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COVID-19 vaccine coverage effectiveness among elderly with geographical information system mapping: what about Indonesia?

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Abstract

Background: The elderly are the next priority after health workers and public service workers get the COVID-19 vaccine to control morbidity and even mortality in the elderly who have a risk factor that is up to 60 times more severe than children.

Objectives: This study aimed to spatially analyze the effectiveness of COVID-19 vaccine coverage among the elderly in Indonesia with geographic information system (GIS) mapping and to analyze the relationship between COVID-19 vaccine coverage in the elderly with the COVID-19 cure rate.

Design: This quantitative study used secondary data on COVID-19 vaccination coverage in the elderly group of Central Java Province, Indonesia in 2021.

Methods: Data were analyzed using a simple linear correlation test to test the relationship between variables with a 1,774,396 elderly sample size, then distributed using mapping of COVID-19 vaccination coverage using a GIS.

Results: The relationship between COVID-19 vaccine dose-2 elderly coverage cure rate showed a strong relationship ($r = 0.677$) and a positive pattern. The coefficient value with a determination of 0.459 means that the regression line equation obtained can explain 45.90% of the variation in the COVID-19 cure rate. There was a significant relationship between COVID-19 vaccine elderly coverage and the COVID-19 cure rate (p-value = 0.005).

Conclusion: Clinicians and public health workers should continue to encourage elderly vaccination at all recommended doses for eligible individuals.

Plain language summary

COVID-19 vaccine coverage effectiveness among elderly with geographical information system mapping: what about Indonesia?

This research analyzed the Effectiveness of COVID-19 Vaccine Coverage among the Elderly in Indonesia with Geographic Information System Mapping and analyzed the relationship between COVID-19 Vaccine coverage in the elderly with the COVID-19 cure rate.

Keywords: COVID-19, vaccine, elderly, effectiveness, geographical information system

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Introduction

Vaccination is an important part of the COVID-19 pandemic response. Indonesia has implemented phase I vaccination for health human resources and phase II for the elderly and public service workers. More than 28 million people have received the first COVID-19 vaccination and more than 13 million have received two complete doses. Phase III vaccination for vulnerable groups and other communities will begin.[1]

The achievement of COVID-19 vaccination as of May 27, 2021, on the Committee for Covid-19 Handling and National Economic Recovery (KPCPEN) dashboard data, is dose 1 of 15.8 million (8.75%) and dose 2 of 10.3 million (5.73%) with the highest vaccination rate nationally being 508,510 on March 24, 2021.[2] The implementation of COVID-19 vaccination is expected to be completed by the end of this year so that herd immunity can be achieved immediately.[3] All Provincial, District, and Municipal Health Offices have organized COVID-19 vaccination services by strengthening communication and socialization efforts to accelerate vaccination for the elderly and identify and implement special strategies that are appropriate to the situation of their respective regions in increasing outreach to the elderly.[1]

The COVID-19 vaccination has been implemented since January 13, 2021, and is carried out in stages with a target audience of 181.5 million people. In connection with the approval of BPOM (Food and Drug Supervisory Agency) for the addition of indications for the administration of COVID-19 vaccination for those aged 60 years and over and considering the size of the target postponed in the implementation of phase I (one) vaccination. The National Immunization Expert Advisory Committee has submitted a study that COVID-19 vaccination can be given to groups aged 60 years and over, comorbidities, COVID-19 survivors, and breastfeeding mothers with additional history taking as per the screening form.[4]

The implementation of vaccination follows the technical guidelines for the implementation of COVID-19 vaccination, where vaccination for the elderly group aged 60 years and over is given two doses with an interval of 28 days (0 and 28), the comorbid hypertension group can be vaccinated unless their blood pressure is above 180/110 MmHg, and blood pressure measurements should be taken before the screening table, diabetic patients can be vaccinated as long as there are no acute complications, and cancer survivors can still be given the vaccine if it has been more than 3 months. This implementation is facilitated at all vaccination service posts under the responsibility of the community health center or hospital.[4]

In early 2022, the number of COVID-19 cases in Indonesia showed a significant decrease compared to the peak of the previous wave. This is largely due to high vaccination rates and the implementation of health protocols. The COVID-19 vaccination program in Indonesia expanded further in 2022. These efforts are helping to reduce the severity of the disease and improve public immunity. Overall, 2022 is a transitional period for Indonesia's COVID-19 response, with an emphasis on vaccination and policy adjustments based on the evolving pandemic situation.

