to quickly restrain the spread of Covid-19 clusters (de Laval et al., 2021). Five countries in Asia Pacific are combining mitigation measures, which focus on contact tracing, testing, isolation efforts, and health care management in an effort to control the spread of COVID-19 (El Guerche-Séblain et al., 2021). Likewise in the city of Ankara, Turkey to the Covid-19 reproduction number to less than 1, there are several methods that can be used, such as maintaining distance, personal hygiene, using masks, contact tracing, testing, quarantine/isolation, to area closure (ŞImŞEk et al., 2020). In addition, contact tracing is able to reduce the risk of death in preventing the transmission of SARS Cov-2 (Fernández-Niño et al., 2021). The reduction in mortality was between 0.8% and 3.4% through contact tracing in the previous 3 to 8 weeks (Vecino-Ortiz et al., 2021). However, other studies say that contact tracing has no role in controlling the transmission rate of COVID-19 (Malheiro et al., 2020).

Contact Tracing Management

There is a need for protocols in initiating plans for epidemiological investigations and contact tracing of confirmed close contacts or travelers from high-risk cities or foreign countries. Furthermore, the symptomatic contacts

were subjected to a pharyngeal swab test to detect the SARS Cov-2 virus. Epidemiological investigations were carried out using the European Center of Disease Control (ECDC) guidelines, which contained socio-personal information such as age, gender, occupation, and health facilities. In addition, information on the date of onset of symptoms and types of symptoms, contact methods with suspected/confirmed cases, vaccination status and isolation compliance are also provided (Squeri et al., 2020). In Colombia the management of the contact tracing program is called PRASS in Spanish, consisting of Test, Tracing, and Select Sustainable Isolation Program (Fernández-Niño et al., 2021). Every case of Covid-19 detected contact tracing is carried out to identify all closely contacts subsequently monitored for 14 days at home (Ng et al., 2021). If symptoms develop within 14 days, they should be reported to the local health center doctor. Then the doctor will refer the patient to the Covid-19 referral hospital by ambulance under the Crisis Coordination Center (ŞImŞEk et al., 2020).

