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Opportunity of Leprosy Information Systems as An Effort to Eliminate Leprosy in Papua: Systematic Review

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A B S T R A C T

Leprosy is a significant health problem in certain countries, including Indonesia. Indonesia has six provinces that have been unable to eliminate leprosy, including Papua. Most leprosy elimination constraints are caused by drinking compliance, socio-cultural factors, health services, and the development of information systems to eliminate leprosy. This study discussed the leprosy information system in the situation in Papua. The applied approach was a systematic review. The researchers reviewed the articles from ProQuest, Ebscohost Medline, Emerald, Clinical key, Science Direct, and Sage Journal databases from 2018-2022. The researchers also applied keywords to filter sources. The author found 329 articles however only six papers met the requirements for analysis. The review found that the information system was an integrated application with reminders, artificial intelligence, epidemiological modeling, and geographic applications. These articles were useful to differentiate some matters, such as detections, reminders, geospatial data, epidemiological modeling, vaccines, and analysis of application reliability with artificial intelligence assistance.

Kata kunci:

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A B S T R A K

Kusta merupakan masalah kesehatan utama di negara-negara tertentu termasuk Indonesia. Indonesia sendiri terdapat enam provinsi yang belum dapat mengeliminasi kusta termasuk Papua. Kendala eliminasi kusta mayoritas disebabkan karena kepatuhan minum, factor sosial-budaya, dan layanan kesehatan. Mengikuti perkembangan sistem informasi yang akhir-akhir ini berkembang pesat dapat dimanfaatkan dalam upaya eliminasi kusta. Untuk itu penelitian ini akan membahas tentang pemanfaatan sistem informasi kusta yang sesuai dengan keadaan Papua. Pendekatan yang digunakan dalam tulisan ini ialah sistematis review pada artikel jurnal memanfaatkan database ProQuest, Ebscohost medline, Emerald, Clinicalkey, Science Direct dan Sage Journal dalam rentang 2018-2022 dan menggunakan kata kunci untuk menyaring sumber. Penulis menemukan sebanyak artikel 329 artikel yang kemudian terdapat 6 artikel yang memenuhi syarat untuk dilakukan analisa. Review menemukan bahwa system informasi yang digunakan yakni aplikasi yang di integrasikan dengan pengingat, artificial intelligen, pemodelan epidemiologi serta aplikasi geografis. Artikel-artikel tersebut mempunyai fungsi dan tujuan yang cenderung berbeda satu sama lain baik pada deteksi sini, reminder, data geospasial, pemodelan epidemiologi, vaksin serta analisa kehandalan aplikasi dengan bantuan kecerdasan buatan.

INTRODUCTION

The World Health Organization (WHO) states that leprosy is a disease with a significant health problem for many countries, including Indonesia. In 2018, the World Health Organization noted the highest prevalence of leprosy was in the Southeast Asia region, with approximately 156,118 cases. The following rank was the United State of America, with 28,806 cases, and Africa with 20,004. The global data showed a decreasing trend for the new cases. However, in some states, the prevalence of leprosy is still relatively high. In 2018, 208,619 new cases of leprosy were diagnosed in Nepal. The high prevalence of leprosy, with a ratio of 1:10.000 population, confirms that leprosy is still a public health problem (WHO, 2022).

Leprosy control reached dramatic success in the 1980s-1990s with the adoption of short-term multidrug therapy (MDT) (Steinmann, et. al, 2020). The administration required regular implementation for six or 12 months depending on the type of leprosy (Rachmani, et.al, 2020). The global prevalence of MDT decreases to less than a ratio of 1:10.000. Recently, leprosy control becomes stagnant (Steinmann, et. al, 2020). The patient's adherence to the MDT regimen becomes a challenge because the long duration of treatment caused new problems and stagnation (Rachmani, et.al, 2020).