The need for access to information on health services is a right for every community as well as an obligation for the state to provide it as mandated by the 2009 Health Law. This demands that information on health facilities must also be easily accessible. Monitoring and mapping including COVID-19 vaccination coverage for the elderly and comorbid groups are needed to provide an overview to the community. This mapping is carried out to optimize the role and function of government health facilities for public health but is constrained in obtaining data that have been done conventionally through geographic information systems (GIS).[5]

Geographic mapping of COVID-19 vaccines, particularly for the elderly, provides several important benefits to public knowledge. Mapping can help identify areas that have high concentrations of older people and low vaccination rates. This allows governments and health agencies to focus on areas that require special attention, ensuring that vaccine distribution is more equitable and efficient. By knowing the location and number of unvaccinated elderly, authorities can optimize the distribution of vaccines and other health resources. This includes placing vaccination centers or mobile teams where they are most needed. Geographic data can be used to launch more targeted education campaigns. For

example, people in certain areas can be given more specific information about the benefits of vaccination and how to access it, reducing hesitation and misinformation.

Mapping COVID-19 vaccines for the elderly has various important benefits in improving the recovery and protection of the elderly. By mapping the elderly and monitoring vaccine distribution, we can ensure that this group receives vaccines in a timely and prioritized manner. The elderly have a high risk of COVID-19, so mapping them helps accelerate vaccination in the most vulnerable groups. Mapping also helps in monitoring the health of the elderly after vaccination. Data from mapping can be used to identify side effects or adverse reactions that may occur in this group, as well as to assess how effective vaccines are in boosting their immunity. Mapping allows authorities to plan and coordinate vaccine distribution more efficiently. This includes determining the most strategic vaccination sites and optimizing resources to ensure that older people have easy and convenient access. Educational efforts on the importance of vaccination can be focused on older people and their families. This helps raise awareness regarding the benefits of vaccination and overcome any doubts or fears that may exist.

Mapping also allows for better evaluation of vaccine effectiveness in the elderly. The data collected can help in understanding how the vaccine works in this age group and whether there is a need for dose adjustment or additional booster doses. With more coordinated and targeted vaccination, the risk of COVID-19 transmission among the elderly can be reduced. This contributes to a decrease in serious cases and complications that can occur in this age group. Effective and timely vaccination for the elderly can return to normal activities with lower risk. This contributes to improving their quality of life and overall well-being.

The Government of Indonesia, together with health and community organizations, has made various efforts to improve vaccination accessibility for the elderly, including engaging various parties in vaccination programs and launching special initiatives to increase outreach to more vulnerable groups. However, challenges remain, and continuously striving to improve accessibility is an important step to ensure vaccination can reach all levels of society.[6]

The purpose of this study is to analyze the relationship between COVID-19 vaccine coverage in the elderly with the COVID-19 cure rate and map the coverage of COVID-19 vaccination for the elderly with GIS mapping using the open-source Quantum GIS (QGIS) application.

Materials and methods

Study design, period, and setting

This study was quantitative research using secondary data on COVID-19 vaccination coverage in the elderly group of Central Java Province, Indonesia in 2021, which is then distributed using mapping of COVID-19 vaccination coverage in this group using a GIS.

Study population

The population of secondary data used is data on the elderly and data on all people in Central Java Province who have been vaccinated against COVID-19 in 2021 obtained from the Central Java Provincial Health Office.

Inclusion and exclusion criteria

The inclusion criteria for the data analyzed were data on the elderly who had been vaccinated against COVID-19 in the second dose, vaccinated in the health services of Central Java Province, Indonesia in 2021. Meanwhile, the exclusion criteria are elderly groups who have a history of comorbid diseases at the time of COVID-19 vaccination.

