Two-intervention social distancing strategy to control COVID-19 in Mosul city; A Comparative study

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Abstract:

Background: Novel coronavirus what known now as COVID-19 pandemic represents worldwide health problem. It presented as an upper respiratory infection, acute respiratory distress syndrome, micro thrombosis, sepsis, septic shock, and multi-organ failure and death. Early recognition of suspected cases allows health staff and local gover-

Nment the sufficient time to initiate the appropriate international and national protocols to control the transmission of infection.

Aim: Evaluate the effectiveness of two- intervention social distancing strategy that was applied to control COVID-19 in Mosul city.

Method: Using mathematical simulation model for COVID-19 spread implemented in Santa Clara City in US to estimate the expected burden of the pandemic in Mosul City. This model give a numerical data about the number of the infected cases and time interval of applying the appropriate intervention control strategies by comparing single-strategy (social distancing) to two-intervention strategy (social distancing & light switch approach).

Results: The two interventions strategy shows that on average, the baseline epidemic scenario affected 12.3% of the population in comparison to 11.6% with single-strategy at 70% contact rate. While at the rate of 20% of social contact, only 0.11 % of the population will be infected in the two-intervention strategy in comparison to 0.165% when the single strategy applied. This means a significant reduction in the spread of the infection and the peak time incidence in all hypotheses will be significantly delayed.

Conclusion: The two- intervention social distancing strategy is an efficient tool to control COVID-19 in Mosul city and this represents a big success for Crisis Cell in controlling the pandemic in Mosul city.

Key words: COVID-19, Mosul, Santa Clara, social distancing and light switch approach.

استراتيجية التدخل المزدوج للابتعاد الاجتماعي للسيطرة على COVID-19 في مدينة الموصل ; دراسة مقارنة

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الخلاصة:

المقدمة: يمثل فيروس كورونا المستجد الذي يعرف الآن باسم جائحة COVID-19 مشكلة صحية عالمية. تتمثل العروى بالفايروس بشكل عدوى في الجهاز التنفسي العلوي، متلازمة الضائقة التنفسية الحادة، الجلطات المايكروية، تسمم الدم، الصدمة الإنتانية، الفشل الأعضاء المتعدد ومن ثم الموت. يتيح التعرف المبكر على الحالات المشتبه بها للعاملين الصحيين والحكومة المحلية البدء بوقت مبكر بتطبيق البروتوكولات الدولية والوطنية المناسبة للسيطرة على العدوى.

الهدف: تقييم فاعلية استراتيجية التباعد الاجتماعي الثنائية التي تم تطبيقها للسيطرة على COVID-19 في مدينة الموصل.

الطريقة: استخدام نموذج المحاكاة الرياضية لانتشار COVID-19 استنادًا إلى بيانات في مدينة الموصل مدينة ومقارنتها مع البيانات المستخدمة في نموذج مدينة سانتا كلارا في الولايات المتحدة الامريكية. المحاكاة يمكن أن تعطي بيانات رقمية محتملة حول عدد الحالات المصابة والفاصل الزمني لتطبيق استراتيجيات التداخل للتحكم بانتشار الفايروس من خلال مقارنة استراتيجية التداخل المنفرد (التباعد الاجتماعي) مع استراتيجية التداخل المزدوج (التباعد الاجتماعي ونهج تخفيف التباعد).

النتائج: تُظهر نتائج هذا العمل عند تطبيق إستراتيجية التداخل المزدوج أن سيناريو الوباء الأساسي سيؤثرعلى 12.3٪ من السكان مقارنة بـ 11.6٪ عند تطبيق استراتيجية التداخل المنفرد عند معدل اتصال اجتماعي بنسبة 70٪. في حين انه عند تطبيق معدل اتصال اجتماعي بمعدل 20٪ فلن يصاب سوى 0.11٪ من السكان في الاستراتيجية المزدوجة مقارنة بـ 0.165٪ عند تطبيق الاستراتيجية التباعد الاجتماعي فقط. وهذا يعني انخفاضًا كبيرًا في انتشار العدوى وسيتأخر حدوث وقت الذروة في جميع الفرضيات بشكل كبير.