According to Steinmann et al., the stagnation leads to drug resistance due to low patient medication adherence. This situation leads to resistance and triggers MDT's failure (Benjak, et. al, 2018). Various factors influence compliance, including socio-cultural factors (Bahari, Sutantri, Huriah, 2022), geographic (De Souza, et. al, 2021; Chen, & Shui, 2021; Machado, et.al, 2022), the health care system in the area (Rachmani, et.al, 2020), and the drug delivery systems and mixed drug regimens (Chales, et. al, 2020).

Based on the goals of the SDGs and the phenomenon of the high prevalence of leprosy presented by WHO, the health problem in Indonesia requires a particular approach. At the national level, Indonesia has achieved leprosy elimination. Unfortunately, leprosy remains observable in six provinces, such as North Sulawesi, West Sulawesi, Maluku, North Maluku, West Papua, and Papua. In 2020, 11,173 new cases of leprosy mostly consisted of multi-bacillary (MB) type leprosy, 86%. The data from the Ministry of Health indicate a downward trend compared to previous years (Kemenkes, 2021).

Figure 1. Indonesia Map of Leprosy Elimination in 2020 (Kemenkes, 2021)

Note: The red-highlighted province highlighted is not free of leprosy.

Papua Province encountered a failure to eliminate leprosy in 2019. The report showed 1,537 new cases of leprosy, both PB and MB types. Table 1 shows the detailed information:

Table 1. New cases of leprosy in Papua Province in 2019 (Dinas Kesehatan Papua, 2020)

No	District/City	New Case								
		Basiler Pause (PB)			Multi Basiler (MB)			Total		
		L	P	L+P	L	P	L+P	L	P	L+P
1	Merauke	10	6	16	82	21	103	92	27	119
2	Jayawijaya	24	6	30	20	5	25	44	11	55
3	Jayapura	15	4	19	30	7	37	45	11	56
4	Nabire	16	4	20	68	17	85	84	21	105
5	Kep. Yapen	3	1	4	11	3	14	14	4	18
6	Biak Numfor	30	7	37	145	36	181	175	43	218
7	Paniai	26	7	33	18	5	23	44	12	56
8	Puncak Jaya	0	0	0	7	2	9	7	2	9
9	Mimika	55	14	69	50	12	62	105	26	131
10	Boven Digoel	38	9	47	94	24	118	132	33	165
11	Mappi	5	1	6	16	4	20	21	5	26

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12	Asmat	0	0	0	40	10	50	40	10	50
13	Yahukimo	0	0	0	0	0	0	0	0	0
14	Peg. Star	0	0	0	0	0	0	0	0	0
15	Tolikara	0	0	0	6	2	8	6	2	8
16	Sarmi	0	0	0	16	4	20	16	4	20
17	Keerom	6	2	8	28	7	35	34	9	43
18	Waropen	3	1	4	7	2	9	10	3	13
19	Supiori	8	2	10	34	9	43	42	11	53
20	Mamberamo Raya	15	4	19	44	11	55	59	15	74
21	guess	0	0	0	0	0	0	0	0	0
22	Lanny Jaya	0	0	0	0	0	0	0	0	0
23	Middle Mom	0	0	0	0	0	0	0	0	0
24	Yalimo	0	0	0	0	0	0	0	0	0
25	Puncak Jaya	0	0	0	0	0	0	0	0	0
26	Dogiyai	0	0	0	0	0	0	0	0	0
27	Intan Jaya	0	0	0	2	0	2	2	0	2
28	Deiyai	0	0	0	0	0	0	0	0	0
29	Jayapura City	41	10	51	212	53	265	253	63	316
Total		**295**	**78**	**373**	**930**	**234**	**1164**	**1225**	**312**	**1537**

Table 1 shows most leprosy cases are observable in coastal areas, from the shore to the mountainous areas. Geographically, Papua is the largest province in Indonesia with proportional numbers of beaches, coastal changes, and mountains. Papua is a region with unequal and limited technology information distribution. Recently, the Information Technology Accessibility Agency built nine signal amplifier stations, including in Puncak Jaya and Membramo Raya. The signal amplifier stations are expected to support the continuity of education, health, and other public services (Kominfo, 2020).