Sample size determination

The sample size was determined using the purposive sampling technique. Data were used on the elderly participants of COVID-19 vaccination in Central Java Province in 2021. With a desired statistical power of 80%, 95% confidence interval, and 5% significance level, the sample size was calculated to be 1.774.396 elderly. Data were calculated until December 19, 2021.

This study used the number of vaccinations rather than the vaccination rate because of the need for absolute data or the number of vaccinations to understand the direct public health impact, namely to determine how many doses of vaccine

need to be provided or produced, or to plan vaccine distribution. Health agencies may need data on the number of vaccinations to plan resource allocation and distribution logistics. To evaluate the effectiveness of vaccination programs, knowing the total number of vaccines administered can provide a clear picture of program achievements. For example, in measuring how successful a vaccination campaign is in reaching the target population. In public health reports, the number of vaccinations is often used to indicate the volume of vaccination activity. This can be an important indicator in assessing how much vaccination coverage has been achieved.

In emergencies such as outbreaks or pandemics, the number of vaccinations is often more relevant as it shows how many individuals are already protected or have received the vaccine. This helps in planning response strategies and real-time assessment of the situation. To formulate health policies and interventions, vaccination count data may be more relevant as it can provide a direct picture of the number of individuals who have been protected through vaccines. However, it is also important to understand that vaccination rates (the percentage of the population vaccinated) are often used in other contexts, such as to evaluate vaccination coverage gains and measure the extent to which vaccination has been accepted among a larger population. Both vaccination rates and numbers have important and complementary roles in public health analyses.

Study variables

The independent variable is COVID-19 vaccine coverage in the elderly. The dependent is COVID-19 cure rates.

Data analysis

The collected data were analyzed using IBM (SPSS) version 21.0: IBM Corp. Data were expressed as means, frequencies, and percentages. Data were analyzed using a simple linear correlation test to test the relationship between variables. A p-value of less than 0.05 was considered statistically significant.

Q-GIS spatial analysis with QGIS. Spatial analysis with QGIS is essential in mapping COVID-19 vaccination in Indonesia, given the complex geographic and demographic challenges of this archipelago nation. To visualize vaccination data, QGIS enabled the creation of thematic maps showing the distribution of vaccination across Indonesia. This helps in understanding how vaccination is spread across provinces, districts, and sub-districts. QGIS can also create heat maps to show areas with very high or low vaccination rates, helping to identify hotspots and areas that require more attention.

QGIS can be used to analyze vaccination data in the context of population density. This is important for identifying areas with high populations that may have urgent vaccination needs. In addition, analysis of the accessibility to vaccination centers using spatial data such as distance to health facilities or vaccination centers can help in planning more efficient vaccine distribution.

Mapping cartography. The development of cartography for COVID-19 vaccination distribution maps is an important tool in visualizing and analyzing vaccine distribution and the effectiveness of vaccination programs.

Required data include the number of vaccine doses administered, vaccination rates in different regions, population demographics, and vaccine availability. Clear and consistent symbols and colors are used to depict vaccination rates. For example, green for high vaccination rates and red for low vaccination rates. Areas with low vaccination rates are identified to determine where interventions are needed. Vaccination distribution patterns are analyzed to understand geographic and demographic trends. Temporal comparison to see the development of vaccination over time is necessary. By following these steps, the COVID-19 vaccination distribution map can be a very useful tool for public health planning, vaccination program monitoring, and data-driven decision-making.

Results

The data used are data on the Indonesian elderly who have been vaccinated with the second dose of COVID-19 and carried out in Central Java Province, Indonesia, which consists of 35 districts/cities. The frequency distribution of the elderly who have been vaccinated with the second dose of COVID-19 is shown in Table 1.

Table 1. COVID-19 vaccine coverage data for the elderly in central Java Province.