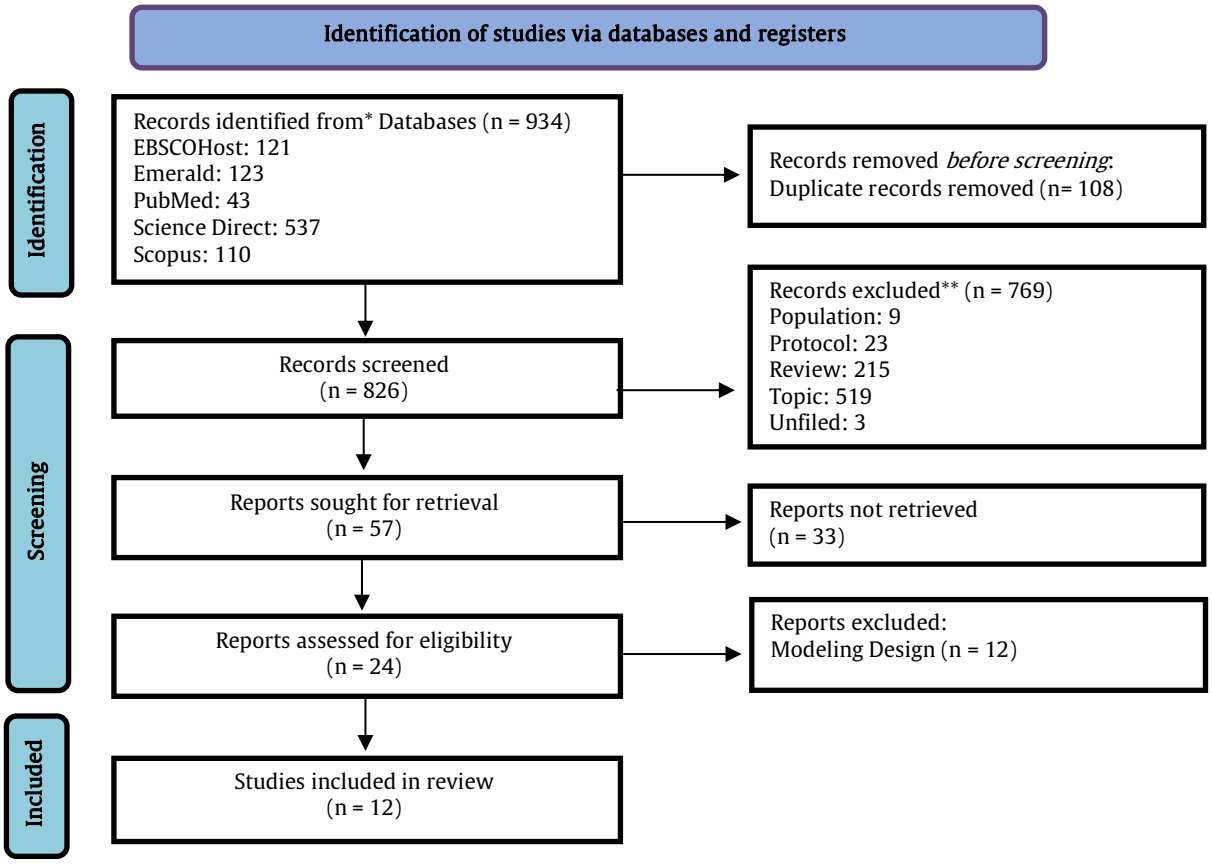

Figure 1: PRISMA flow diagram

Obstacles to Implementing Contacts Tracing

One strategy to control the COVID-19 outbreak in Washington state is Case Investigation and Contact Tracing (CICT). However, it takes trust and community involvement in identifying close contacts, COVID-19 swab testing, self-isolation and quarantine, so that the CICT process runs effectively (Miller et al., 2021). The slowest time of finding secondary cases from the main case and unidentified contacts can also hamper the effectiveness of breaking the chain of transmission of COVID-19 (Keeling et al., 2020). Other obstacles, such as the risk of personal data leakage for users of health applications used for monitoring covid-19 tracing (Rahimi et al., 2021). Perceptions that arise for some people regarding the use of tracing applications in the UK such as confused in using them, assumptions and personal; little information about how the application functions; and Perception of a better tracing system, causing confusion to use this application (Williams et al., 2021).

Tabel 1.
Data Extraction

Author/Year	Study Aim	Setting & Design	Data Collection & Participants	Findings
de Laval, Grosset-Janin et al / 2021	Objective this paper is strategies and consequences of the examination concerning coronavirus	In Creil, France. This study is mix methods.	The data from this study were the Covid19 RT-PCR tests and questionnaire. 24 cases were confirmed.	There are 24 confirmed covid-19 patients. The assault rate was 29%. Just three cases were asymptomatic. 19 cases suggestive of respiratory

	episode in a proficient local area.			disease, two of which were extreme.
El Guerche-Séblain, Chakir et al / 2021	This study to explain how the epidemic control strategy occurs when there is a spike in the first wave of covid-19 cases and epidemiology.	The five Asia-Pacific countries	From official institutions reports and literature review articles. One thousands population in five Asia-Pacific countries.	The five countries combined strategies in determining measures to control the spread of COVID-19 which focused on tracking systems, testing, quarantine/isolation, and health care arrangements.
Fernández-Niño, Peña-Maldonado et al / 2021	This study to determine the effect of contact tracing in reducing mortality due to COVID-19 in Colombia.	Retrospective cohort design. In the colombia	This study used anonymized data from SEGCOVID19. Among 1.4 million cases	It was found that the search was able to reduce deaths by 48%. The results obtained from sensitivity analyzes are consistent with reduced mortality at the individual level and a higher protective effect with higher number of contacts being tracked.
Keeling, Hollingsworth et al / 2020	The aim of the study to evaluate the implementation of the tracing system for containment of covid-19.	In the UK. Cross-sectional	This article leverage detailed social network data from the UK. Over 5800 respondents to be participants	The findings of this study predict that contact tracing is effective in less than 1 in 6 cases which will result in further untraceable infections. With an increase in untracked cases, this review found that close contact tracing took more than 4 hours to control deployment of coronavirus
Malheiro, Figueiredo et al / 2020	To assess the effect of mitigation strategies in restraining the rate of transmission of covid19.	in Eastern Porto and this design is retrospective cohort study.	Of 630 COVID-19 cases. Data sourced from SINAVE and protected databases.	Contact tracing and quarantine of close contacts had no effect on secondary case rates, indicating that further action may be needed to break the chain of transmission of COVID-19. However, national restrictions could have an impact in reducing the chain of transmission of COVID-19.
Miller, Bonacci et al / 2021	to evaluate Washington state in confirmed case investigations and coronavirus tracing systems	Washington state. This study is mix methods.	Data obtained from CICT komunitas and interviews. A total of 4,987 cases were referred for community case investigation and contact tracing (CICT).	As many as 3,572 individuals who were asked about close contacts, there were 68% who said they did not have close contacts. 968 confirmed cases said they had close contacts. With an overall average of 2.4 contacts per case.
Ng, Marimuthu et al / 2021	This study systematically investigated the overall prevalence of coronavirus infection and epidemiological risk factors.	Singapore. The study design is a retrospective cohort study.	7770 close contacts . The data in this article were extracted from the Ministry of Health contact tracing database.	Based on the results of Bayesian analysis it was found that a total of 7770 contacts were identified, 1150 close contacts were symptomatic of the results. so it is estimated that 36% of individuals with coronavirus infection show symptoms.
Rahimi, Khoundabi et al / 2021	This study aims to analyze the factors that influence the use of mobile health applications for "contact tracing" and "symptom monitoring" of COVID-19.	In Iran. A cross-sectional study.	Data obtained through online surveys on social media. A total of 1031 participants aged 18 years were surveyed	Based on the findings of this paper, most of the participants agreed to use the mobile health app.
ŞImŞEk, Kara et al / 2020	The purpose of this study is to evaluate the management of tracing covid-19 cases such as case detection, testing, and follow-up	In Ankara. This method is Cross-sectional.	Data were obtained from the General Directorate of Public Health of the Ministry of Health of the Republic of Turkey, where there were 190,283 contacts made by PCR test.	The number of contacts per case was 4.07 and the number of contact tracing per case was 4.05. With a total of 398 "Field Contact Tracking Teams" consisting of 1 doctor and 2 health workers across the city, the average 50 ± standard

