

# Artificial Intelligence on Queue Patients of Madiun City's Regional Public

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## ABSTRACT

The patients' main objection was the application of public services in a queue of patients online and offline in the RSUD Madiun City, East Java, Indonesia. The number online is generally lower than on site, when services are merged hence all hospital patients are offline. Over 90% of outpatients are public health insurance (BPJS Kesehatan) participants. On-site queues with restrictions on the number of patients at a doctor must queue 4 - 7 hours before the service opens so that brokers queue up. This study aims to develop artificial intelligence in an integrated patient queuing system between BPJS Kesehatan, doctors, clinics, medical records, and pharmacies; for service time efficiency. This study uses a soft system methodology.

The RSUD Madiun medical records show that over 55% of outpatients aged 54 years have minimal internet access and gadgets. The Covid-19 Pandemic requires innovation to prevent crowds, so chronic outpatients are provided with a queue list facility by clinic staff after completing the doctor's examination for the next month. The clinic staff monitor displays the remaining medication, date of referral, planned visit, queue number, and future service hours. Visits were efficient, chronic outpatient treatment at that time, and getting the queue number for the next visit. Artificial intelligence innovation that integrates offline and online patient queue numbers appropriately compromises visiting services' efficiency to minimise patient complaints.

**Keywords:** Artificial Intelligence, Efficiency of Visit, Outpatient, Patient Queues, Queue Brokers

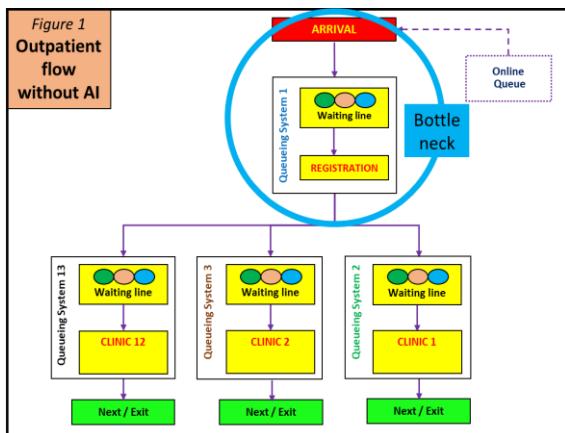
## 1. INTRODUCTION

The Madiun City Regional Public Hospital, following the mandate of the Law of the Republic of Indonesia Number 23 of 2014 Article 12 paragraph 1, is in charge of organizing public services and management related to individual referral health in the Madiun area. During the Covid-19 pandemic, hospital services had to implement strict health protocols. Improving the queuing system in the public service process is a major issue so that registrants can be served quickly, reducing the crowd in the registration room

and immediately to the clinic waiting room. Heizer [1] states that a queue is an event where goods or people will go through a process starting upon arriving, participating in the queue, waiting for service in the waiting room, until the last to receive service. The type of service queuing model at the RSUD (regional hospital) Madiun uses Multi-Channel Multi-Phase. Hospital outpatient services are follow-up services from first-level health facilities, emergency services, or follow-up services from inpatients. The outpatient service flow at the registration section opens at 07.00 am (one hour before service at the clinic at 08.00 am). BPJS

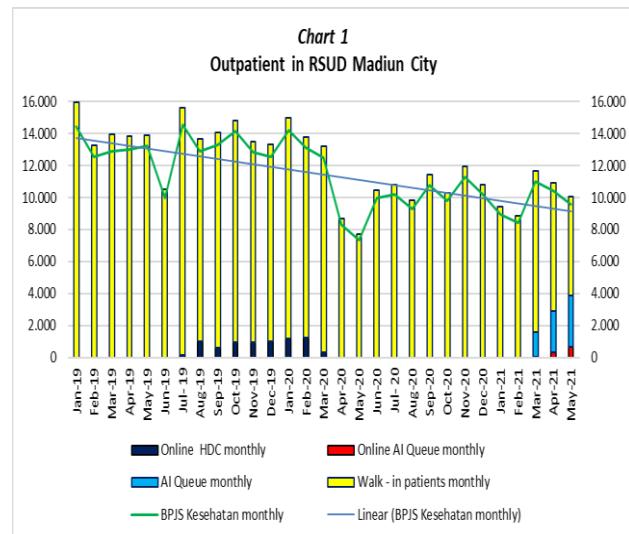
(health insurance) patients must be examined at registration to qualify for claims for on-site patients.