No	District/city	Dose 1		Dose 2	
		f	%	*f*	%
1	Banjarnegara	68,567	2.72	33,549	1.89
2	Banyumas	133,286	5.29	93,055	5.24
3	Batang	36,014	1.43	15,463	0.87
4	Blora	64,310	2.55	32,419	1.83
5	Boyolali	89,899	3.57	71,136	4.01
6	Brebes	92,445	3.67	54,848	3.09
7	Cilacap	141,743	5.63	78,297	4.41
8	Demak	65,684	2.61	51,097	2.88
9	Grobogan	110,405	4.39	65,004	3.66
10	Jepara	49,732	1.98	21,102	1.19
11	Karanganyar	85,628	3.40	74,819	4.22
12	Kebumen	99,507	3.95	56,628	3.19
13	Kendal	63,858	2.54	52,306	2.95
14	Klaten	126,702	5.03	110,327	6.22
15	City of Magelang	13,894	0.55	11,249	0.63
16	City of Pekalongan	16,060	0.64	10,747	0.61
17	City of Salatiga	15,237	0.61	13,378	0.75
18	City of Semarang	130,785	5.20	120,088	6.77
19	City of Surakarta	55,512	2.21	52,159	2.94
20	City of Tegal	15,887	0.63	12,621	0.71
21	Kudus	41,806	1.66	24,647	1.39
22	Magelang	90,100	3.58	64,085	3.61
23	Pati	80,767	3.21	37,723	2.13
24	Pekalongan	40,632	1.61	22,653	1.28
25	Pemalang	55,687	2.21	35,179	1.98
26	Purbalingga	64,064	2.54	34,581	1.95
27	Purworejo	66,195	2.63	49,008	2.76
28	Rembang	38,878	1.54	20,931	1.18
29	Semarang	86,127	3.42	70,604	3.98

(Continued)

Table 1. (Continued)

No	District/city	Dose 1		Dose 2	
		f	%	*f*	%
30	Sragen	87,746	3.49	80,175	4.52
31	Sukoharjo	70,921	2.82	63,742	3.59
32	Tegal	64,563	2.56	35,941	2.03
33	Temanggung	52,494	2.09	41,303	2.33
34	Wonogiri	140,786	5.59	129,061	7.27
35	Wonosobo	61,353	2.44	34,471	1.94
Total		2517,274	100.00	1774,396	100.00

(1) Primary data (Table 1).

