IGHS COVID-19 Series - Italy & Iran: Lessons from the front edge of the pandemic

IRAN

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Topics

- Iran in transition
- COVID-19 in the Middle East
- Early track of COVID-19 in Iran
- Current pattern
  - Cases / Deaths
  - Testing and Hospitalization
- Response teams
  - National committee
  - Campaigns
- Non-pharmaceutical interventions in Iran
- Forecast trend and future waves
- Conclusion

Iran overview

USA: 59,957.72$ (2017) (rank 9)

- GDP per capita: 5,627.75$ (2017) (rank 95).

- Population = 83m (rank 18)

- Population density = 134 people per mi^2 (rank 158)

- Population in cities of more than 1 million = 26%

- Literacy rate= 86% (68% in College/University)

- Physician per 1,000 population = 1.6

- Insurance coverage = 97% basic insurance since 2015
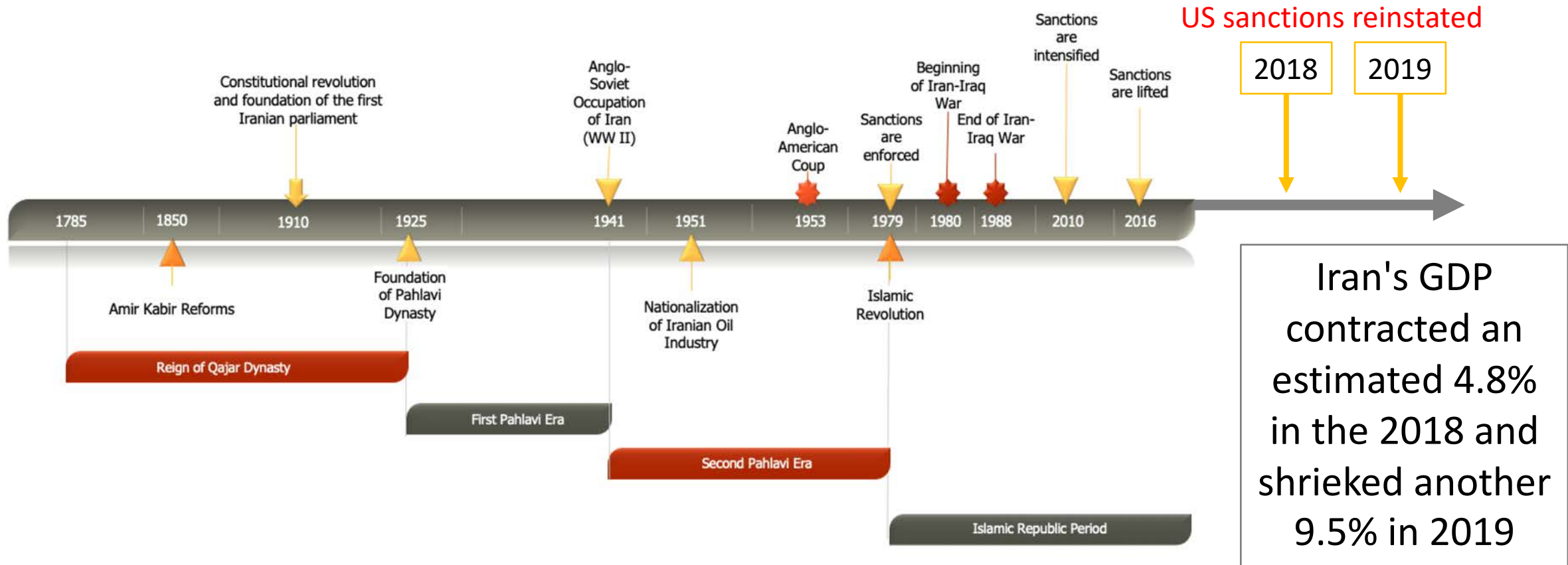
- Life expectancy = 76.3 years (2017)