الخلاصة: إن إستراتيجية التباعد الاجتماعي المزدوج هي أداة فعالة للسيطرة على انتشار COVID-19 في مدينة الموصل وقد شكلت نجاحًا كبيرًا لخلية الأزمة في السيطرة على الوباء في مدينة الموصل

الكلمات المفتاحية: COVID-19 ، الموصل ، سانتا كلارا ، التباعد الاجتماعي ونهج تخفيف التباعد

Introduction:

The outbreak of the novel coronavirus what know now as COVID-19 started in December 2019 in Wuhan city in China, and spread worldwide within days[1]. This virus represents a novel mutant version of a known coronavirus family that caused a serious form of respiratory tract infection that associated with moderate fever 98 %, dry cough 76%, nasal congestion and fatigue 44%. Symptoms start after less than a week of exposure to the virus and resolve after 10-14 days In immuno-compromised patient more serious complication may occur like; pneumonia, acute respiratory distress syndrome (ARDS) 29%, sepsis, thrombosis, shock, acute organ failure in kidney 7% and /or heart 14% [2,3]WHO statistics stated that about 81% of people with COVID-19 have the mild-uncomplicated illness, 14% may present with a severe illness that needs hospitalization and have oxygen support. Only 5% will seriously need intensive respiratory care unit admission and may require mechanical ventilation. The development of a new vaccine may need 12-18 months to be available in the markets. Not to mention that the mass production may take another 3-6 months to reach different countries with acceptable cost[4].

Early recognition of suspected cases allows health local authorities sufficient time to adopt appropriate international and national measures to control the spread of the infection. These measures mostly based on social movement restrictions or what is known now as “social distancing”. This is in addition to other emergency measures like; support health facilities and it’s infrastructures, collaborate with media to provide correct and scientific facts about the disease and the precautions to decrease the spread of the disease[5]. Identification of COVID-19 at early stages provides precious time for both the patient and the health authorities to optimize patients need for health care in a safe, rapid and efficient way. This may include; referral, admission

to isolation-hospital or even admission to the intensive respiratory care unit according to the national protocols and patient's condition. Also, it provides time for both health and local government to take the proper measures such as; start emergency plans, support the hospitals with proper protective equipment, instruments and supplies, promote public awareness and collaborate with national and international Organizations. This study aims to evaluate the effectiveness of the two- intervention social distancing strategy that applied to control COVID-19 in Mosul city.

Methods

Data about the COVID-19 infections collected from the Directorate of Health in Ninawa and WHO/Iraq. These data were applied to an interactive model that produced by *Childs et al*, on 2020 in Santa Clara City in California, USA available at; (http//covid-measures.github.io/?fbclid=IwAR1UMVE6vQ37geEu0AbZzWS6BVRLAM3WK30mTRTyPD7O5JS Q2Bvb5EVZJ4)[6] and the applied setting is portrayed in Figure 1. The model recruits two non-pharmacological strategies to control COVID-19 infection in Mosul city. The first strategy was various degrees of social distancing that were categorized according to the proportion of baseline contact rate among people to; Extreme social distancing 25% contact, Strong social distancing 40%, Medium social distancing 50%, and Light social distancing 60%. The second strategy was a "light-switch method" which means when the number of infected persons exceeds the hospitalization bed capacity. Therefore, if strong social distancing 20% will be applied on and when this value lowered blow the hospitalization bed capacity in three successive weeks, the social distancing may be lowered to 40-50 %. Then, if the cases still below after three weeks, social distancing can be lowered to 60%. The model gives 15 January 2020 as the theoretical date for the start of infection break up the number of population number, hospital bed, date of starting strategy one, length of time for strategy.

The percentage of infected cases was calculated by dividing the simulated number of cases over the population of both Santa Clara and Mosul Cities respectively [6].