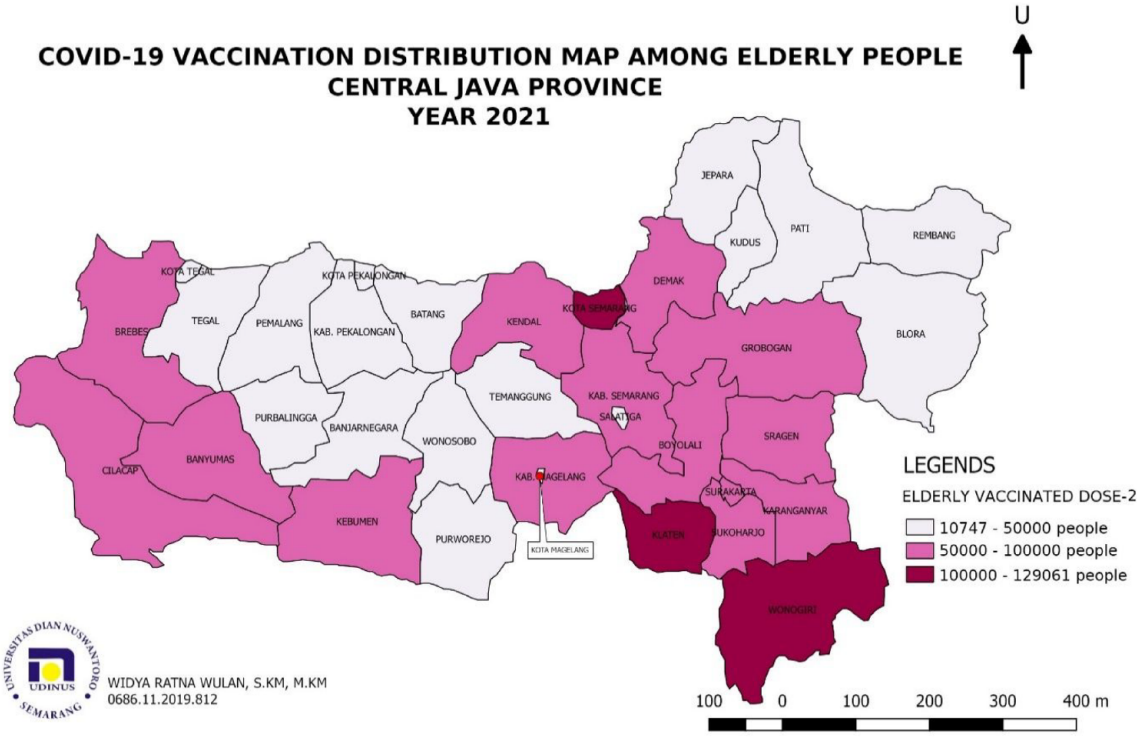

Figure 1. COVID-19 vaccination dose-2 distribution map among elderly people, Central Java Province, Indonesia, 2021.
Source. Created by the author using the Quantum-Geographic Information System (Q-GIS) Application.

Table 1 shows the coverage of dose 1 and dose 2 vaccinations among the elderly in Central Java Province in several districts and cities. Based on this data, dose-2 vaccination coverage is highest in Semarang City, Klaten Regency, and Wonogiri Regency. This is following the results of mapping using the open-source QGIS application which illustrates areas with darker colors based on the distribution map of the second dose of COVID-19 vaccination in Figure 1.

Table 2. Correlation and regression analysis of COVID-19 vaccine coverage in the elderly with COVID-19 cure rates.

Variable	*r*	*R2*	Line equation	*p* Value
COVID-19 vaccine coverage in the elderly	0.677	0.459	COVID-19 cure rates = 3722.972 + 0.250*COVID-19 vaccine coverage in the elderly	0.0005

(2) SPSS analysis (Table 2).

The next analysis is related to the hypothesis of a relationship between the coverage of the second dose of COVID-19 vaccination and the recovery rate in the elderly group. This is a measure of the successful implementation and efficacy of the COVID-19 vaccine that is being implemented by the government, especially in the elderly group. The results of the linear regression correlation test analysis are shown in Table 2.

Table 2 shows that the relationship between COVID-19 vaccine dose-2 coverage in the elderly and the COVID-19 cure rate in Central Java Province shows a strong relationship ($r = 0.677$) and a positive pattern. This means that the higher the coverage of the COVID-19 vaccine in the elderly, the higher the recovery rate from COVID-19. The coefficient value with a determination of 0.459 means that the regression line equation obtained can explain 45.90% of the variation in the COVID-19 cure rate or that the line equation obtained is good enough to explain the variable COVID-19 cure rate. The statistical test results showed that there was a significant relationship between COVID-19 vaccine coverage in the elderly and the COVID-19 cure rate in Central Java Province (p-value = 0.005). From the line equation obtained, the dependent variable (COVID-19 cure rate) can be predicted by the independent variable (COVID-19 vaccine coverage in the elderly).

Discussion

An elderly group is a group that needs more attention because they are vulnerable to infection. This is due to the presence of chronic aging diseases that interfere with motor function, organs, and the immune system. According to data from the World Health Organization (WHO), more than 95% of deaths from COVID-19 occur in people over 60 years old. More than 50% of all deaths involved occur in people over the age of 80. Given the high incidence and mortality rate of the elderly, WHO needs to establish various health standards to protect and save the elderly from this dangerous virus.[7,8]

The Indonesian government urges the public to carry out the COVID-19 vaccination program in addition to health protocol rules. As a group that is very vulnerable to COVID-19 exposure, the elderly are the next priority after health workers and public service workers get the COVID-19 vaccine in the hope of controlling morbidity and even mortality in the elderly. Based on data from the Ministry of Health, the elderly have a risk factor that is up to 60 times more severe than children, even during the pandemic, it was recorded that the group that required hospitalization was dominated by the elderly.[9,10]