Age - Cumm %

https://tradingeconomics.com/iran/population-density-people-per-sq-km-wb-data.html
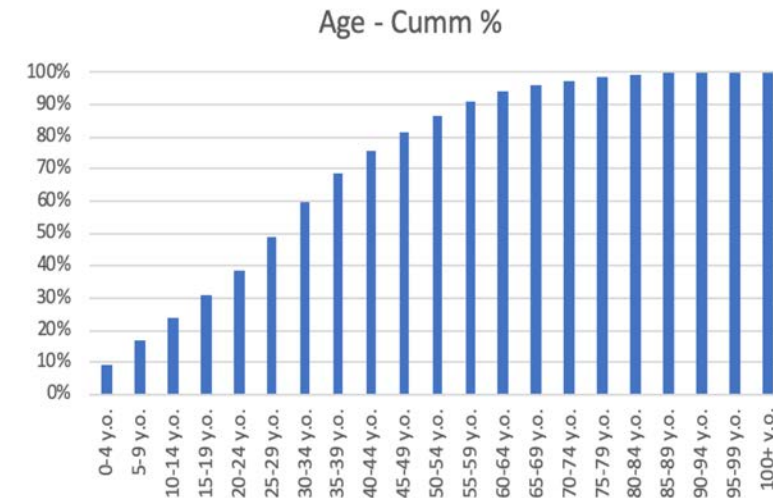
Source:
Statistical Centre of Iran, Population projected to 2019

Iran in Transition
## Historical timeline of contemporary Iran

US sanctions reinstated

Iran's GDP contracted an estimated 4.8% in the 2018 and shrieked another 9.5% in 2019

Danaei, Goodarz et al. **Iran in transition** The Lancet 2019. 393(10184): 1984 - 2005