				deviation reached 99.4% in a few hours.
Squeri, Levita et al / 2020	Describes the need to implement correct tracing management in cases of infectious diseases such as COVID-19 and report the number of positive health workers.	Southern Italy. This study is Qualitative Research.	Data obtained from the results of interviews with HCWs and collected nnasopharyngeal swabs by all HCWs. 43 participants	There is a need for protocols in initiating plans for epidemiological investigations and contact tracing of confirmed close contacts or travelers from high-risk cities or foreign countries.
Vecino-Ortiz, Villanueva Congote et al / 2021	This study analyzes the impact of contact tracing measures in middle-income countries such as Colombia, data availability in expanding tracking and optimizing tracking system strategies to control coronavirus infection control.	In Colombia. This study is an quasi-experimental.	From the "Open Data" portal of the Colombian National Institute of Health. 54,931 cases identified.	The study found that contact tracing was associated with a reduction in COVID-19 deaths between 0.8% and 3.4%, which is reflected in a 10 percent increase in the proportion of cases identified.
Williams, Armitage et al / 2021	Find out how the UK public is responding to the use of contact tracing apps.	In the UK. Qualitative design	Participants are UK citizens aged 18 years and over, which is 27 participants. By conducting a focus group discussion technique, a group of people is selected to discuss a particular topic or problem in depth.	Model simulations on an expanded network of 5000 students, can also reduce infections by up to 79% as is the case with contact tracing applications.

Based on the results of several reviews of the articles above, it is explained that testing and contact tracing have a positive impact in controlling the Covid-19 outbreak. This can also be another strategy in easing social distancing policies without the existence of group immunity against the SARS Cov-2 type of virus (Aleta et al., 2020). However, other research based on the results of the review above, explains that contact tracing does not play a significant role in reducing the chain of transmission of COVID-19 (Malheiro et al., 2020). Perhaps this is due to some obstacles in implementing contact tracing such as trust and community involvement (Miller et al., 2021). Community participation and the principle of building trust are important elements in achieving the successful implementation of contact tracing (Organization, 2021).

Although mostly in several countries such as South Korea with tracing and testing systems managed to control the spread of the Covid-19 outbreak. However, this is not the case in many states in the United States, where this is affected by a lack of national coordination and an inadequate supply of testing tools (Clark et al., 2021). One of the successful implementations of COVID-19 contact tracing is influenced by the adequacy of testing. The act of isolating/quarantining recommended by local health workers on identifying close contacts, when testing has not been carried out is effective in reducing the transmission of covid-19 (Koetter et al., 2020).