Vaccines are one way to prevent the spread of infectious diseases that is very easy and economical. Research is forming a vaccine development that is useful for weakening infection from the COVID-19 virus. The COVID-19 vaccine is safe and has caused a significant immune response after a single immunization in most recipients.[11] Data on COVID-19 vaccination coverage in the elderly in Indonesia in April 2022 for the first vaccine reached 17.5 million (81.66%), the second dose 13.9 million (64.74%), and the third/booster dose only reached 3.7 million (17.22%). Based on WHO and the Indonesian Technical Advisory Group on Immunization (ITAGI) recommendations, the formation of herd immunity can be achieved with a minimum vaccination target of 70%. Based on this data, accelerating COVID-19 vaccination is important to prevent transmission.[7,12]

Based on the results of previous studies through the interview method regarding the knowledge of the elderly about the COVID-19 vaccine 10 elderly people, the following data were obtained: six elderly people said they did not know what the

COVID-19 vaccine was, the purpose of the COVID-19 vaccine, and the benefits of the COVID vaccine, the elderly's preparation was absent because they were afraid of the COVID-19 vaccination, and considered the COVID-19 vaccine to provide the COVID-19 virus, while three elderly people said the COVID-19 vaccination was a good idea.[13]

This study's results showed the relationship between COVID-19 vaccine dose-2 coverage in the elderly and the COVID-19 cure rate in Central Java Province had a strong relationship, which means that the higher the coverage of the COVID-19 vaccine in the elderly, the higher the recovery rate from COVID-19. There was a significant relationship between COVID-19 vaccine coverage in the elderly and the COVID-19 cure rate. This is in line with previous research which states that the immunization efficacy of the COVID-19 vaccine in the elderly is evident, especially after multiple doses of vaccination, and the incidence of Adverse Events (AEs) in the elderly is low, suggesting that vaccination in the elderly is safe has proven to be effective in Zhang et al.[14] COVID-19 vaccination significantly reduced hospitalization and death in elderly patients (age 60+) after at least one dose. Comorbidity does not change the median age of her moderate/severe COVID-19 cases and the number of days these patients need to be hospitalized.[15,16] It is also in line with research conducted in neighboring Malaysia where vaccination rates were calculated based on the proportion of people in each region who had completed the primary dose (27,275,616 people) and a booster dose (16,230,989 people). Visualization of the region-specific geographic spatial analysis results with choropleth maps shows that pandemic indicators can be effectively controlled by vaccination.[17]

In a linear study of US adults hospitalized with COVID-19, unvaccinated adults were more likely to be hospitalized compared with vaccinated adults. The hospitalization rate was the lowest among those who received booster shots. Vaccinated and hospitalized individuals were older, more likely to have three or more underlying medical conditions, and were residents of a long-term care facility compared with non-vaccinated hospitalized individuals.[18,19]

The effectiveness of COVID-19 vaccines in the elderly and its implications for public health policy in Indonesia is an important topic to understand, given the elderly population in Indonesia and the challenges faced in vaccinating this group. COVID-19 vaccines are effective in reducing the risk of COVID-19 infection in the elderly, although the effect may be slightly lower than in younger age groups. Vaccination significantly reduced the risk of COVID-19-related death and hospitalization in the elderly. This is a very important result as the elderly are the most vulnerable group to serious complications from this virus. Protection from vaccines can decrease over time, so booster doses are often recommended for the elderly to maintain optimal protection. Decreased effectiveness over time is one important reason to update vaccination policies, including booster doses.[20,21]

Mitigating and controlling COVID-19 in Indonesia, especially for the elderly, is an important priority as this age group has a high risk of COVID-19 infections and complications. Priority scheduling, elderly-specific programs, affordability of health care facilities, home vaccination, education and outreach, health worker training, improved quality of services, and monitoring and evaluation focusing on the special needs of the elderly, Indonesia can improve the effectiveness of its COVID-19 vaccination program and protect the most vulnerable age group.[22,23]

QGIS spatial analysis

QGIS helps in planning the distribution of vaccines to different areas by considering factors such as distance, infrastructure, and capacity of health facilities. Mapping the location of vaccination facilities, vaccine storage, and health workers allows for better planning in the use and allocation of resources.