Iran in Transition
Health and Infections

Development of **modern medical education system** in Iran
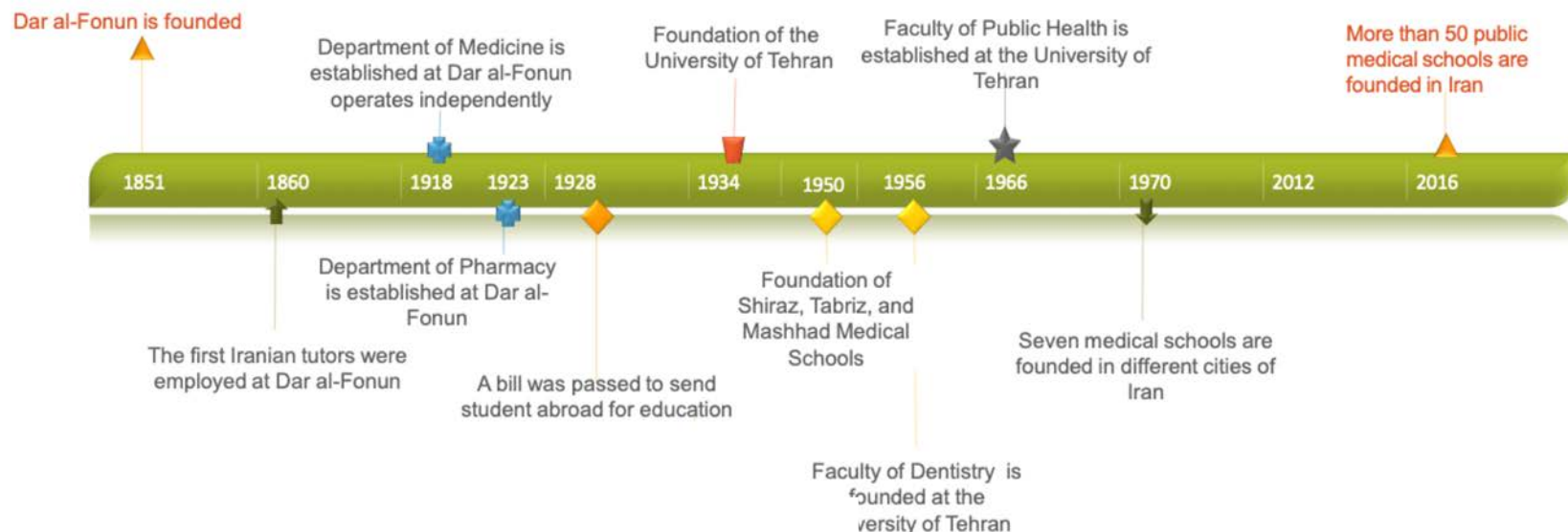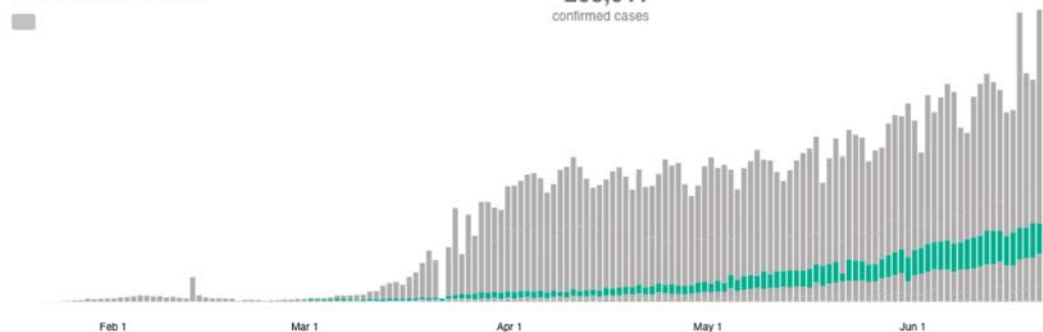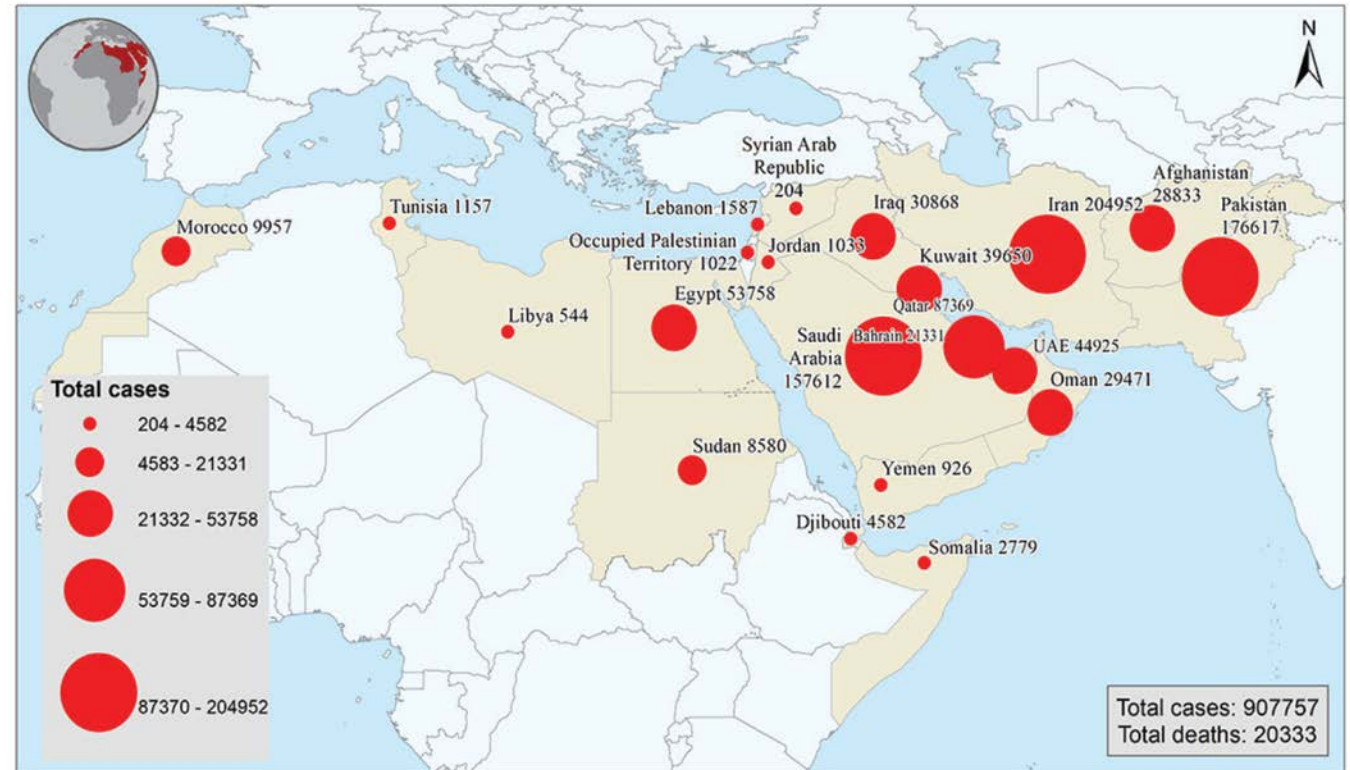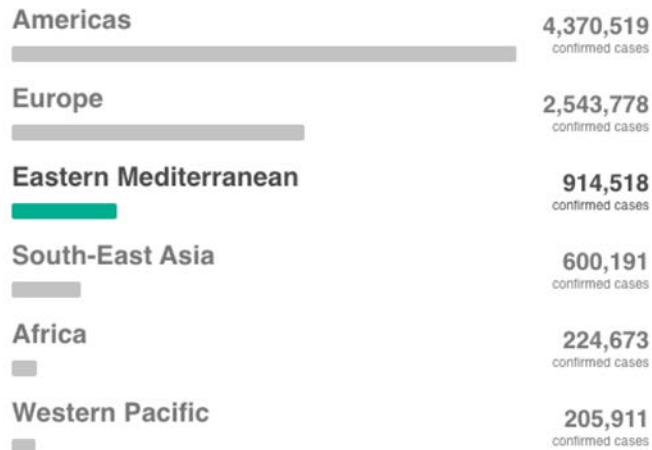
Infectious Diseases in Iran