Rachmani et al. revealed an integrated and innovative approach to eliminating leprosy. This approach included information technology and digital health in leprosy control, recommended disease prevention, surveillance, self-management, and compliance programs with a focus on public health initiatives. The information technology for disease control has been widely carried applied, for example, to control malaria Baliga, et. al, 2019; Subbarao, et. al, 2019; Karundend, Titin Sutini, Suhendar, 2020; Baliga, et. al, 2021); filariasis (Devi & Raju, 2018; Prada, et. al, 2020); and Leprosy (Chen, & Shui, 2021; De Souza, et. al, 2021 dan Machado, et.al, 2022)..

The uses of technology included digital geographic monitoring (Baliga, et. al, 2019), Bionomics vector (Subbarao, et. al, 2019), development of control systems (Baliga, et. al, 2021), Short Message Service health-control reminder) (Karundeng, Titin Sutini, Suhendar, 2020), interface reporting system with web design (Devi & Raju, 2018), and Transmission Assessment Surveys (TAS) (Prada, et. al, 2020). From the data and the review, this research focused on the information system opportunities to eliminate leprosy.

METHOD

This systematic review study applied the PICO grid logic approach. The researchers used the approach to focus on the use of information technology to eliminate leprosy. The researchers took the data from ProQuest, Ebscohost, Emerald, Clinicalkey, Science Direct, and Sage Journal published from 2018-2022. This Systematic review used keywords, such as “System Information” OR “Technology information” AND “Leprosy” OR “Leprosy elimination”.

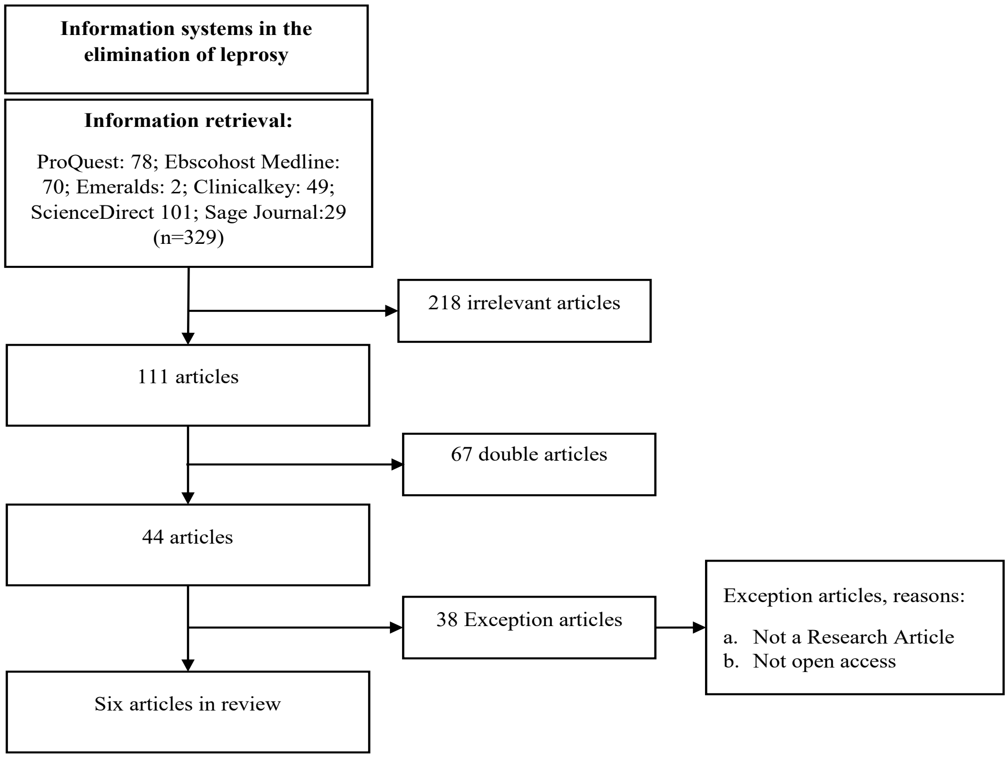

Figure 2.
Database search di agram using the PICO approach

RESULTS

The literature search results assessed six articles shown in Table 2. The study's results are based on the literature on information technology and leprosy elimination.

