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Mathematical Modeling and Statistical prediction of the spread of the Covid-19 Epidemic in Iraq with use SIR, R0

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ABSTRACT

In this research, a mathematical model was used to find epidemiological predictions for the coronavirus epidemic in Iraq to control and prevent the epidemic. Where the data of the reported cases until Nov. 21, 2020 from the Iraqi Ministry of Health and the Iraqi Public Health Committee were used, where the parameters of the form were determined and based on determining the number of reported cases, the unreported cases are determined and then the model is used to project the epidemic forward with appropriate levels of Iraqi Public Health Authority interventions. The model's predictions underscore the importance of major public health interventions in controlling COVID-19 epidemics. Whereas, the research work strategy was adopted by Liu et al (2020). The simulation was performed with R.

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Introduction

The purpose of this work is to select an appropriate mathematical model, which infer from the reported case data the number of unreported cases of the COVID-19 pandemic in Iraq. A modeling approach for this epidemic outbreak was developed in Tang et al. 2020 which did not take into account unreported cases. Our work is based on validating the results (Magal et al. (2020), Ducrot et al. (2020), and Liu et al. (2020)), for the application of the epidemiological model in Iraq. The primary problem is to define key parameters in the chosen mathematical epidemiological model. We address the following basic issues related to the spread of this epidemic in Iraq: How will Coronavirus develop in Iraq in relation to the number of reported and unreported infections how will the number of unreported infections affect the spread of the epidemic in the Region how will public health measures such as health isolation

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and complete lockdown contribute to the spread of Covid-19? We were guided by Liu et al (2020) procedures and conclusions.

2- *Mythology*

The research model is represented by the following arrangement of ordinary differential equations[1]:

$$S'(t) = -\tau\, S(t) * [I(t) + U(t)],$$

$$I'(t) = \tau\, S(t) * [I(t) + U(t)] - vI(t), \quad \dots \ 1$$

$$R'(t) = v_1 I(t) - \gamma R(t),$$

$$u'(t) = v_2 I(t) - \gamma U(t).$$

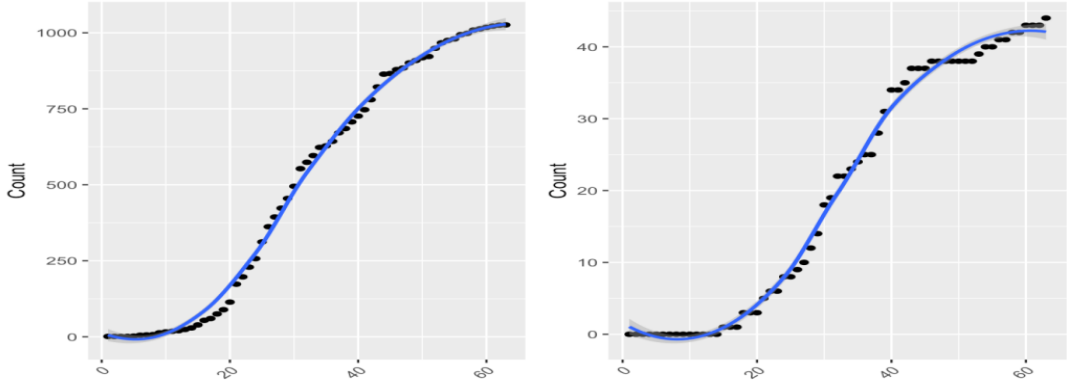
Here, $t \geq t_0$ "is time in days, t_0 is the beginning date of the epidemic, S(t) is the number of individuals susceptible to infection at time t, I(t) is the number of asymptomatic infectious individuals at time t, R(t) is the number of reported symptomatic infectious individuals (i.e. symptomatic infectious with severe symptoms) at time t, and U(t) is the number of unreported symptomatic infectious individuals (i.e. symptomatic infectious with mild symptoms) at time t. This system is supplemented by initial data"

$$S(t_0) = S0 > 0, I(t_0) = I_0, \qquad R(t_0) = R_0 = 0 \ \text{ and } \ u(t_0) = U_0 \geq 0$$

The data flow model and parameters can be listed as follows:

We used data reported by the Iraqi Public Health Authority in Iraq to build our model for a specified period. Which represents the transmission of the epidemic in Iraq. The first case was revealed on 24/2/2019. The trend curve increased with respect to the number of confirmed patients in Iraq (Fig.1). Where was the transmission of this epidemic was so rapid after April 24, that the number of confirmed patients doubled

Fig. 1 confirm cases COVID-19 in IRAQ



If we put the exclusion rate in the following Form $\nu = \nu 1 + \nu$, where $\nu 1$ is the rate of cases exclusion with apparent indications, and $\nu 2$ is the rate of elimination of unreported cases for all reasons such as the absence of indications or minor symptoms, as for the cumulative number of infected individuals with severe indications at the time T expresses It is $CR(t)$,and it takes the following form [1]

$$CR(t) = \aleph_1 \exp(\aleph_2 t) - \aleph_3 \ \dots 2$$

A model for the time of the onset of the epidemic to can be formulated as follows:

$$CR(t_0) = 0 \ \leftrightarrow \ \aleph_1 \exp(\aleph_2 t_0) - X_3 = 0 \ \rightarrow \ t_0 = \frac{1}{\aleph_2}(\ln(\aleph_3) - \ln(\aleph_1)) \ \dots 3$$