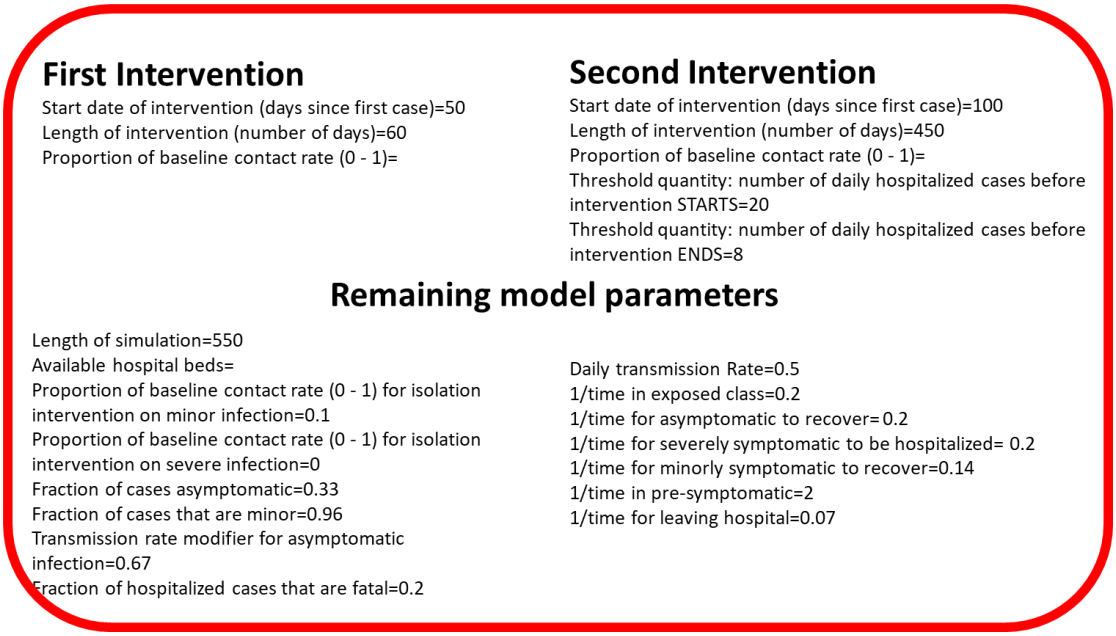

Figure (1): The sitting that applied in the simulation and comparison between Santa Clara and Mosul city.

Results

The hospital bed capacity calculated by dividing the number of beds in the city on the population and multiply by 1000. This capacity considered passed when it is over (6.5) folds [7]. For Santa Clara, the hospitalization bed capacity was 2.32 beds/1000 patients and considered sufficient when 15 cases/week exists[6]. While in Mosul, the hospitalization bed capacity was 0.043 beds/1000 persons and considered passed when 0.3 cases/week exists (i.e. one case every three weeks) as shown in Figure 2. This represents a huge challenge for both health and local authorities as any outbreak will lead to devastating effect overall society.

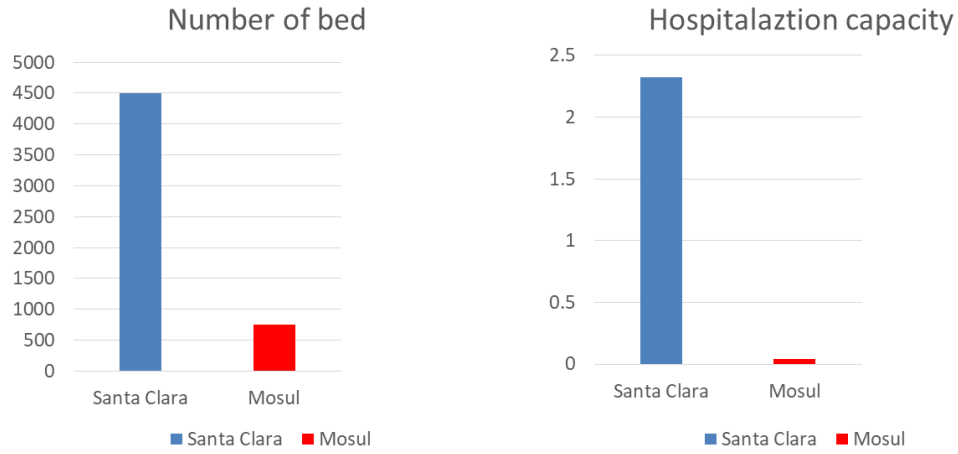

Figure (2): Comparison between Santa Clara and Mosul city in Hospital bed number (left) and hospitalization bed capacity (Right) respectively.

The result from simulation showed that measures taken by the Crisis Cell in Mosul City including; restriction of movement and prevention of in and out movement across the city gave better control in reducing the epidemic and led to prevent the dramatic spread of the infection. Within 60 days of social distancing measures, only six cases reported, while the expected number of new cases from the model was more than 190 000 each day.

Application of the two-intervention model strategy (Distancing + Light switch approach) for 60 days shows that the first-intervention (social distancing) plays a vital role in the initial control of the epidemic until we reach the steady-state. Then the second intervention will give a similar effect to that obtained from a single strategy alone from 40% up to 60% contact rate (see table 1 and 2). When we increase the contact rate to 70% the single strategy seems to be more effective but on the expense of the whole society freezing which leads to intolerable consequences.

Application of two interventions model strategies (Distancing + Light switch approach) shows that, on average, the baseline epidemic scenario affected 12.3% (200 000) of the population to be infected in comparison to 11.6% (190000), if there is no real distancing (contact rate 70%). While in 20% of social contact rate only 0.11 % (1900) of the population will be infected in comparison to 0.165% (2700). This means a significant reduction and the peak time incidence in all hypothesis will be significantly delayed as shown in the following table 1 and 2 and appendix 1 and 2.

Table (1): Comparison between Santa Clara City and Mosul City in the expected number of infections according to a simulation model that produced by Childs et al, applying one strategy (Distancing only).