Tracing management in different countries varies greatly depending on guidelines and local health professionals (Vogt et al., 2022). WHO (2021) divides tracing management in several steps as a guideline while implementing contact tracing which includes contact identification, close contact follow-up, contact information, managing and monitoring contacts. There are obstacles in contact tracing such as unidentified contacts, slow testing, quarantine notifications, so a digital-based tracking tool is needed. A digital-based contact tracing tool is a medium that is intended to be able to improve the tracing system that has been implemented previously. However, ethical issues such as privacy, accessibility, security, and accountability need to be considered (Organization, 2021). Therefore it is necessary to be careful in integrating contact tracing. Besides that, this digital-based tool costs money to develop and requires continuous use, so this is a challenge in implementing digital contact tracing, especially for low-income people and living in an area with limited access (Organization, 2020).

LIMITATION OF THE STUDY

This article is only limited to the search sources for the five databases analyzed due to the lack of research that discusses this issue and all the literature sources obtained in this study are English articles.

CONCLUSIONS AND SUGESTIONS

A total of 12 articles were extracted, we found several things in analyzing the implementation of contacts tracing such as the impact of implementing contacts tracing, contact tracing management, and obstacles to implementing contacts tracing in controlling covid-19 outbreak.

From the discussion described above, it is said that contact tracing or tracing systems have a positive impact in reducing and controlling the transmission and spread of the COVID-19 disease. Digital contact tracing is designed to help improve tracing activities that have been running previously.

However, it is necessary to pay attention to ethics related to the use of digital-based contact tracing tools such as privacy, security, accountability, and accessibility.

There are still limited studies that discuss this issue, so it is hoped that in the future there will be more studies that address this issue.

ETHICAL CONSIDERATIONS

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Conflict of Interest Statement

The authors declares that there is no conflict of interest in the writing and publication of this paper. This paper can be accounted for by the authors.

REFERENCES

Aleta, A., Martin-Corral, D., Pastore y Piontti, A., Ajelli, M., Litvinova, M., Chinazzi, M., Dean, N. E., Halloran, M. E., Longini Jr, I. M., & Merler, S. (2020). Modelling the impact of testing, contact tracing and household quarantine on second waves of COVID-19. *Nature Human Behaviour*, *4*(9), 964-971.

Anglemyer, A., Moore, T. H., Parker, L., Chambers, T., Grady, A., Chiu, K., Parry, M., Wilczynska, M., Flemyng, E., & Bero, L. (2020). Digital contact tracing technologies in epidemics: a rapid review. *Cochrane Database Syst Rev*, *8*(8), Cd013699. https://doi.org/10.1002/14651858.Cd013699

Arakpogun, E. O., Elsahn, Z., Prime, K. S., Gerli, P., & Olan, F. (2020). Digital contact-tracing and pandemics: Institutional and technological preparedness in Africa. *World Development*, *136*, 105105. https://doi.org/https://doi.org/10.1016/j.worlddev.2020.105105

Barrat, A., Cattuto, C., Kivelä, M., Lehmann, S., & Saramäki, J. (2021). Effect of manual and digital contact tracing on COVID-19 outbreaks: a study on empirical contact data. *Journal of the Royal Society Interface*, *18*(178), 20201000.

Chakrabarti, S. S., Kaur, U., Banerjee, A., Ganguly, U., Banerjee, T., Saha, S., Parashar, G., Prasad, S., Chakrabarti, S., Mittal, A., Agrawal, B. K., Rawal, R. K., Zhao, R. C., Gambhir, I. S., Khanna, R., Shetty, A. K., Jin, K., & Chakrabarti, S. (2020). COVID-19 in India: Are Biological and Environmental Factors Helping to Stem the Incidence and Severity? *Aging and disease*, *11*(3), 480-488. https://doi.org/10.14336/AD.2020.0402

Clark, E., Chiao, E. Y., & Amirian, E. S. (2021). Why Contact Tracing Efforts Have Failed to Curb Coronavirus Disease 2019 (COVID-19) Transmission in Much of the United States [Article]. *Clinical Infectious Diseases*, *72*(9), e415-e419. https://doi.org/10.1093/cid/ciaa1155

de Laval, F., Grosset-Janin, A., Delon, F., Allonneau, A., Tong, C., Letois, F., Couderc, A., Sanchez, M.-A., Destanque, C., Biot, F., Raynaud, F., Bigaillon, C., Ferraris, O., Simon-Loriere, E., Enouf, V., Andriamanantena, D., de Santi, V. P., Javelle, E., & Mérens, A. (2021). Lessons learned from the investigation of a COVID-19 cluster in Creil, France: effectiveness of targeting symptomatic cases and conducting contact tracing around them [journal article]. *BMC Infectious Diseases*, *21*(1), 1-9. https://doi.org/10.1186/s12879-021-06166-9