We fix S0 = 533555, "which corresponds to the total population of IRAQ. We assume that the variation in S(t) is small during the period considered", and we fix $\nu, \gamma, f\nu \cdot f$ We can estimate the parameters $\tau, \nu 1, \nu 2$ "and the initial conditions U0 and I0 from the cumulative reported cases" CR(t). We then construct numerical simulations and compare them with data. we obtain

$$I(t) = I_0 \exp\left(X_2(t - t_0)\right) \text{ and } I_0 = \frac{X_3 \aleph_2}{fv} \quad \text{we must have } U(t) = U_0 \exp\left(\aleph_2(t - t_0)\right) \ldots 4$$

So by substituting thes expression (4) in (1)to provous identites, we obtian :

$$\aleph_2 I_0 = \tau S_0(I_0 + U_0) - V I_0 \aleph_2 U_0 = V_2 I_0 - \gamma U,$$

$$\tau = \frac{\aleph_2 + v}{S_0} \frac{\gamma + \aleph_2}{(1-f)*v + \aleph_2 + \gamma} \quad and \quad U_0 = \frac{(1-f)v}{\aleph_2 + \gamma} I_0 \quad \ldots 5$$

Here we fix τ in such a way that value $\aleph_2$ became the dominant eigenvalue of

$$A = \begin{pmatrix} \tau S_0 - v & \tau S_0 \\ v(1-f) & -\gamma \end{pmatrix}$$

and $(I0, U0)$is the positive eigenvector affiliated with this dominant eighenvalue $\aleph_2$, we use implicitly the Perron _ Frobenius theorem [2] . Furthermore, the exponentially increasing solution $(I(t), U(t))$ that we study (which is beginning very close to (0,0) "follows the direction of the positive eigenvector associated with the dominant eighenvalue $\aleph_2$ ". Therefore, the calculation of the basic reproduction number can be formulated as follows

$$R_0 = \frac{\aleph_2 + v}{v} \frac{\gamma + \aleph_2}{(1-f)*v + \aleph_2 + \eta} \left(1 + \frac{(1-f)v}{\gamma}\right) \quad \ldots 6$$

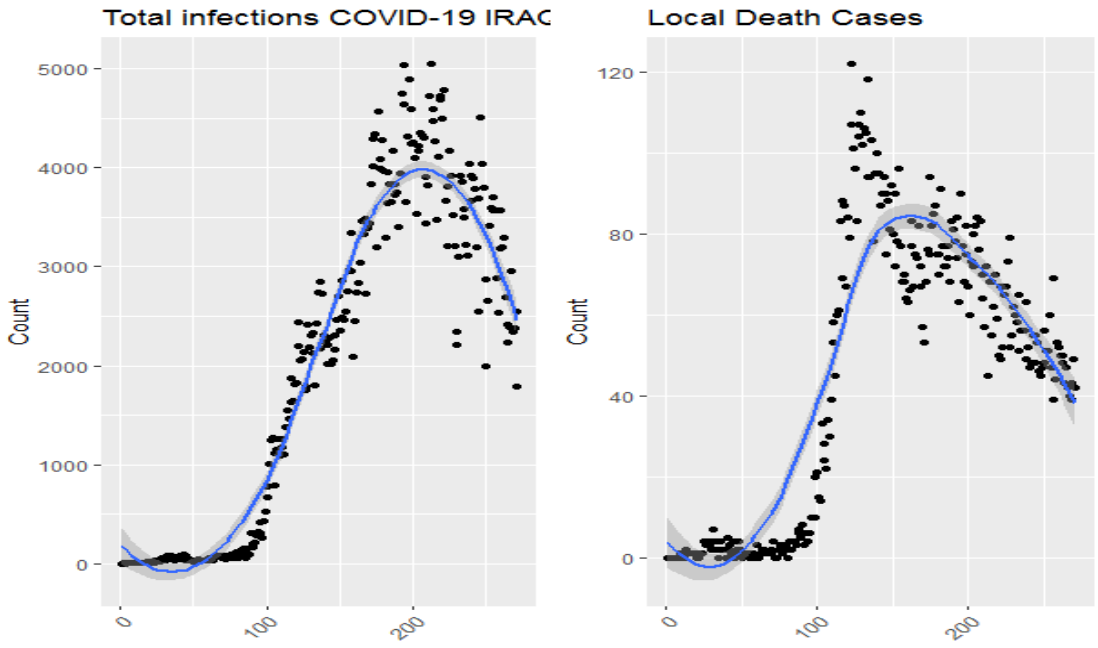
3- *Simulations*

We can choose multiple values of γ, ν *and* f That gives a great fit to the data. To apply our model, γ, ν and f must change in a sensible range. For the COVID-19 in IRAQ at its current stage, the values of γ, ν, and f are not known. From the introductory information, we use the values, Assuming that the Iraqi population adheres to public health instructions at 80%

Table 1-The initial values of the parameters

f	v	γ
0.8000000000000	0.1428571428571	0.1428571428571

Fig.2- 'Total infections COVID-19 Iraq'



