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An Expert System Dataset for Checking the Potential for Administering a Covid-19 Vaccine in Indonesia: Forward-Chaining Inference Machine Approach

Rosyid R. Al Hakim[1,2*], Glagah E. Setyowisnu[3], Agung Pangsetu[4]
[1*]Post-Graduate Program in Electrical Engineering, FECS, Jakarta Global University, Indonesia, 16412
[2]Post-Graduate Program in Primatology, Graduate School, IPB University, Indonesia, 16680
[3]Post-Graduate Program in Mathematics, FMIPA, Institut Teknologi Bandung, Indonesia, 40132
[4]Electrical Engineering Department, FECS, Jakarta Global University, Indonesia, 16412

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ABSTRACT

Covid-19 has now spread extremely worldwide. World still fighting against Covid-19, as well as vaccination programs. The problem to get one of the existing vaccines, it is required first to carry out a vaccination eligibility screening test, then usually carried out with traditional form method by the healthcare staff. Seeing the development of an expert system that can be used as an alternative for health workers to help reduce the number of Covid-19 suppression so that it does not spread to health workers, because after all, someone who will vaccinate Covid-19 must be in good health, this is related to the pre-vaccination procedure. We proposed the expert system with forward-chaining method. The result is the dataset (rules collection) of an expert system based on a forward-chaining inference machine for administering all Covid-19 vaccines.

Corresponding Author:

Mr. Rosyid Ridlo Al Hakim
Post-Graduate Program in Electrical Engineering, FECS, Jakarta Global University, Indonesia, 16412
Email: rosyidridlo10@gmail.com

1. INTRODUCTION

Covid-19 has now spread worldwide with positive numbers that continue to increase. The government has made various efforts to overcome the increasing number of Covid-19 transmissions, including vaccination programs [1]–[4]. Successful vaccination is necessary for a large population to form natural immunity. Indonesia has a relatively high transmission rate of Covid-19 [5]–[11]. The Indonesian government is trying to implement a vaccination program for all Indonesian people [12] by targeting five vaccines available for the people of Indonesia [13]. Of course, to get one of the existing vaccines, it is required first to carry out a vaccination eligibility screening test, usually carried out before the vaccine injection process is carried out; this is important because it is related to the condition of a person's body who will be assessed for the feasibility or potential of being given a vaccine whether it is appropriate to be given or vice versa [12]. For the number of people who have been vaccinated as of December 26, 2021, the vaccination rate in Indonesia can be seen in Figure 1.

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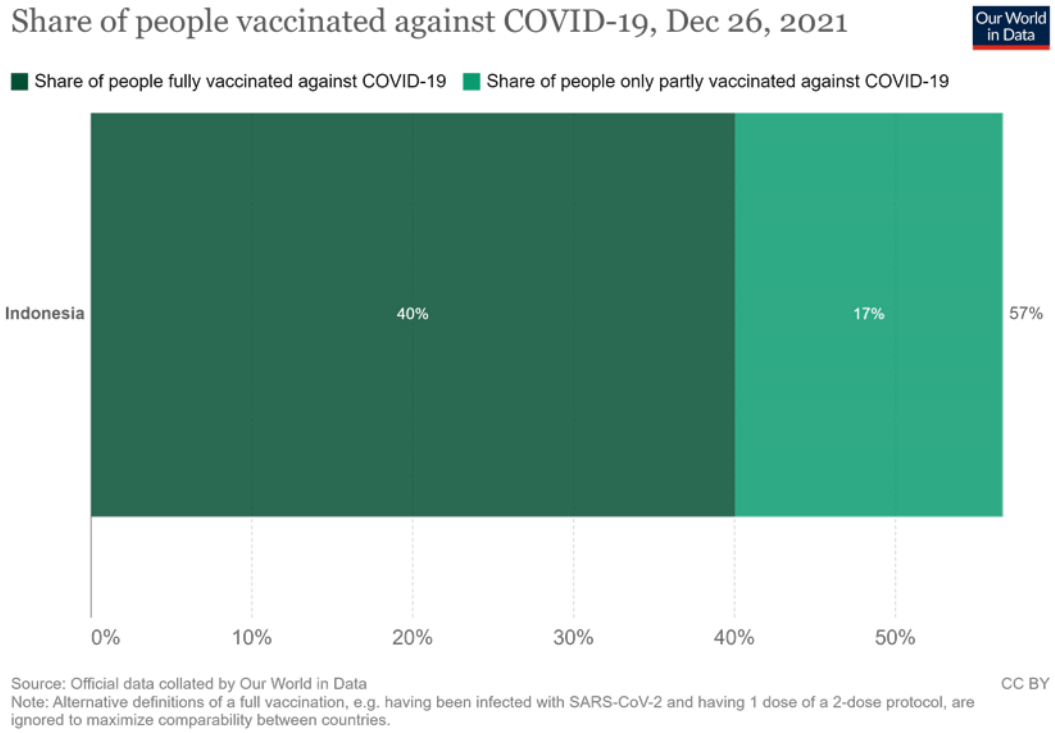

Figure 1. Vaccination rates in Indonesia as of Dec 26, 2021. Dataset from [14].

An expert system can replace the role of an expert with a system. Expert systems have been used for various fields, including health and medical, such as self-diagnosis of disease [15]. Seeing the development of an expert system that can be used as an alternative for health workers to help reduce the number of Covid-19 suppression so that it does not spread to health workers, because after all, someone who will vaccinate Covid-19 must be in good health, this is related to the pre-vaccination procedure [16]. The human body condition is confirmed not to be included in the category of having the potential to experience post-vaccination follow-up events [17]. It would be terrific if the screening test to check someone who has the potential to be given the Covid-19 vaccine is feasible or cannot be carried out independently by everyone through an expert system. This study was conducted because the researchers found that every health worker who led a screening test on a candidate could be vaccinated or not, still manually by being given a form containing questions about the condition of the body's health and the use of drugs and a history of the disease that had been suffered. Because there is not yet a system that can provide whether a candidate for vaccination can be worthy of being given a vaccine or vice versa, we provide a solution with an expert system with a forward chaining inference machine approach that can be applied in the future study.