Dewi, A., Nurmandi, A., Rochmawati, E., Purnomo, E. P., Rizqi, M. D., Azzahra, A., Benedictos, S., Suardi, W., & Kusuma Dewi, D. T. (2020). Global policy responses to the COVID-19 pandemic: Proportionate adaptation and policy experimentation: A study of country policy response variation to the COVID-19 pandemic [Article]. *Health Promotion Perspectives*, *10*(4), 359-365. https://doi.org/10.34172/hpp.2020.54

El Guerche-Séblain, C., Chakir, L., Nageshwaran, G., Harris, R. C., Sevoz-Couche, C., Vitoux, O., & Vanhems, P. (2021). Experience from five Asia-Pacific countries during the first wave of the COVID-19 pandemic: Mitigation strategies and epidemiology outcomes [Article]. *Travel Medicine and Infectious Disease*, *44*, Article 102171. https://doi.org/10.1016/j.tmaid.2021.102171

Fernández-Niño, J. A., Peña-Maldonado, C., Rojas-Botero, M., & Rodriguez-Villamizar, L. A. (2021). Effectiveness of contact tracing to reduce fatality from COVID-19: preliminary evidence from Colombia [Article]. *Public Health (Elsevier)*, *198*, 123-128. https://doi.org/10.1016/j.puhe.2021.07.013

Ferretti, A., Hedrich, N., Lovey, T., Vayena, E., & Schlagenhauf, P. (2021). Mobile apps for travel medicine and ethical considerations: A systematic review. *Travel Medicine and Infectious Disease*, *43*, 102143. https://doi.org/https://doi.org/10.1016/j.tmaid.2021.102143

Hellewell, J., Abbott, S., Gimma, A., Bosse, N. I., Jarvis, C. I., Russell, T. W., Munday, J. D., Kucharski, A. J., Edmunds, W. J., Sun, F., Flasche, S., Quilty, B. J., Davies, N., Liu, Y., Clifford, S., Klepac, P., Jit, M., Diamond, C., Gibbs, H., . . . Centre for the Mathematical Modelling of Infectious Diseases, C.-W. G. (2020). Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts [Article]. *The Lancet Global Health*, *8*(4), e488-e496. https://doi.org/10.1016/S2214-109X(20)30074-7

Keeling, M. J., Hollingsworth, T. D., & Read, J. M. (2020). Efficacy of contact tracing for the containment of the 2019 novel coronavirus (COVID-19) [Article]. *Journal of Epidemiology and Community Health*, *74*(10), 861-866. https://doi.org/10.1136/jech-2020-214051

Kleinman, R. A., & Merkel, C. (2020). Digital contact tracing for COVID-19 [journal article]. *CMAJ: Canadian Medical Association Journal*, *192*(24), E653-E656. https://doi.org/10.1503/cmaj.200922

Koetter, P., Pelton, M., Gonzalo, J., Du, P., Exten, C., Bogale, K., Buzzelli, L., Connolly, M., Edel, K., & Hoffman, A. (2020). Implementation and process of a COVID-19 contact tracing initiative: leveraging health professional students to extend the workforce during a pandemic. *American Journal of Infection Control*, *48*(12), 1451-1456.

Malheiro, R., Figueiredo, A. L., Magalhães, J. P., Teixeira, P., Moita, I., Moutinho, M. C., Mansilha, R. B., Gonçalves, L. M., & Ferreira, E. (2020). Effectiveness of contact tracing and quarantine on reducing COVID-19 transmission: a retrospective cohort study [Article]. *Public Health (Elsevier)*, *189*, 54-59. https://doi.org/10.1016/j.puhe.2020.09.012

Mbunge, E. (2020). Integrating emerging technologies into COVID-19 contact tracing: Opportunities, challenges and pitfalls. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *14*(6), 1631-1636. https://doi.org/https://doi.org/10.1016/j.dsx.2020.08.029

Miller, J. S., Bonacci, R. A., Lash, R. R., Moonan, P. K., Houck, P., Van Meter, J. J., Butler, M., Everson, T., Morrison, B., Sixberry, M., Person, A., & Oeltmann, J. E. (2021). COVID-19 Case Investigation and Contact Tracing in Central Washington State, June-July 2020. *J Community Health*, *46*(5), 918-921. https://doi.org/10.1007/s10900-021-00974-5