In date of April 13th and according to data set t = t0 of the epidemy is correspond to 20 February, in fact the value t0=10.97 means that the starting time of the epidemic is 2 Mars + 11 days. In the other hand, as long as the number of reported cases follows, we can predict the future values of CR(t). For $\aleph_1 =$ 76.7 ,$\aleph_2 = 0.$, *and* $\aleph_3 = 128$, we obtain: The fit model is

Table 2-The fit model

day	Fit mod
1	**-493.3551**
2	**-475.6600**
3	**-457.9599**
4	**-440.2548**
5	**-422.5448**
6	**-404.8298**
7	**-387.1098**
8	**-369.3848**
9	**-351.6548**
10	**-333.9199**
11	**-316.1800**
12	**-298.4351**

From the above data, we calculate the following important measures

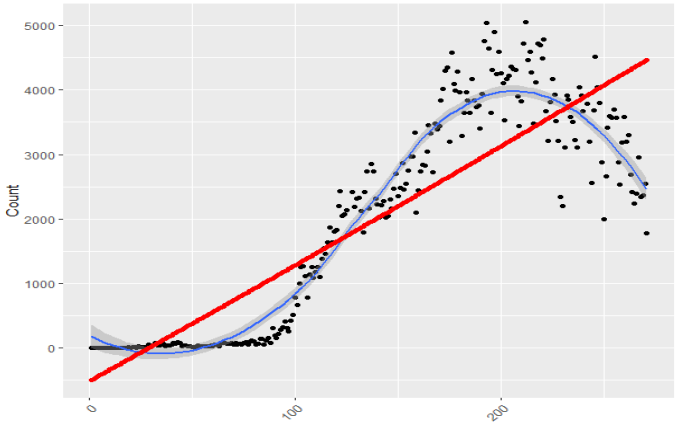
Table 3-Some statistical measures values

SSR	TSS	R^2
178578239	**746665169**	**0.7608322**

Note that the value of $R^2 = 0.7608322$ and therefore the model is identical to the data

Through the following figure, we note the extent of the convergence of the data modeling with the real data

Fig. 3- 'Total infections" for fit-mod



And in increasing cases N=272 we count and we get the estimate the parameters:

Table 4- the estimate the parameters values

τ	$\aleph_1$	$\aleph_2$	$\aleph_3$	t_0
0.0000002236336	62947.9812294970	0.0002809885	63459.0264464577	41.5151448998

And we calculates the fit - Mod values in the following table

Table 4- the fit - Mod values

Day	Fit- mod
1	1410.272 1428.502 1446.738 1464.978 1483.223 1501.474 1519.730 1537.991
9	1556.257 1574.528 1592.804 1611.085 1629.372 1647.664 1665.960 1684.262
17	1702.569 1720.882 1739.199 1757.521 1775.849 1794.182 1812.520 1830.863
25	1849.211 1867.565 1885.923 1904.287 1922.656 1941.030 1959.409 1977.794
33	1996.183 2014.578 2032.978 2051.383 2069.793 2088.209 2106.629 2125.055
41	2143.486 2161.922 2180.364 2198.810 2217.262 2235.719 2254.181 2272.648
49	2291.120 2309.598 2328.081 2346.569 2365.062 2383.561 2402.064 2420.573
57	2439.087 2457.606 2476.131 2494.660 2513.195 2531.735 2550.280 2568.831
65	2587.386 2605.947 2624.513 2643.085 2661.661 2680.243 2698.830 2717.422
73	2736.020 2754.622 2773.230 2791.843 2810.462 2829.085 2847.714 2866.348
81	2884.987 2903.632 2922.282 2940.937 2959.597 2978.262 2996.933 3015.609
89	3034.290 3052.977 3071.669 3090.366 3109.068 3127.775 3146.488 3165.206
97	3183.929 3202.658 3221.392 3240.131 3258.875 3277.625 3296.380 3315.140
105	3333.905 3352.676 3371.452 3390.233 3409.020 3427.811 3446.608 3465.411
113	3484.218 3503.031 3521.850 3540.673 3559.502 3578.336 3597.175 3616.020
121	3634.870 3653.725 3672.586 3691.452 3710.323 3729.199 3748.081 3766.968
129	3785.860 3804.758 3823.661 3842.569 3861.483 3880.402 3899.326 3918.256
137	3937.191 3956.131 3975.077 3994.027 4012.984 4031.945 4050.912 4069.884
145	4088.862 4107.845 4126.833 4145.826 4164.825 4183.829 4202.839 4221.854
153	4240.874 4259.899 4278.930 4297.967 4317.008 4336.055 4355.108 4374.165
161	4393.228 4412.297 4431.370 4450.449 4469.534

,As for the EIGHEN VALUO and EIGHEN VECTOR they were as follows:

Table 4- The Eighen value and eighen vector

EIGHEN VALUO	-0.1666744591	0.0002809885
EIGHEN VECTOR	-0.1957459	0.7681182
	0.9806546	0.6403080

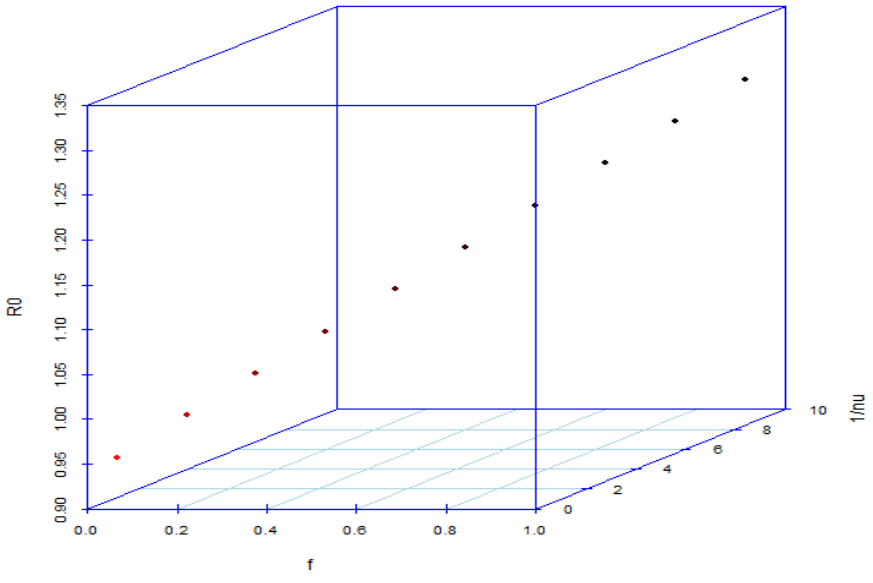
Presumably, we bear in mind that strict isolation measures have been imposed in all regions of Iraq since March 24th. Specifically, since March 24, residents of Iraq should not leave the house. Assuming this public intervention is necessary, the transmission of COVID-19 from infectious to vulnerable individuals should stop after Nov 26.

Depending on the initial values, it is possible to find the value of R0, a measure of reproductive growth, and taking into account that we assumed that the population had a percentage of compliance with health instructions is 0.80, we note that the values of the estimates areAs for Evolution of the basic number of R0 (" I will use the same model already used in Epidemiology: How contagious is Novel Coronavirus (2019-nCoV)?; https://blog.ephorie.de/epidemiology-how-contagious-is-novel-coronavirus-2019-ncov See ON Bjørnstad (2018) Epidemics: Models and Data using R. Springer").

Table 5- value of R0

S0	I0	U0	R0
533555.000000	**156.0235**	**31.14344**	**1.002295**

Fig.4- Evolution of the basic number of R0



Where we note here from the value of R0 and from the graph in Figure (5) of the cumulative function of the number of infections that the epidemic is closer to the stage of stability when taking the necessary measures by health centers such as banning and quarantine of patients, so it is necessary to beware of spreading in the study area, And hence we can note that $As\ t \to \infty$,(I (t) ،) U (t)) $\to (0,0)$

Fig. 5- the cumulative reported cases CR(t)

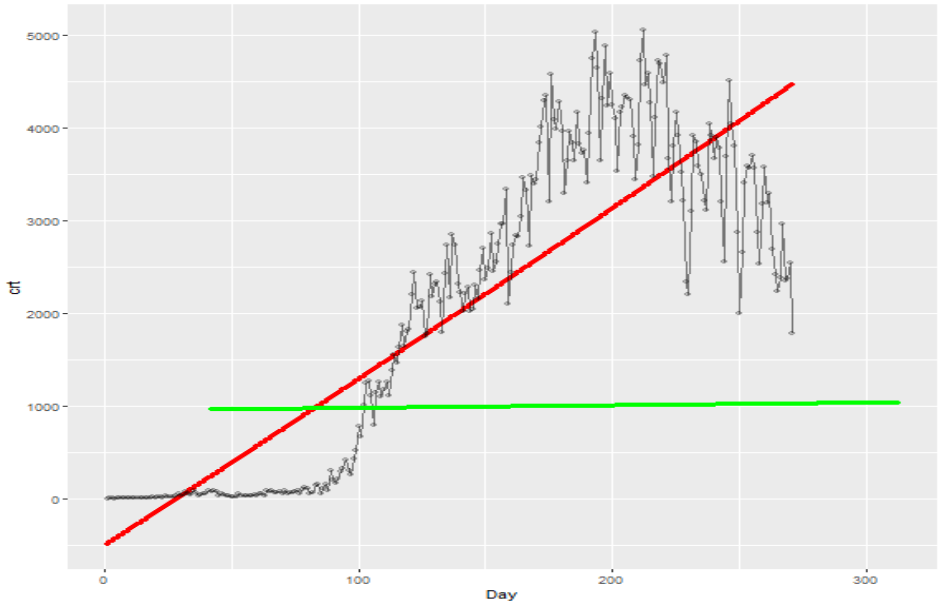
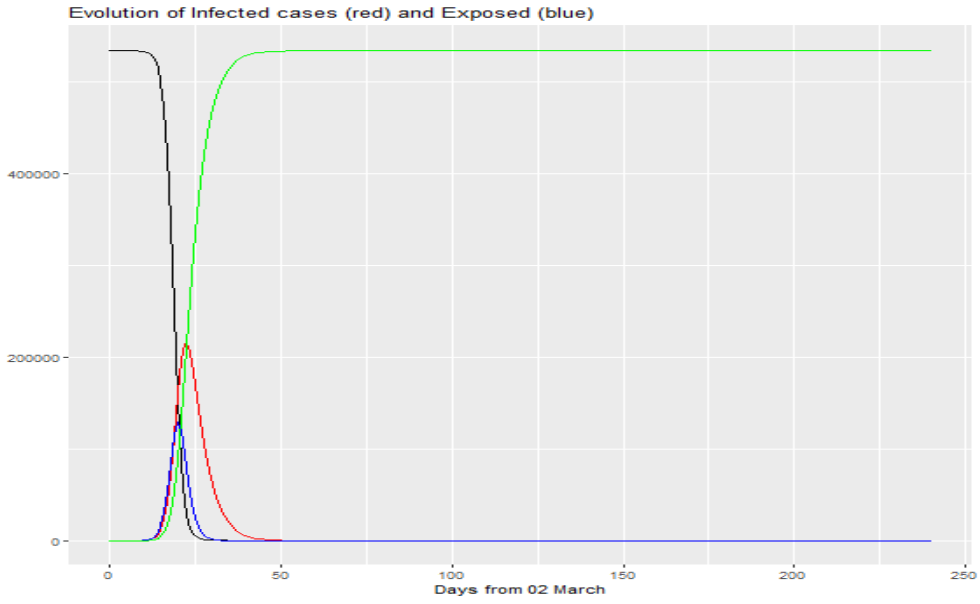