Table 2. Summary of Articles reviewed

No	Author/ Year	Title	Design	Location	Sample/population	Information System Type	Findings/ Results
1	Rachmani et al. (2020).	The implementation of an integrated e-leprosy framework in a leprosy control program at primary health care centers in Indonesia	*Mix method* longitudinal analysis and two groups	Pekalongan Regency, Indonesia	Patients' families, 27 leprosy surveillance staff at primary centers, and leprosy supervisors in the Pekalongan district	e-leprosy with SMS reminders to surveillance staff and patients	The use of e-leprosy increased annually; with significant acceptance by health workers due to computer and internet literacy, and increased patient attendance for medication purposes.
2	Steinmann, P., Dusenbury, C., Addiss, D., Mirza, F., & Cairns S Smith, W. (2020)	A comprehensive research agenda for zero leprosy	Qualitative*:* Expert consensus	-	-	Integration of diagnostics, location mapping, use of digital technology and innovation, epidemiological modeling, and vaccines	The zero leprosy agenda required multi-disciplinary efforts; this approach combined a leprosy information system application for early detection and treatment, including reminders and mapping.
3	Chen, & Shui(202	The state of the leprosy	Quantitative with the help	Yunnan, China	The population in	Leprosy management	The combination of information &

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	1)	epidemic in Yunnan, China 2011–2020: A spatial and spatiotemporal analysis, highlighting areas for intervention	of software *Spatial distribution of newly detected leprosy case*(ArcGIS 10.6.1), Spatial autocorrelation analysis (GeoDa 1.8.8), and Spatiotemporal clustering analysis (SaTScan 9.4.3)		this study uses data from the National Bureau of Statistics of the People's Republic of China.	information system in China (LEPMIS)	management systems for leprosy with Arcgis and StatsCan is a system for early symptoms/early detection. LEPMIS was important to accommodate leprosy patient data, including the general data, gender, number of families, social, and environment so that future research should develop more and focus on the integration of elimination strategies. LEPMIS is the first step in planning an elimination program
4	De Souza et al. (2021)	Leprosy Screening Based on Artificial Intelligence: Development of a Cross-Platform App	Quantitative with Python Analysis	Brazil	-	National Notifiable Diseases Information System (SINAN) and Artificial intelligence model	Making a new patient classification on SINAN to realize an accurate new incidence mapping
5	Rosewell , et al. l (2021)	Transforming the health information system using mobile and geographic information technologies, Papua New Guinea	Quantitative, Cohort Study	Papua New Guinea	184 Health facilities in five Provinces		This research focuses on the benefit of cell-based health information systems and geographic information technology for health workers in primary care facilities. The article focused on the system integration between health and geographic information to improve health service management in Papua New Guinea.
6	Chua-Intra, et al. (2021)	Effectiveness Of Enhancement Strategy For New Case Findings At District Level And Impact On Sustainable Leprosy Elimination And Leprosy-Free Thailand	Quantitative: Retrospective description and analytical analysis of the epidemiological situation with frequency distribution and presentation, comparative analysis	928 District / District	Thailand	Integrating a geographic information system and leprosy database	Early incident detection with effective leprosy elimination, 60% of the targeted district within two years (2017-2019).

DISCUSSION

Of the six articles, the researchers found the information system (IS) about the patient. The patient information system was integrated with reminders via short message service (SMS) (Rachmani, et.al, 2020); geographic mapping applications (Steinmann, et. al, 2020; Rosewell, et. al, 2021;Chua-Intra, et. al, 2021; Chen & Shui, 2021); and Early detection applications, such as ArcGIS, GeoDa &SatScan (Chen & Shui, 2021); epidemiological and vaccine modeling;[2] and artificial intelligence modeling (De Souza, et. al, 2021). In addition, the other applications were the website-based system information and cellular-based application.