As of April 1, 2019, the RSUD Madiun City cooperated with HDC for drug delivery services to patients and online queues for one year. This collaboration with HDC has agreed on the cost of sending drugs to patients of IDR 10,000 and providing online queuing services. HDC's online queuing service is not integrated with the hospital's offline queue. The online patient list is manually combined with offline hospital visits on the day of the visit. In busy clinics, the queue number of patients during appointments to the clinic is often greater than the queue number obtained in the HDC online queue; this causes patient dissatisfaction. This complaint is submitted verbally to the registration officer. In March 2020, HDC asked for an increase in the cost of drug delivery from IDR 10,000 to IDR 15,000 (up 50%), and price negotiations failed, so the cooperation ended on March 31, 2020. Drug delivery services were stopped on April 1, 2020, and the queue for outpatients is running offline. To deliver drugs to patients, the hospital made an addition for the residents of Madiun in the form of a "Pendekar Obat" (drug delivery service) launched on July 17, 2020. The offline queue was valid on that day. Clinic services are FIFO, so patients assume that they will get an initial number if they arrive early and be served immediately. About 20% of patients came before registration opened, and 50% of patients had already arrived an hour later. As a result, there is a buildup of patients at the beginning of the service opening, and this patient queue only finishes 2 to 3 hours later. The flow of this service is shown in **Figure 1**.



This phenomenon gave rise to public complaints due to inefficient service and unpredictable time estimations. On the other hand, during the Covid-19

pandemic, health protocols must be implemented strictly. According to Nilsson [2], Artificial Intelligence is an activity that makes machines capable of functioning properly with future environmental considerations. Moreover, Robandi [3] revealed that adopting animal intelligence for daily work will make work time more efficient, specifically faster and smaller losses. In principle, AI is used for work that is tracking and rationalising.



Insurance patients (BPJS Kesehatan), as shown in chart 1, are more than 90 %. Thus, it will be efficient if a queue is created with artificial intelligence to detect eligibility to claim from insurance so that hospitals do not close due to failed claims. BPJS Kesehatan Chronic Patients receive 30 days of medication. Before using artificial intelligence, the officer could not schedule the correct patient control time so that after the doctor's examination, the patient could get the medicine on the same day. Queues with artificial intelligence can be accessed online through <http://rsud.madiunkota.go.id> because it prioritizes local patients; this website uses Indonesian. The problem is: How to build artificial intelligence that can solve the bottleneck phenomenon at registration, serve the community 24 hours so that patient visiting hours and service time can be divined?

This research is important so that the Madiun regional hospital can build public services through information communication technology during a pandemic. ICT can reduce crowds in the registration room to reduce the risk of Covid-19 transmission, and the community can be served with service times that can be accurately predicted.

## 2. METHOD

The method used in this study is a soft system methodology with maximum consideration in resolving the problem to the source. First, the HIS (Hospital Information System) Team carried out focus group discussions with BPJS Health and medical records to ensure what data BPJS could provide as a means of completing claims and what reports were needed in the medical record. Second, conducting FGDs by the HIS Team with doctors and clinics to ascertain what data is needed for patient diagnosis and therapy. Third, the HIS Team conducted FGDs with the pharmacy department to ensure what data would be used to maximize service, recording and reporting. The results obtained from the FGD: BPJS Kesehatan has an application that can be bridged with the hospital information system. BPJS Kesehatan patients with chronic diseases have limitations on the type and amount of drug given. Doctors hope that the scheduling of control patients can be more interactive with patients. The clinic asks for a schedule setting guide from the application to be scheduled when the drug is finished. The pharmacy asked the clinic to notify the patient if, at that time, the patient would not get the drug so that there would be no complaints. Medical records want to be able to send the desired report by the local health department on time.

## 3. BASIC THEORY

The Smart hospital concept occurs because of the rapid digitization in the health industry with technology, especially Artificial Intelligence, data analysis, personal services, and the Internet of Things, as stated by Uslu [4], Rath [5], Shah [6].

Furthermore, Catarinucci [7], Roper [8], Vecchia [9], Moatari-Kazerouni [10] show that Wireless Sensor Network, Radio Frequency Identification, and smartphones support the implementation of smart hospitals. From Ronanki's research [11] Agrawal [12] dan Alami [13], Implementing Artificial Intelligence is a big investment, and automation will reduce employee tasks, so organizational readiness is needed. RFID is the easiest and most frequently used IoT because it is efficient and expensive in initial investment but cheap in operational costs.

Research by Gil & Choi [14] in South Korea concluded that economically weak patients, old age, and recipients of health care assistance prefer government hospitals to private hospitals.

According to Shen et al. [15], Zhao & Mourshed [16], patient satisfaction can be obtained from room design and continuous improvement of the outpatient service process.