Fig. 6- Evolution of Infected cases



Finally : To model, the dynamics of the epidemic spread in Iraq, required three differential equations, one for change in each set, where β is the parameter is the one that controls the shift between S and I and γ that controls the shift between I and R.:

$$\frac{dS}{dt} = \frac{-\beta IS}{N}$$

$$\frac{dI}{dt} = \frac{\beta IS}{N} - \gamma I$$

$$\frac{dR}{dt} = \gamma I$$

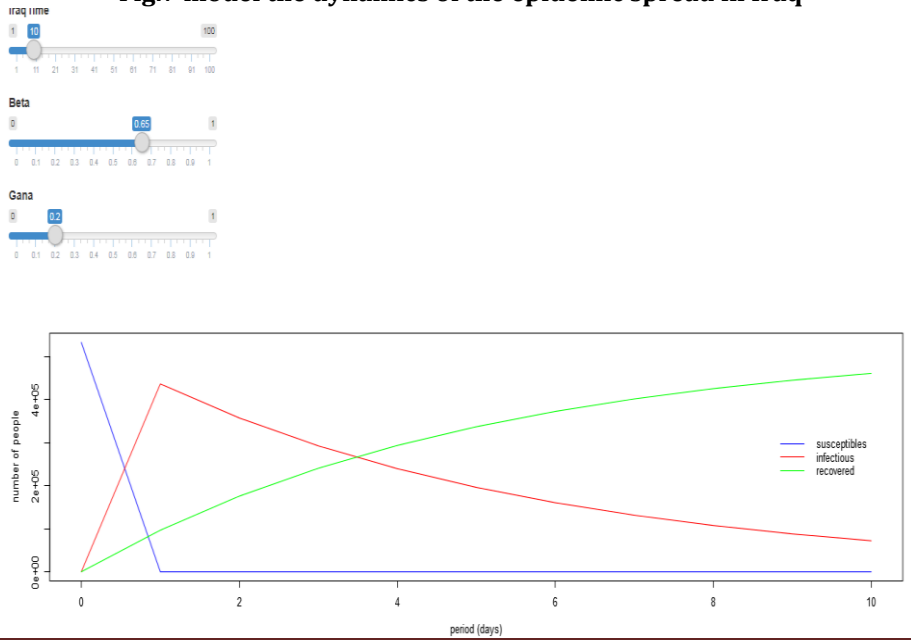
and $\quad RSS(\beta, \gamma) = \sum_t (I(t) - \hat{I}(t))^2$

And it can easily be applied in R cod.In the correct line chart below, we see that the model appears to fit the values well. Some very interesting stats can be extracted is One of the important numbers is the basic reproduction number R0 which we mentioned earlier, which mainly shows the number of healthy people who are infected by a sick person as follows:

$$\mathbf{R_0} = \frac{\beta}{\gamma} \quad \text{with } \boldsymbol{\beta} = 0.3596390 \; \boldsymbol{\gamma} = 0.3108059 \rightarrow \quad R0{=}1.15711767$$

The basic multiplication number can be calculated for any value given to the parameters $\boldsymbol{\gamma}, \boldsymbol{\beta}$

Fig.7 model the dynamics of the epidemic spread in Iraq



4- *Conclusions*

- As a result of this study, we note that public health measures, such as isolation, quarantine, and complete closure, significantly reduce the size of the final spread of the epidemic, and make the turning point much earlier than without these measures. But if the residents of the region do not abide by these measures, it will become a rapid outbreak of the epidemic in the region

- We set F = 0.8, which means that about 80% of infections were reported in the model, assuming that the cases are well documented in Iraq. Thus, we only assume that a small fraction of 20% is not reported. Of cases

- We note that the predictive power of our model requires correct estimates of the parameters F,γ and v are based on medical and biological epidemiologists' information.
- Our results can contribute to limiting and controlling the spread of the COVID-19 epidemic in Iraq.
- From the formula (CR (t) it turned out to be very descriptive until March 26 for the data of the reported case in Iraq - the dates can be changed as desired by the researcher. This indicates that the turning point is very strong
- Multiple values of f, γ, and v can be chosen and fit well into the data. Values were chosen 1 / v = 7 day, 1 / γ = 7 day and other values can be chosen. This also means changing the values of f and v using other methods and days taken from information on previous COVID-19.

