Model of Vaccination Clinic

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ABSTRACT

This model represents a simulated vaccination course for Welsh people. Many simulations were carried out to obtain the best possible model. Each time the number of nurses per shift changed, as well as the availability of individual workstations. The capacity of waiting queues was also taken into account. All this in order to vaccinate as many patients as possible in the shortest possible time.

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INTRODUCTION

Covid-19 causes chaos around. The virus spreads rapidly and leads to severe respiratory complications and even death. That is why it is so important to vaccinate as many people as possible in the shortest possible time.
Plenty of temporary vaccination clinics are opening in Wales. For such a place to work efficiently and effectively, it is necessary to analyse the situation, the potential of the place as well as qualified medical staff.

Given that every vaccinated patient saves £120 for the NHS (hospitalization costs for respiratory complications), and the average salary of a nurse is £30,000, costs need to be minimized while maximizing the number of vaccinated people.
There can be a maximum of 10 nurses on one shift, there are 3 shifts (8-14, 10-16, 13-19)
To avoid the spread of the virus, the time spent in the clinic by the patient is also an important factor (the longer the time, the greater the risk of contracting covid-19). It is assumed that this time should not be longer than 60 minutes.

DATA

Table 1: Distribution of patient arrival

Time of Day	*Arrivals per hour*	*Distribution*
8am-9am	12	Exponential
9am-11am	6	Exponential
11am-1pm	12	Exponential
1pm-4pm	6	Exponential
4pm-6pm	15	Exponential
6pm-7pm	0	Fixed

Table 2: Distribution of selected processes

Process	*Distribution*	*Values*
Registration time	Triangular	0.5, 1.5, 1
Health Check	Triangular	8, 25, 15
Vaccination Time	Triangular	5, 15, 9
Refreshments	Fixed	15

Information that affects the simulation:

- Capacity of queue for registration is 4. If the waiting room is full every incoming patient leaves.
- In this case nurses work in two shifts (8-14, 13-19).
- To improve the functioning of the clinic, 7 nurses work every shift. Nurses check general health and vaccinate patients. They don't do other extra work (for example, registering incoming people)
- work breaks are not taken into account

SIMULATION

RESULTS

	Base Run Run 19:39:19 28/11/2022
Arrivals.Net Number Entered	90
Queue for Registration.Average Queuing Time	1.39543
Queue for Registration.% Queued Less Than Time Limit	100
Queue for Health Check.Current Contents	4
Vaccinated.Number Completed	74
Vaccinated.Average Time in System	60.90525
Vaccinated.% In System Less Than Time Limit	51.35135
Leaving.Number Completed	4
Too many people in queue.Number Completed Jobs	1
Health Check Fail.Number Completed Jobs	4

Table 1. Results of the simulation.

74 people were vaccinated which is £120x74=£8880 savings for NHS.
14 nurses, this is the cost of £1615.32 per day.
Overall profit: £8880 - £1615.32 = £7264.68

DISCUSSION

Potentially 90 people come to the clinic, of which 5 people are not vaccinated : the arrival leaves when a queue for registration is full (in this case it is one person) and 4 people fail the general health exam.
People who come to thje clinic, wait in line to register for an average of 1.4 minutes. They do not crowd and this stage goes smoothly. The next queue holds a maximum of 4 people, thanks to which people wait for the nurse in a small group.
At 4 stations, 4 nurses check the general health of patients all day. After that, people briefly wait for the next nurse who do the vaccine. 3 out of 4 vaccination stations are available all day.
After vaccination, patients go to the refreshment area for 15 minutes, after which they are allowed to leave the clinic.
The entire stay in the clinic lasts on average 60 minutes. This has a positive effect on the well-being of patients as well as on safe vaccination.
The overall saving for the NHS is £7,264.63 each day.

CONCLUSIONS

If the priority is to vaccinate people with minimal risk of spreading the virus, then the above model is accurate and quite realistic. Patients do not spend more than an hour in the clinic, which means that they do not crowd into a group. The process is running smoothly.
There is probably another (better) model, whose simulation will give greater savings. That's why it's important to prioritize your expectations.

REFERENCES

1. Model of Vaccination Clinic – information given by N. Andrews
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