With QGIS, vaccination data can be monitored in real time or at specific intervals, making it easier to evaluate the effectiveness of vaccination programs. The creation of maps with time data allows analysis of vaccination trends over time, assisting in assessing the progress and effectiveness of vaccination programs. Geographic mapping is an important tool in COVID-19 pandemic control strategies, especially for vulnerable groups such as the elderly. It helps in planning vaccine distribution, health center placement, and more focused health policy implementation. Let us see how COVID-19 control strategies for the

elderly in Indonesia and other countries integrate geo-mapping.

Indonesia has many islands and remote areas. QGIS helps in vaccination planning and logistics by considering distance and access to hard-to-reach locations. Spatial analysis allows adjustments to topography that may affect vaccine distribution and accessibility. QGIS enables the integration of vaccination data with other data, such as health, demographic, and infrastructure data, for more comprehensive analyses. Spatial data generated from QGIS supports better strategic decision-making in vaccination planning and implementation and assists in prioritizing vaccinations based on factors such as health risks, population density, and ease of access.

QGIS provides a powerful tool for spatial analysis that can improve the effectiveness and efficiency of COVID-19 vaccination programs in Indonesia. By utilizing spatial analysis, stakeholders can make more informed and strategic decisions, ensuring that vaccinations are carried out evenly and effectively across all regions of the country.

Control strategies for elderly COVID-19 in other countries with geographic mapping

In the United States, geographic mapping is used to track COVID-19 cases and vaccinations at the district and city levels. The data help determine priorities in vaccine distribution and implementation of booster programs. The US used the data to establish vaccination centers in areas with high elderly populations and utilized mobile clinics to reach the elderly in remote or hard-to-access areas.[24,25] The UK uses geo-mapping to locate vaccination centers and optimize vaccine distribution across the country. Demographic and health data are used to ensure older people get timely access. The UK also utilizes geographic data to coordinate with social services and local communities to ensure that older people living in care homes or similar facilities get the necessary vaccinations.[26–28]

Australia uses mapping data to monitor the spread of the virus and vaccinations, focusing efforts on areas with high cases and large elderly populations. Mapping assists in designing localized information and support campaigns for older people, with a focus on more vulnerable areas.[28,29]

Canada uses geographic mapping to identify hotspots and prioritize vaccinations. The strategy includes setting up vaccinations in community centers and healthcare providers to reach older adults. Mapping data is used to work with community organizations and local healthcare providers to improve vaccine access for older adults.[30]

Geographic mapping is a vital component of COVID-19 control strategies for older adults in many countries, including Indonesia. Using this data, countries can plan and execute more effective vaccine distribution, design more focused education campaigns, and better manage public health responses. These strategies ensure that older people, as the most vulnerable group, receive optimal protection and equitable access to vaccines and health services.[31]

The findings of this study suggest that clinicians and public health workers should continue to encourage vaccination at all recommended doses for eligible individuals. This vaccination is a preventive strategy to boost immunity in the elderly.

COVID-19 vaccines have been highly effective in preventing severe outcomes such as COVID-19-related hospitalizations and ICU admissions in the elderly, who bear the most significant disease burden. The observed results show signs of decline in the first 6 months after completing two doses, but the third dose restored high levels of protection for at least 2–3 months. Our data analysis in early 2022 suggests that even after the advent of Omicron, the third dose still provides high protection against severe COVID-19.[32]