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Appendix A: symbols and real data

A.1 Symbols

"1 / v Average time during which asymptomatic infectious are asymptomatic fixed
F fraction of asymptomatic infectious that become reported symptomatic infectious fixed
v1 = f v Rate at which asymptomatic infectious become reported symptomatic fitted
v2 = (1 – f) Rate at which asymptomatic infectious become unreported symptomatic fitted
1 /γ Average time symptomatic infectious have symptoms fixed"

A.2 Real data: the data of the cases reported until November 21, 2020 from the Iraqi Ministry of Health and the Iraqi Public Health Committee

date	infected	death	relife	total_death	total_infected	total_relife	total_healthy

24/02/2020	1	0					
25- February	4	0			5		
27- February	2	0			7		
28- February	1	0			8		
29- February	5	0			13		
01-Mrch	6	0			19		
02- Mrch	8	0			27		
03- Mrch	5	0			32		
04- Mrch	8	1			40		
05- Mrch	2	0			42		
06- Mrch	8	1	1		50	1	
07- Mrch	8	0	0		58	1	
08- Mrch	7	2	0		65	1	
09- Mrch	6	1	0		66		
10- Mrch	5	1	15		71		
11- Mrch	6	1			77		
12- Mrch	6	1			83		
13- Mrch	10	1	8	9	93		
14- Mrch	17	1		10	110		
15- Mrch	4	0		10	114		
16- Mrch	19	0			133	32	
17- Mrch	21	1		11	154		
18- Mrch	10	1		12	164		
19- Mrch	28	1		13	192	49	
20- Mrch	15	4		17	207	50	
21- Mrch	17	3		17	224	50	
22- Mrch	19	3		20	233	57	
23- Mrch	33	3	5	23	266	62	
24- Mrch	50	4	13	27	316	75	
25- Mrch	30	2		29	346	89	
26- Mrch	37	7		36	382	105	
27- Mrch	76	4		40	458	122	
28- Mrch	48	2		42	506	131	
29- Mrch	41	0		42	547	143	
30- Mrch	83	4		46	630	152	
31- Mrch	65	4		50	695	170	
01-April	34	2	12	52	728	182	
02- April	44	2	20	54	772	202	
03- April	48	0		54	820	226	
04- April	58	2	33	56	878	259	
05- April	83	5	20	61	961	279	
06- April	70	3	65	64	1031	344	
07- April	91	1	29	65	1122	373	
08- April	80	4	79	69	1202	452	
09- April	30	0	44	69	1232	496	
10- April	47	1	54	70	1279	550	
11- April	39	2	51	72	1318	601	
12- April	34	4	39	76	1352	640	
13- April	26	2	77	78	1378	717	
14- April	22	0	49	78	1400	766	
15- April	15	1	46	79	1415	812	
16- April	19	1	44	80	1434	856	
17- April	48	1	50	81	1482	906	
18- April	31	1	47	82	1513	953	
19- April	26	0	56	82	1539	1009	
20- April	35	0	34	82	1574	1043	
21- April	28	1	53	83	1602	1096	
22- April	29	0	50	83	1631	1146	
23- April	46	0	25	83	1677	1171	
24- April	31	3	33	86	1708	1204	
25- April	55	0	20	86	1763	1224	

26- April	57	1	39	87	1820	1263	
27- April	27	1	23	88	1847	1286	
28- April	81	2	33	90	1928	1319	
29- April	75	2	27	92	2003	1346	
30- April	82	1	29	93	2085	1375	
01-May	68	1	39	94	2153	1414	
02- May	66	1	59	95	2219	1473	
03- May	77	2	17	97	2296	1490	
04- May	50	1	54	98	2346	1544	
05- May	85	4	27	102	2431	1571	
06- May	49	0	31	102	2480	1602	
07- May	63	0	24	102	2543	1626	
08- May	60	2	35	104	2603	1661	
09- May	76	3	41	107	2679	1702	
10- May	88	2	32	109	2767	1734	
11- May	51	1	56	110	2818	1790	
12- May	95	2	113	112	2913	1903	
13- May	119	3	63	115	3032	1966	
14- May	111	0	62	115	3143	2028	
15- May	50	2	61	117	3193	2089	
16- May	67	4	37	121	3260	2126	
17- May	144	2	92	123	3404	2218	
18- May	150	4	92	127	3554	2310	
19- May	57	4	56	131	3611	2366	
20- May	113	3	72	134	3724	2438	
21- May	153	6	45	140	3877	2483	
22- May	87	7	49	147	3964	2532	
23- May	308	5	53	152	4272	2585	
24- May	197	8	153	160	4469	2738	
25- May	163	3	73	163	4632	2811	
26- May	216	6	41	169	4848	2852	
27- May	287	6	52	175	5135	2904	
28- May	322	4	67	179	5457	2971	
29- May	416	6	73	185	5873	3044	
30- May	306	10	66	195	6179	3110	
31- May	260	10	46	205	6439	3156	
01-June	429	10	119	215	6868	3275	
02- June	519	20	233	235	7387	3508	
03- June	781	21	587	256	8168	4095	
04- June	672	15	243	271	8840	4338	
05- June	1006	14	235	285	9846	4573	
06- June	1252	33	331	318	11098	4904	
07- June	1268	28	282	246	12366	5186	
08- June	1115	24	386	370	13481	5572	
09- June	787	22	259	392	14268	5831	
10- June	1146	34	383	624	15414	6214	
11- June	1261	30	345	457	16675	6568	
12- June	1095	39	300	496	17770	6868	
13- June	1180	53	647	549	18950	7515	
14- June	1259	58	606	607	20209	8121	
15- June	1106	45	1150	652	21315	9271	
16- June	1385	60	591	712	22700	9862	
17- June	1554	61	908	773	24254	10770	
18- June	1463	83	563	856	25717	11333	
19- June	1635	69	872	925	27352	12205	
20- June	1870	88	1006	1013	29222	13211	
21- June	1646	87	724	1100	30868	13935	
22- June	1808	67	850	1167	32676	14785	
23- June	1826	84	968	1251	34502	15753	
24- June	2200	79	1061	1335	36702	16814	