Danaei, Goodarz et al. **Iran in transition** The Lancet 2019. 393(10184): 1984 - 2005
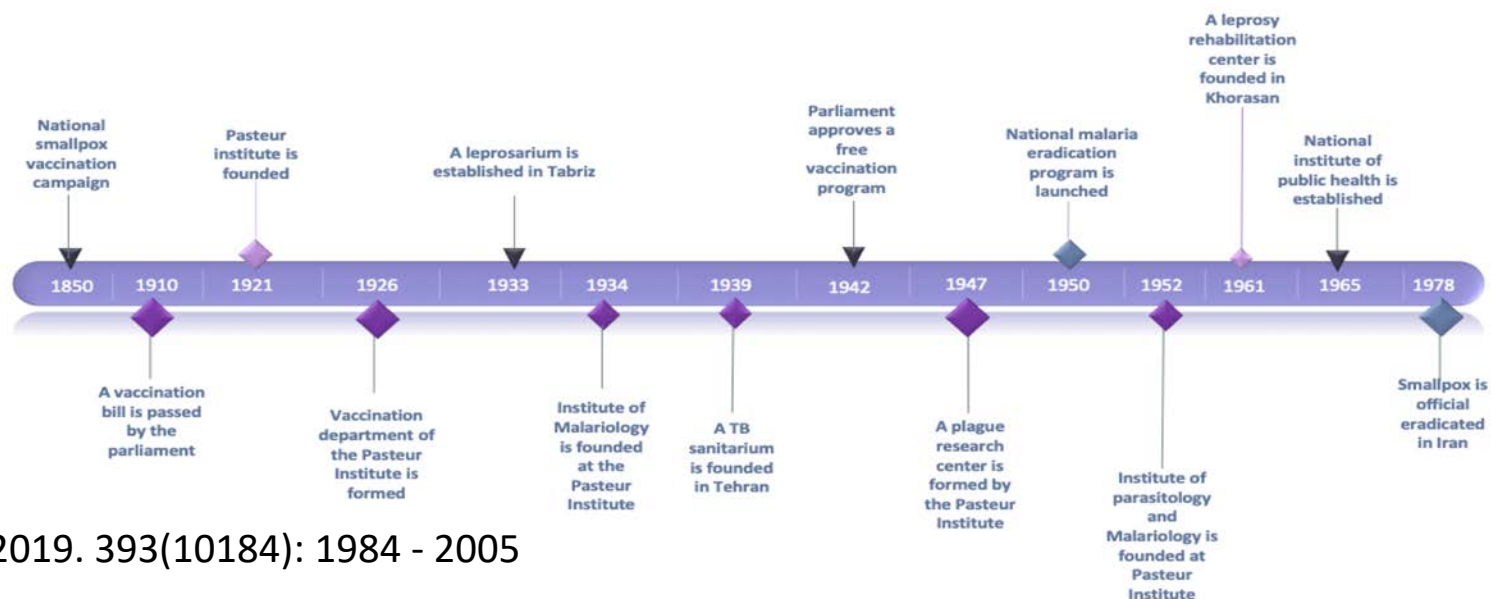
COVID-19 in the Middle East
as of 21 June 2020