Meanwhile, research on waiting time by Ameh [17], McCarthy [18], Patwardhan [19], Tan et al. [20], Tran [21], Nguyen et al. [22], and Adamu [23] can be summarized in **table 1**.

| No. | Researcher (year) | Country   | RESEARCH AREA |   |   |   |   |   |   |   | Results   |
|-----|-------------------|-----------|---------------|---|---|---|---|---|---|---|---|
|     |                   |           | A             | B | C | D | E | F | G | H |   |
| 1   | Ameh (2013)       | Nigeria   |               |   |   | D | E |   |   |   | (D) = median 97,2 mins (range 5 mins-300 mins)<br>(E) = median 30,3 mins (range 20 mins-4 h).   |
| 2   | McCarthy (2000)   | Ireland   | A             |   |   | D |   |   |   |   | (A) = mean 50 days ± SD 56; median 28 days (range 0-336) (D) = mean 61 mins ± SD 46 median 60 mins (range 0-270)  |
| 3   | Patwardhan (2013) | USA       |               | B | C | D |   |   |   |   | (B+C+D) = CCC=18,8 mins; non_CCC = 21,4 mins  |
| 4   | Tan (2017)        | Singapore | A             |   |   |   |   |   |   |   | (A) = reduce mean from 50 ± 5 days to 35 ± 7 days.  |
| 5   | Tran (2017)       | Vietnam   |               | C | D |   |   |   |   |   | (C+D) = mean 46,62 mins ± 35,50 mins  |
| 6   | Nguyen (2018)     | Vietnam   |               |   | D | E | F | G | H | I | (D+E+F+G+H+I) = mean 104,1 mins ± 96,4 mins   |
| 7   | Adamu (2014)      | Nigeria   | B             | C | D | E |   |   |   |   | (B+C) = Mean 78,23 ± 22,70 mins, median 76,00 (range 1,00-132,00) (D) = Mean 83,74 ± 38,57 mins, median 79,00 (range 10,00-167,00) (E) = Mean 7,18 ± 4,55 mins, median 6,45 (range 1,54-25,15) (B+C+D+E) = Mean 168,41 ± 35,73 mins, median 167,00 (range 69,00 - 246,00) |

Notes:

A Appointment  
B Registration queue  
C Registration

D Clinic queue  
E Clinic consultation  
F Queue of Supporting Examination

G Queue of Supporting Examination Results  
H Pharmacy queue  
I Payment queue

Research on waiting time, the area studied, still varies from waiting time for appointments to payment. No research has been focused on the area that has the most influence on the pandemic, namely at the time of registration (C), especially to reduce crowds and maintain distance.

## 4. FINDINGS AND DISCUSSION

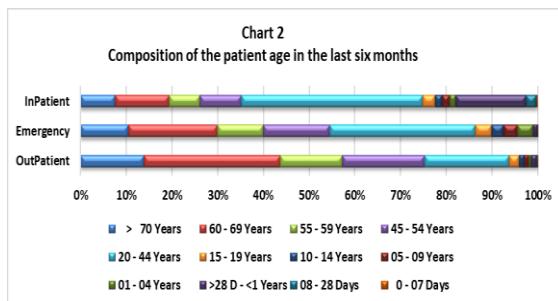
The flow of services at the RSUD Madiun City is shown in Figure 1. All patients must register manually before heading to the 12 existing clinics. The bottleneck phenomenon appears in the registration room. Upon registration, the FIFO queuing system causes patients to arrive early before service to get an initial number and get service immediately. Registration time at the clinic is limited to be able to provide quality services. One senior specialist only serves 20 patients in one day, which has triggered fanatical patients to come 4 to 7 hours early to get an initial queue number to meet the senior specialist. As a result, it causes the emergence of queue brokers.

Before the pandemic, the waiting chairs provided in the registration room were 20% of the total waiting for chairs in the outpatient clinic with the calculation that there were not many idle seats in the outpatient after registration because the clinic and

registration rooms were separate. During the pandemic for physical distance, only 50% of the capacity can be used, so waiting seats for registration are only 10%, which creates a crowd at the time of registration. It should be designed to speed up the registration process and manage time so that patients do not come simultaneously.