25- June	2437	107	1237	1437	39139	18051	
26- June	2054	122	808	1559	41193	18859	
27- June	2069	101	1079	1660	43262	19938	
28- June	2140	96	1184	1756	45402	21122	
29- June	1749	83	1852	1839	47151	22974	
30- June	1786	104	1786	1943	49109	24760	
01-july	2415	107	1507	2050	51524	26267	
02- July	2184	110	1645	2160	53708	27912	
03- July	2312	102	1,688	2,262	56020	29600	
04- July	2334	106	1477	2368	58354	31077	
05- July	2125	105	1940	2473	60479	33017	
06- July	1796	94	1724	2567	62275	34741	
07/07/2020	2426	118		2685	64701	65815	
08/07/2020	2741	94	1627	2779	3789	67442	
09/07/2020	2170	103	1623	2882	69612	67442	
10/07/2020	2848	78	1878	2960	41380	72460	
11/07/2020	2734	95	1699	3055	43079	75194	
12/07/2020	2312	95	1645	3150	44724	77506	
13/07/2020	2229	100	2274	3250	79735	46998	
14/07/2020	2022	95	3784	3345	81757	50782	
15/07/2020	2210	87	1839	3432	83967	52621	
16/07/2020	2281	90	1695	3522	86148	54316	
17/07/2020	2023	94	2179	3616	88171	56495	
18/07/2020	2049	75	1997	3691	90220	58492	
19/07/2020	2310	90	2036	3781	92530	60528	
20/07/2020	2163	88	2308	3869	94693	62836	
21/07/2020	2466	81	2114	3950	97159	64950	
22/07/2020	2706	92	2197	4042	99865	67147	
23/07/2020	2361	80	2258	4122	102226	69405	
24/07/2020	2485	90	1863	4212	104711	71268	
25/07/2020	2862	72	2049	4284	107573	73317	
26/07/2020	2459	78	1900	4362	110032	75217	
27/07/2020	2553	96	1927	4458	112585	77144	
28/07/2020	2747	77	3918	4535	115332	81062	
29/07/2020	2968	68	2399	4603	118300	83461	
30/07/2020	2963	68	2085	4671	121263	85546	
31/07/2020	3346	70	1888	4741	124609	87434	
01/08/2020	2095	64	1841	4805	126704	89275	
02/08/2020	2447	63	2611	4868	129151	91886	
03/08/2020	2735	66	2225	4934	131886	94111	
04/08/2020	2836	83	1992	5017	134722	96103	
05/08/2020	2834	77	2339	5094	137556	98442	
06/08/2020	3047	67	2583	5161	140603	101025	
07/08/2020	3461	75	2172	5236	144064	103197	
08/08/2020	3325	74	2307	5310	147389	105504	
09/08/2020	2726	82	2271	5392	150115	107775	
10/08/2020	3484	72	2015	5464	153599	109790	
11/08/2020	3396	67	2312	5531	156995	112102	
12/08/2020	3441	57	2439	5588	160436	114541	
13/08/2020	3841	53	2667	5641	164277	117208	
14/08/2020	4013	68	2921	5709	169290	120129	
15/08/2020	4293	76	2571	5785	172585	122700	
16/08/2020	4348	75	2674	5860	176931	125374	
17/08/2020	3202	94	3571	5954	180133	128945	
18/08/2020	4576	82	2895	6036	184709	131840	
19/08/2020	4093	85	2529	6121	188802	134369	
20/08/2020	3995	87	2831	6208	192797	137200	
21/08/2020	4288	75	3246	6283	197085	140446	
22/08/2020	3965	70	2947	6353	201050	143393	
23/08/2020	3291	75	3016	6428	204341	146409	
24/08/2020	3644	91	3980	6519	207985	150389	