Country	Cumulative Cases	Cumulative Deaths	Country	Cumulative Cases	Cumulative Deaths
Afghanistan	28,833	581	Palestine	1,022	5
Bahrain	21,331	61	Oman	29,471	131
Djibouti	4,582	45	Pakistan	176,617	3,501
Egypt	53,758	2,106	Qatar	87,369	98
Iran	204,952	9,623	Saudi Arabia	157,612	1,267
Iraq	30,868	1,100	Somalia	2,779	90
Jordan	1,033	9	Sudan	8,580	521
Kuwait	39,650	326	Syria	204	7
Lebanon	1,587	32	Tunisia	1,157	50
Libya	544	10	UAE	44,925	302
Morocco	9,957	213	Yemen	926	255
Total				**907,757**	**20,333**

Case Comparison
WHO Regions

Americas — 4,370,519 confirmed cases
Europe — 2,543,778 confirmed cases
Eastern Mediterranean — 914,518 confirmed cases
South-East Asia — 600,191 confirmed cases
Africa — 224,673 confirmed cases
Western Pacific — 205,911 confirmed cases

WHO Coronavirus Disease (COVID-19) Dashboard
Data last updated: 2020/6/22, 3:50pm CEST

Total cases
204 – 4582
4583 – 21331
21332 – 53758
53759 – 87369
87370 – 204952

Total cases: 907757
Total deaths: 20333

Data source: World Health Organization
Map production: Health Emergency Information and Risk Assessment (HIM) Unit
World Health Organization