Information system integration with a reminder

Rachmani et al started their study about the integration of IS with reminders and identification by the Leprosy Surveillance Staff (SSK) with high leprosy program workloads in Pekalongan, Central Java, Indonesia.

The integrated information system was useful to be a reminder for the patients to use the e-leprosy for both the SSK, patients, their families, the primary center, and the leprosy supervisors at the district level. The results indicated that SSK had a positive perception and increased e-leprosy use (Rachmani, et.al, 2020). The integration also improved patients' medicine compliances (Karundeng, Titin Sutini, Suhendar, 2020); and health reminders for the workers; and malaria management (Kaunda-Khangamwa, et al, 2018). Figure 3 shows the e-leprosy framework by Rachmani.

Figure 3.
E-leprosy framework (Rachmani et al. 2020)

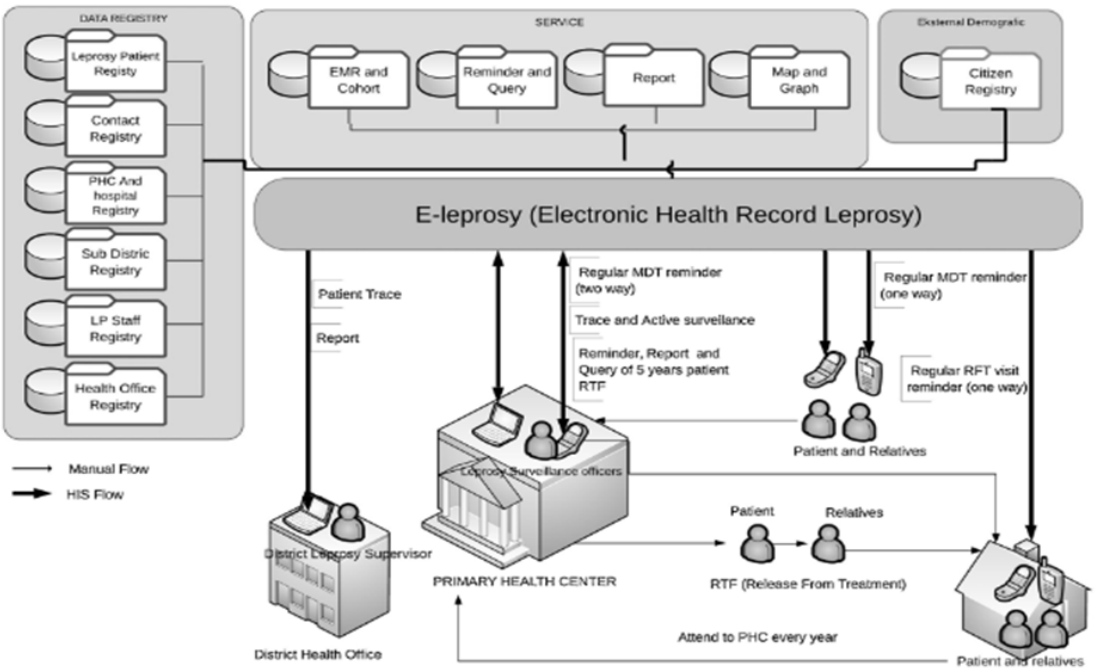

Table 2
Format of e-leprosy program reminder messages

Function	Format	Example
Pick-up time	Patient <space> name #no.reg#ID <space> Puskesmas name <space> place <space> MDT <space> number <space> time of collection	Patient A #123#768 Puskesmas Pekalongan #, please take MDT with number 3 #on Monday, May 3, 2022
If not / have not taken *	MDT <space> number <space> Patient <space> name #no.reg#ID <space> Puskesmas name <space> has not taken MDT <space> Description of time	MDT No.3 #Patient A ##123#768 Pekalongan Health Center #not yet taken MDT #Tuesday, May 4, 2022

Note: *This reminder is given a week before the MDT runs out
**If the patient has not taken the drug, the Researcher will send an SMS for three consecutive days, and then if it has not been taken for three days, the SSK can be sent to the patient's family. However, if the family also does not take the drug, SSK is expected to be able to deliver the drug directly to the patient.