25/08/2020	3962	77	3372	6596	211947	153761	
26/08/2020	3837	72	3454	6668	215784	157215	
27/08/2020	3651	72	3794	6740	219435	161009	
28/08/2020	4177	74	3865	6814	223612	164874	
29/08/2020	3834	77	4146	6891	227446	169020	
30/08/2020	3731	68	3860	6959	231177	172880	
31/08/2020	3757	83	3722	7042	234934	176602	
01/09/2020	3404	81	2947	7123	238338	180473	
02/09/2020	3946	78	3732	7201	242284	184205	
03/09/2020	4755	74	3552	7275	247039	187757	
04/09/2020	5036	84	3611	7359	252075	191368	
05/09/2020	4644	63	3891	7422	256719	195259	
06/09/2020	3651	90	3301	7512	260370	198560	
07/09/2020	4314	77	4299	7589	264684	202859	
08/09/2020	4894	68	3465	7657	269578	206324	
09/09/2020	4243	75	3669	7732	273821	209993	
10/09/2020	4597	82	3824	7814	278418	213817	
11/09/2020	4254	67	3579	7881	28 2672	217396	
12/09/2020	4106	60	3887	7941	286778	221283	
13/09/2020	3531	73	3422	8014	290309	224705	
14/09/2020	4169	72	4427	8086	294478	229132	
15/09/2020	4224	80	4214	8166	298702	233346	
16/09/2020	4357	82	3895	8248	303059	237241	
17/09/2020	4326	84	3859	8332	307385	241100	
18/09/2020	4305	76	4205	8408	311690	245305	
19/09/2020	3907	83	4234	8491	315597	249539	
20/09/2020	3438	64	4052	8555	319035	253591	
21/09/2020	3821	70	4484	8625	322856	258075	
22/09/2020	4724	57	3682	8682	327580	261757	
23/09/2020	5055	72	3231	8754	332635	264988	
24/09/2020	4471	45	3773	8799	337106	268761	
25/09/2020	4593	68	4505	8867	341699	273266	
26/09/2020	4270	68	3652	8935	345969	276918	
27/09/2020	3481	55	3755	8990	349450	280679	
28/09/2020	4116	62	4111	9052	353566	284784	
29/09/2020	4724	70	4028	9122	358290	288812	
30/09/2020	4691	59	3385	9181	362981	292197	
01/10/2020	4493	50	3685	9231	367474	295882	
02/10/2020	4785	67	3922	9298	372259	299804	
03/10/2020	3672	49	3861	9347	375931	303665	
04/10/2020	3210	52	3817	9399	379141	307482	
05/10/2020	3808	65	4676	9464	382949	312158	
06/10/2020	4172	67	4213	9531	387121	316371	
07/10/2020	3923	73	3413	9604	391044	319784	
08/10/2020	3522	79	4031	9683	394566	323815	
09/10/2020	3214	52	4282	9735	397780	328097	
10/10/2020	2344	55	4233	9790	400124	332330	
11/10/2020	2206	62	3827	9852	402330	336157	
12/10/2020	3107	60	3893	9912	405437	340050	
13/10/2020	3921	58	4158	9970	409358	344208	
14/10/2020	3857	51	3188	10021	413215	347396	
15/10/2020	3587	65	3356	10086	416802	350752	
16/10/2020	3501	56	3210	10142	420303	353962	
17/10/2020	3221	56	3329	10198	423524	357291	
18/10/2020	3110	56	3186	10254	426634	360477	
19/10/2020	4044	63	3055	10317	430678	363532	
20/10/2020	3920	49	2602	10366	434598	366134	
21/10/2020	3667	52	2876	10418	438265	369010	
22/10/2020	3899	47	2816	10465	442164	371826	
23/10/2020	3785	48	3362	10513	445949	375188	

24/10/2020	3204	55	3021	10568	449153	378209	
25/10/2020	2554	55	3140	10623	451707	381349	
26/10/2020	3691	48	3244	10671	455398	384593	
27/10/2020	4510	53	3488	10724	459908	388081	
28/10/2020	4043	46	2929	10770	463951	391010	
29/10/2020	3804	45	3376	10815	467755	394386	
30/10/2020	2878	47	2855	10862	470633	397241	
31/10/2020	1997	48	2414	10910	472630	399655	
01/11/2020	2658	56	3127	10966	475288	402782	
02/11/2020	3413	51	2995	11017	478701	405777	
03/11/2020	3595	51	2979	11068	482296	408756	
04/11/2020	3574	60	8479	11128	485870	417235	
05/11/2020	3701	47	603	11175	489571	420206	
06/11/2020	3568	69	3060	11244	493139	423266	
07/11/2020	2880	39	2660	11283	496019	425926	
08/11/2020	2530	44	3002	11327	498549	428928	
09/11/2020	3184	53	3305	11380	501733	432233	
10/11/2020	3577	52	2432	11432	505310	434665	
11/11/2020	3198	50	1992	11482	508508	436657	
12/11/2020	3298	50	2571	11532	511806	439228	
13/11/2020	2690	48	2628	11580	514496	441856	
14/11/2020	2419	43	2370	11623	516915	444226	
15/11/2020	2237	47	2813	11670	519152	447039	
16/11/2020	2390	42	2526	11712	521542	449565	
17/11/2020	2961	40	3460	11752	524503	453025	
18/11/2020	2349	43	2151	11795	526852	455176	
19/11/2020	2374	39	2314	11834	529226	457490	
20/11/2020	2543	49	2904	11883	531769	460394	
21/11/2020	1786	42	2646	11925	533555	463040	55944