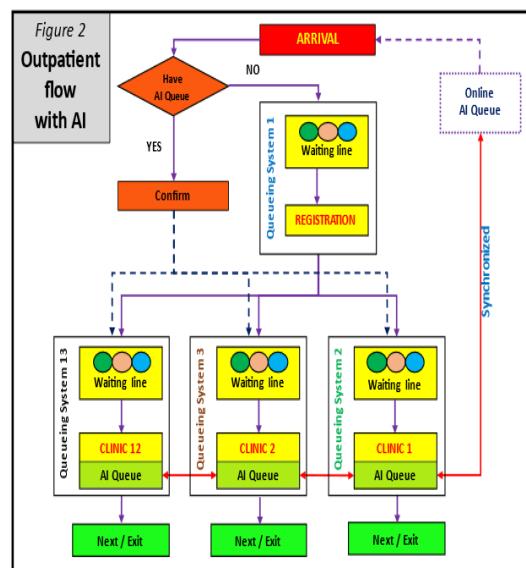
The use of AI starts on March 19, 2021; online and offline AI queues can be used. Online queues can be carried out a maximum of 1 day before the planned visit. With some technical considerations, on April 19, 2021, online queues can be carried out on the day of the visit until 09.00 pm.

Based on the results of the FGD, artificial intelligence was created to manage the queuing system, and BPJS Health patients' verification of participation is still active, and referrals are still active according to the intended clinic. The mechanism is to set the queue number according to the date and clinic the patient is going to; if the queue number at the clinic has exceeded the quota, the intelligence system will notify the patient to move to another day. The queue also mentions the estimated hours of service at the clinic so that patients come 30 minutes before the service time at the clinic.

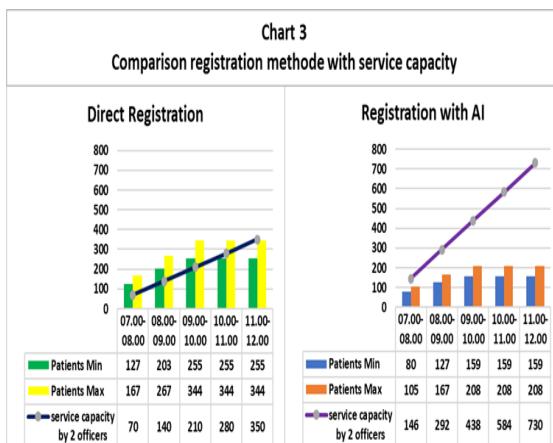


From chart 2, it was found that the highest number of outpatients in hospitals aged 55 years and over reached 57.28%. This group has very minimal access to the internet. As suggested by Chen [24], which examines technology acceptance, conveys the perception of ease of use and usefulness of electronic appointments having a significant effect on the sustainability of use. Need special study for older users and potential users who are less computer literate. Even though online registration has been made, a policy still needs to be taken upon registering the patient manual after completing the doctor's examination by issuing a ticket for the patient who will be in control at the next visit.

As a result of the input, a new outpatient flow was created, as shown in Figure 2. The average outpatient visit before the pandemic was between 620 – 783 patients per day; after the pandemic began in April 2020, it was 414 – 543 patients per day.



There was a decrease in visits between 31% - 39%. The number of officers serving registration is five people with registration service speed without AI Queue on average 118 seconds per patient, and with the application of AI registration, service speed becomes 49 seconds. Patient Registration with AI can be served in a standing position so that the use of waiting chairs can be reduced and the capacity of the waiting room can be increased. In the 3rd month of AI implementation, there were 6.85% online AI Queues, 31.57% Offline AI Queues, 38.42% AI queues. Patients registered for AI will receive a queue number at the clinic; the rest of the patients who come directly to register will receive a queue number after the number used by AI Queue. Zhang's research results in 2014 [25] the Chinese government has implemented web-based appointment systems (WAS) since 2009; only 17% of outpatients use it. The rest come directly to the hospital and register as usual.



In order to reduce crowds during the pandemic, it is necessary to develop a drive-thru registration system. Patients who get a small queue number can immediately park the vehicle and go directly to the clinic. Patients who get a large queue and the service is still long can wait outside the hospital, then go directly to the clinic according to the estimated service time without going through the registration room.

As shown in chart 3, two direct registration officers can serve all patients after 5 hours. Meanwhile, 2 AI Queue officers can serve all patients according to the arrival time at registration. Patients with AI queues will get a queue number at the clinic and an estimated service time. Patients with AI queues can save 1 to 2 hours if their arrival is close to service time. The total time needed from registration to getting medicine at the pharmacy cannot be calculated because the AI developed is more focused on registration and insurance claims.

Queue brokers can be eliminated, fanatical patients who want to consult a senior doctor can be scheduled. Queues can be booked up to 40 days in advance of visiting time.

## 5. CONCLUSION

Artificial intelligence in outpatient queues helps implement physical distancing during the COVID-19 pandemic by eliminating the bottleneck phenomenon in the registration room. Eliminate queuing brokers by booking up to 40 days in advance of the visit. Arrival at the scheduled time can reduce 1 to 2 hours of waiting time at the clinic. Visits were efficient, chronic outpatient treatment at that time, and getting the queue number for the next visit.

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