Mitra, P., Misra, S., & Sharma, P. (2020). COVID-19 Pandemic in India: What Lies Ahead. *Indian Journal of Clinical Biochemistry*, *35*(3), 257-259. https://doi.org/10.1007/s12291-020-00886-6

Ng, O. T., Marimuthu, K., Koh, V., Pang, J., Linn, K. Z., Sun, J., De Wang, L., Chia, W. N., Tiu, C., Chan, M., Ling, L. M., Vasoo, S., Abdad, M. Y., Chia, P. Y., Lee, T. H., Lin, R. J., Sadarangani, S. P., Chen, M. I., Said, Z., . . . Lee, V. J. (2021). SARS-CoV-2 seroprevalence and transmission risk factors among high-risk close contacts: a retrospective cohort study. *Lancet Infect Dis*, *21*(3), 333-343. https://doi.org/10.1016/s1473-3099(20)30833-1

Organization, W. H. (2020). *Digital tools for COVID-19 contact tracing: annex: contact tracing in the context of COVID-19, 2 June 2020*.

Organization, W. H. (2021). *Contact tracing in the context of COVID-19: interim guidance, 1 February 2021*.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Bmj*, *372*, n71. https://doi.org/10.1136/bmj.n71

Rahimi, R., Khoundabi, B., & fathian, A. (2021). Investigating the effective factors of using mHealth apps for monitoring COVID-19 symptoms and contact tracing: A survey among Iranian citizens [journal article]. *International Journal of Medical Informatics*, *155*, N.PAG-N.PAG. https://doi.org/10.1016/j.ijmedinf.2021.104571

Salathé, M., Althaus, C. L., Neher, R., Stringhini, S., Hodcroft, E., Fellay, J., Zwahlen, M., Senti, G., Battegay, M., Wilder-Smith, A., Eckerle, I., Egger, M., & Low, N. (2020). COVID-19 epidemic in Switzerland: on the importance of testing, contact tracing and isolation. *Swiss Med Wkly*, *150*, w20225. https://doi.org/10.4414/smw.2020.20225

ŞImŞEk, A. Ç., Kara, A., Baran-Aksakal, F. N., GÜLÜM, M., iLter, B., Ender, L., Bulut, Y. E., GÜL, H., Irmak, H., Altunay, K., ÇAkmak, D., Tosun, E., GÜLegen, E. C., & DemirkasimoĞLu, M. (2020). Contact tracing management of the COVID-19 pandemic [Article]. *COVID-19 pandemisinde filyasyon ve temaslı yönetimi.*, *77*(3), 269-280. https://doi.org/10.5505/TurkHijyen.2020.80688

Squeri, R., Levita, A., Intelisano, R., Costa, G. B., Mancuso, G., Grasso, L., D'Amato, S., Mazzitelli, F., Squeri, A., Midiri, A., Biondo, C., Alesci, D., Bonaccorso, V., Bitto, A., & Genovese, C. (2020). Correct management and low rate of contagiousness of healthcare workers in a University Hospital in Southern Italy: from contact tracing to serological investigation. *Acta Biomed*, *91*(9-s), 79-86. https://doi.org/10.23750/abm.v91i9-S.10118

Vecino-Ortiz, A. I., Villanueva Congote, J., Zapata Bedoya, S., & Cucunuba, Z. M. (2021). Impact of contact tracing on COVID-19 mortality: An impact evaluation using surveillance data from Colombia [Article]. *PLoS ONE*, *16*(3), 1-12. https://doi.org/10.1371/journal.pone.0246987

Vogt, F., Kurup, K. K., Mussleman, P., Habrun, C., Crowe, M., Woodward, A., Jaramillo-Gutierrez, G., Kaldor, J., Vong, S., & Vilas, V. D. R. (2022). Contact tracing indicators for COVID-19: Rapid scoping review and conceptual framework [Review]. *PLoS ONE*, *17*(2 February), Article e0264433. https://doi.org/10.1371/journal.pone.0264433

Williams, S. N., Armitage, C. J., Tampe, T., & Dienes, K. (2021). Public attitudes towards COVID-19 contact tracing apps: A UK-based focus group study [Article]. *Health Expectations*, *24*(2), 377-385. https://doi.org/10.1111/hex.13179

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