Contact %	Santa Clara	Mosul city	Distancing type
20 %	0.15 % (2900)	**0.165 % (2700)**	Extreme
30%	0.154 %	**0.159 %**	Strong - Extreme
40%	2.0 %	**1.8 %**	Strong
50%	5.16 %	**5.2 %**	moderate
60%	8 %	**9 %**	Light
70%	12.4 % (240 000)	**11.6 % (190 000)**	Open

*The percentage calculated from dividing the simulated case number/ population of each city.

Table(2):Comparison between Santa Clara City and Mosul City in the expected number of infections according to a simulation model that produced by Childs et al, applying two strategies (Distancing and Light-Switch Approach).

Contact %	Santa Clara	Mosul city	Distancing type
20 %	0.09 % (1800)	**0.11 % (1900)**	Extreme
30%	1.1 %	**1.4%**	Strong - Extreme
40%	2.%	**1.8%**	Strong
50%	5.16 %	**5.2%**	moderate
60%	8.%	**9 %**	Light
70%	12.4% (240 000)	**12.3% (200 000)**	Open

*The percentage calculated from dividing the simulated case number/ population of each city

Discussion

Non- pharmacological interventions (NPIs) include actions that individuals and households can adopt (e.g. frequent hand washing, covering coughs and sneezes, and keeping a distance from sick people) and social distancing that communities can tolerate (e.g. closing schools, working from home, restricting public gatherings and movement). These are specifically geared to limit the spread of a disease that is transmitted from person to person8. The NPIs help to reduce the impact of a pandemic by delay the effects and give more time for the health and the local authorities to synchronize the response efforts. In addition, it helps to reduce the number of people who are exposed to the infection and may get sick or die. This also will reduce the pressure on health facilities and health staff, as they will deal with a smaller number of patients. Finally, these measures will have an impact on jobs, as NPIs help to keep local businesses and city infrastructures such as water, electricity, and transportation in operation.

Distancing is a cornerstone in the management of pandemics related to respiratory tract infections. To study the effect on the distancing of any pandemic, there are many models or strategies used. One modelling study from China estimated that if a range of NPIs including social distancing, had been conducted one week, two weeks, or three weeks earlier in the

country, the number of COVID-19 cases could have been reduced by 66%, 86%, and 95%, respectively, together with significantly reducing the number of affected areas9.

The used models in this study based on Mosul city-data suggest that on average, the baseline epidemic scenario (70% contact rate or more) causes 12.3% of the population to develop COVID-19 infection. If 20% of social contact rate is applied, the overall attack rate is reduced to 0.11% and the peak time is significantly delayed. In contrast, if the 50% social contact rate is applied, the attack rate increased to 5.2 %, and the peak time is short. This suggests that there is duplication in the number of infected persons each time the distancing increases by 10 %. Also, as early as we control the infected person the city will be safer. The same result obtains if we apply the one-intervention strategy but with intolerable consequences on both social and economic levels.

The local authority was successful in their decision by applying to severe restriction of movement in the early period of the COVID-19 pandemic and the change to the light-switch approach after. This will reduce the economic, social, and psychological consequences of prolonging distancing period. Studies showed that living in prolong social distancing can produce post-traumatic stress symptoms.

The community should be provided with a clear rationale cause for quarantine to reduce the negative feelings to the minimum. Also, they should be provided with regular updates about disease situation and other information, so people know what to do, besides maintaining sufficient food and supplies10.

Mass testing is one of the tools used to test the magnitude of the spread of the infection, including identifying asymptomatic individuals who can then isolate themselves before they further spread the virus. In the absence of widespread testing, however, the centerpiece of the public health response to COVID-19 is social distancing. The crowded workplace like markets, universities, schools, and factories should be closed in the initial controlling period. Then in the second phase, the number of workers should be minimized as much as possible to carry only the vital operations.

In conclusion, the two- intervention social distancing strategy was an efficient tool to control COVID-19 in Mosul city and this represents a big success for Crisis Cell in controlling COVID-19 in Mosul City.

Recommendations can be elicited as; Mosul city borders should be closed to sustain the achievements, Media should keep its awareness messages to maintain the personal interaction control measures like; frequent hand washing, avoid handshaking, covering coughs and sneezes, and keeping a distance from sick people. The next step should be mass screening in the city looking for any hidden case or at least screening of the health staff working in the field. Although many factors other than social distance may affect the level of spread but it's clear that social distancing is the most effective.

Finally, the collaboration between academies in Mosul city with the directorate of the health of Ninawa is essential to help the Crisis Cell to keep the city clean from the infection through intimate research work.

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