The actual efficacy of the two-dose CoronaVac schedule was 47% for symptomatic COVID-19 disease, 56% for COVID-19-related hospitalizations, and 61% for infections. Symptomatic COVID-19 disease is a COVID-19-related death in people aged 70 years or older that occurred during a gamma-mutant-associated epidemic in Brazil. Several evidence gaps regarding the use of CoronaVac vaccination demonstrated efficacy against COVID-19 with the widespread transmission, including serious consequences. Single-person CoronaVac doses had little protective effect against symptomatic COVID-19 infection and hospitalization and observed that vaccine efficacy decreased with increasing age in adults aged 70 years and older.[33]

Current data suggest that the reported side effects may help identify depression in older adults. Accurate representation of vaccinated elderly information about depression symptoms and treatment centers should be helpful. Psychoeducational interventions that emphasize that vaccination side effects do not compromise vaccine safety or efficacy may help reduce underlying depressive symptoms.[34]

Indonesia's good cooperation across sectors by introducing improvements in health planning, conducting equitable community-based interventions, and expanding primary healthcare capacity is critical for better pandemic preparedness and response in many places. As the COVID-19 pandemic is no longer classified as a global health emergency, we advocate urgent attention to strengthening and improving global pandemic preparedness strategies.[35]

Indonesia's population-level interventions in response to the COVID-19 outbreak have shown real-time effects in disrupting overall transmission dynamics. Indonesia needs to balance between economic activity and disease transmission, the control measures implemented in the four main phases in substantially real time, allowing public health professionals to adjust easing decisions by ensuring that the COVID-19 transmission rate is significantly reduced or leveled off, while still keeping it less than 1. Lower vaccine efficacy values will result in higher herd immunity thresholds.[36]

In general, Indonesia's pandemic control strategy is in line with many other countries in terms of prioritizing the elderly for vaccination and using booster doses to maintain protection. However, each country customizes its approach based on local context, health system capacity, and pandemic dynamics. International collaboration and experience sharing between countries can strengthen the global response to a pandemic and help in optimizing control strategies across different contexts.

Study limitation

A limitation of this study was that, when studying the burden or distribution of something across geographical areas, it is important to consider the population size of each area. Larger areas often have larger populations, so analyses based solely on area without considering population density or population size can be biased. For example, if we analyze disease prevalence across multiple regions, larger regions with large populations may appear to have a higher disease burden compared to smaller regions. However, if we do not take into account population density or population size, we may get an inaccurate picture of the true prevalence.

To overcome this bias, more standardized metrics are often used, such as calculating population density to make it easier to compare between areas with different population sizes, using proportions or percentages of the total population to give a more balanced picture, and using indices or ratios that take into account various factors including population size and density. With this approach, we can obtain a more accurate and representative analysis of the burden or distribution in different geographical areas.

Conclusion

There was COVID-19 vaccine coverage effectiveness among the elderly evidenced by the significant relationship between COVID-19 vaccine coverage in the elderly toward COVID-19 cure rates, which means that the higher the COVID-19 vaccine coverage in the elderly, the higher the recovery rate from COVID-19. This showed the success of the government program in implementing a vaccination program to reduce morbidity and mortality from COVID-19. Clinicians and public health workers should continue to encourage vaccination at all recommended doses for eligible individuals.

Declarations

Ethics approval and consent to participate

This research has passed an ethical review by the Health Research Ethics Committee Faculty of Health Dian Nuswantoro University with a description of ethical approval No: 140/EA/KEPK-Fkes-UDINUS/I/2022. No identification features were included to protect the confidentiality of respondent/informant (participant) data. Participants were structurally explained about the purpose of the study.

Consent for publication

All participants were aware that the data were collected for research and consented to publication. No images or identification of personal data are included in this paper.

Author contributions

Widya Ratna Wulan: Conceptualization; Data curation; Formal analysis; Methodology; Project administration; Resources; Supervision; Validation; Writing – original draft; Writing – review & editing.

Evina Widianawati: Formal analysis; Methodology; Validation; Writing – review & editing.

Anis Tri wahyuni: Project administration; Resources; Writing – review & editing.

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Competing of interests

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Availability of data materials

These data will be made available on reasonable request.

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