Information system with geospatial data/geographical mapping

The integrated SI with geospatial data provided immediate and precise efforts. These integrations included mobile-based (Rosewell, et. al, 2021) and SINAN (De Souza, et. al, 2021). Contrary, Steinmann et al. explained geospatial with geolocation.

Chua-Intra et al promoted a study about geospatial utilization and incident mapping. The researchers conducted the research in Thailand and adopted three epidemiological indicators. They were the discovery of new cases every year; 2) new issues in children; 3) 10 new cases or more for five consecutive years. The researchers analyzed the indicators with geospatial data to provide immediate care for the exposed parts (Chua-Intra, et al, 2021). Rosewell et al. chose a mobile-based to facilitate the implementation because, in Papua, the cellular infrastructure had a broader range of internet access than cable-based internet. However, in general, the integration of geospatial data to map new and old cases of leprosy was useful to assess the elimination program. The studies were in line with Hierink's research. The researcher found the existence of geographical data facilitated the health care system response and rehabilitation (Requia, Koutrakis, & Arain, 2018).

Integrated information system

Steinmann et al. initiated an integrated information system by integrating all elements of digital technology. These elements were registration, leprosy health workers, and access to smartphone-based specialist doctors to facilitate the diagnostics and promoted therapy by SSK; to provide MDT and digital diagnostics; and geolocation.

Chen & Shui only integrated the information systems with the leprosy management information system in China (LEPMIS). LEPMIS included general patient data, such as social and environmental conditions, early symptom monitoring, and software dissemination. The applied software *was spatial distribution* (ArcGIS 10.6.1), spatial autocorrelation analysis (GeoDa 1.8.8), and spatiotemporal clustering analysis (SaTScan 9.4.3).

Epidemiological modeling and case investigation

The model was useful at the intervention stage to analyze the impacts, the risks, and the required costs of the leprosy elimination program per patient, including the socio-economic impacts caused (Steinmann, et. al, 2020). Require, Koutrakis & Arain applied epidemiological modeling and case investigation to identify the population distribution for health exposure studies.[24]

Vaccine

Heretofore, BCG immunological therapy is the only applicable option. However, in the future, updated development about the vaccine's effectiveness is important to prevent leprosy, for example, by changing the strain of the BCG vaccine (Steinmann, et. al, 2020). Many types of research supported the use of a vaccine to eliminate diseases, such as hepatitis (Sonderup, & Spearman, 2022); Leprosy (Muniyandi, et al, 2021); HIV (McNaughton, et al, 2019); and many illnesses.

National Notifiable Disease Information System (SINAN) and Artificial Intelligence model

SINAN is a term that De Sauza et al. refer to all applied applications to treat diseases, including leprosy. SINAN was analyzed using an artificial intelligence model. The result showed that the application could create/select a new patient classification. Thus, the application was effective to promote the leprosy elimination program in Brazil (De Sauza, et. al, 2021).

CONCLUSION

The information system is an application integrated with reminders, artificial intelligence, epidemiological modeling, and geographic applications. These articles are different from one another in terms of detection, reminders, geospatial data, epidemiological modeling, vaccines, and analysis of application reliability with the assistance of artificial intelligence based on the condition of Papua Province. Thus, the integrated leprosy information system for early detection, reminder, and geospatial data are important. The integration with reminders is important for the patients, family, community, primary center leprosy staff, and leprosy supervisors at the district level. Some leprosy incidence applied new and processed treatment of geospatial data. In addition, this information system was useful for early detection efforts so that the primary center and related stakeholders could take immediate and appropriate actions for the program elimination.

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This review has no conflicts of interest

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