2. PROPOSED METHOD

We proposed the expert system with forward-chaining method. First, we collect the data based on interviews with professional medical care, doctors, and vaccination staff. The data collected in screening data includes age, disease history, drugs consumed, allergic reactions. The screening data is used as a knowledge representation for the expert system to conclude whether a person is eligible (code L01) or not worthy of being given the vaccine (code L02) or delayed giving the vaccine with a doctor's consultation first (code L03).

3. RESULTS AND DISCUSSION

The screening data is then used as screening points to equip the system with knowledge. Based on interviews from medical expert, we collect the screening data as well as in pre-vaccination form that must filled before vaccination. The screening data can be shown in Table 1.

Table 1. Screening data.

Code	Screening Points
S01	Under 18 years old
S02	18-59 years old
S03	Over 59 years old
S04	Severe allergic reaction (either after the first dose of vaccine or any vaccine
S05	History of autoimmune disease
S06	Having an acute infection
S07	Having one/more of history of blood cancer, solid tumor cancer, blood disorders like immunohematology, hemophilia, blood clotting disorders
S08	Are taking immunosuppressant drugs, cytostatic, radiotherapy (example: dexamethasone, methylprednisolone, prednisone)
S09	Are undergoing chemotherapy or radiotherapy (radiation therapy)
S10	Having one/more of history of DM, COPD, asthma, hypertension, epilepsy, metabolic disease, uncontrolled HIV-AIDS
S11	Having one/more of history of heart disease, kidney (failure/dialysis), liver disorders
S12	Is pregnant?
S13	Vaccination history other than Covid-19 is less than 1 month
S14	Having a history of Covid-19 (survivors) or currently Covid-19

Based on Table 1, each user's screening points are required to answer the choice of "*Yes*" or "*No*," then the system will continue to process each user's answer with a binary number in the form of the number "0" for the answer "*No*" and the number "1" for the answer "*Yes*." The knowledge representation of this expert system uses a forward chaining inference engine; that is, the system will understand the knowledge it already has (in the form of screening points) and then test the truth of the hypothesis through a set of rules, thus providing someone's inference (conclusion) vaccinated (L01), not vaccinated (L02), or delayed administration of vaccines by consulting a doctor first (code L03). Answer "0" means not experiencing any of the screening points (logic *NOT*), while "1" means experiencing any of the screening points. Table 2 describes the rules set for the forward chaining inference engine in this expert system for checking vaccine administration potential.

Table 2. Forward-chaining inference machine rules.

Rules	Eligible Code	Rule Explanation with Logic
R01	L01	IF S02 NOT S01 NOT S03 NOT S04 NOT S05 NOT S06 NOT S07 NOT S08 NOT S09 NOT S10 NOT S11 NOT S12 NOT S13 NOT S14 THEN L01
R02	L01	IF S03 NOT S01 NOT S02 S04 NOT S05 NOT S06 NOT S07 NOT S08 NOT S09 NOT S10 NOT S11 NOT S12 NOT S13 NOT S14 THEN L01
R03	L02	IF S01 NOT S02 NOT S03 THEN L02
R04	L02	IF S02 OR S03 AND S04 THEN L02
R05	L02	IF S02 OR S03 AND S05 THEN L02
R06	L02	IF S02 OR S03 AND S06 THEN L02
R07	L02	IF S02 OR S03 AND S07 THEN L02
R08	L02	IF S02 OR S03 AND S08 THEN L02
R09	L02	IF S02 OR S03 AND S09 THEN L02
R10	L02	IF S02 OR S03 AND S11 THEN L02
R11	L02	IF S02 OR S03 AND S12 THEN L02
R12	L02	IF S02 OR S03 AND S14 THEN L02
R13	L03	IF S02 OR S03 AND S10 THEN L03
R14	L03	IF S02 OR S03 AND S13 THEN L03

Based on Table 2, the generalized modus ponens can be used using forward-chaining [18]. This expert system adopted all knowledge bases that will inference the new conclusion that can be used for more inference. Forward-chaining can be used if some new facts were added to the knowledge base and we'll try to influence the logical consequences [18]. This dataset (rules collection) for hypotheses L01, L02, L03 will provide the valid inference while the screening points have fulfilled with a series of logical processes. If some logical set doesn't meet the criteria for each rule, the inference will not provide the inference (conclusion for the final diagnosis result). Further research is also needed for considering this dataset's rules with other expert systems' reasoning techniques, like first-order logic, backward-chaining, and fuzzy set. This expert system's dataset has been validated with professional medical doctors, Aviasenna Andriand, MD, for the further must always be maintained both the programs that have been coded, updated symptoms after vaccinated and requirement of vaccine product and if this dataset reported with wrong or misconception, in the future to be repaired immediately to provide support for the better expert system. There may also be information updates along with the development of the vaccination process in Indonesia, upgrading the work of the expert system to be embedded in mobile apps or website-based, and routine checks with professional medical doctors to provide full support for the expert system.

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4. CONCLUSION

We propose the dataset (rules collection) of an expert system based on a forward-chaining inference machine for administering all Covid-19 vaccines with the case study in Indonesia (based on the Indonesian Ministry of Health Covid-19 vaccination policy). We hope any other feedback that will increase this expert system's knowledge can be applied in mobile apps, web-based, and others.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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