World Health Organization
REGIONAL OFFICE FOR THE Eastern Mediterranean

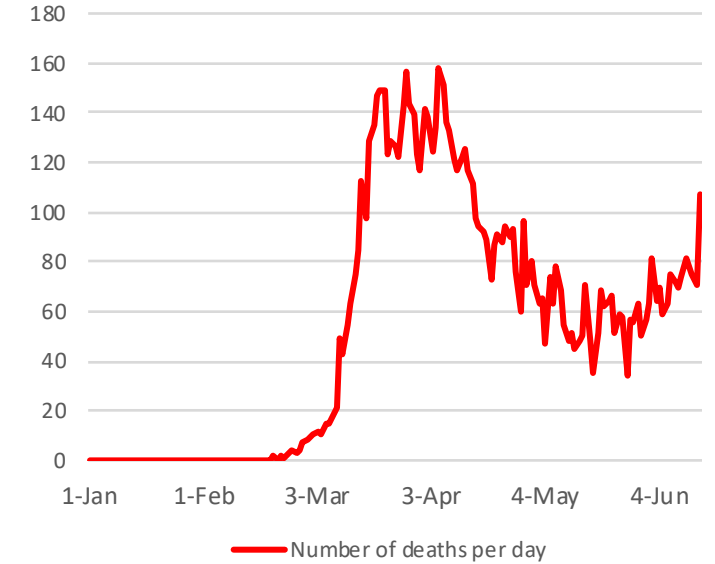# COVID-19 Cases/Deaths

- Iran (till June 14)

Overall deaths = 8,837/186,476 = **4.74%**

Source: Iran MOH

Number of reported cases per day
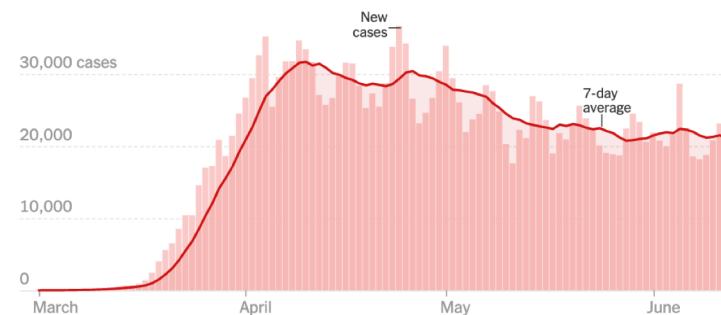
Number of deaths per day
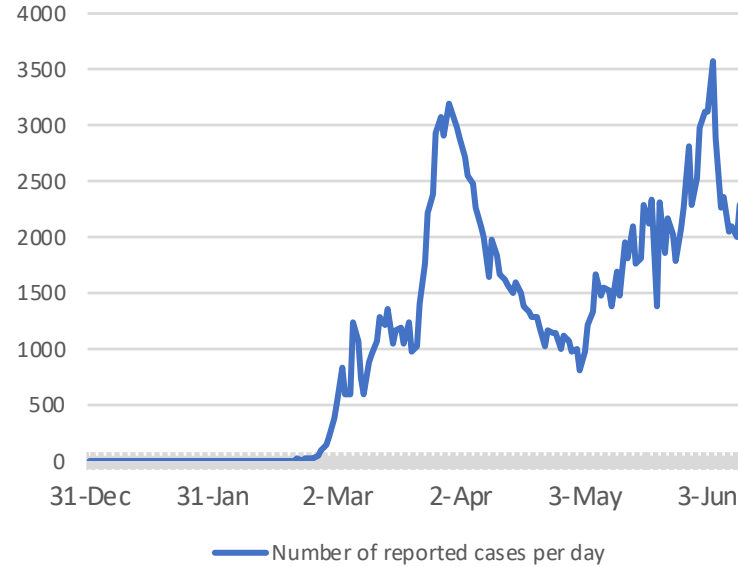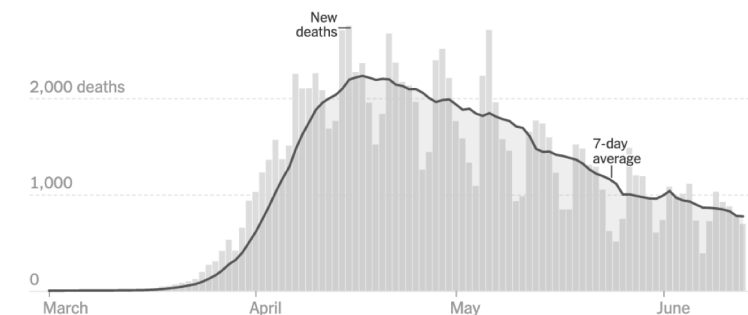
- United States (till June 14)

Overall deaths = 115,271/2,063,812 = **5.58%**

Source: US CDC

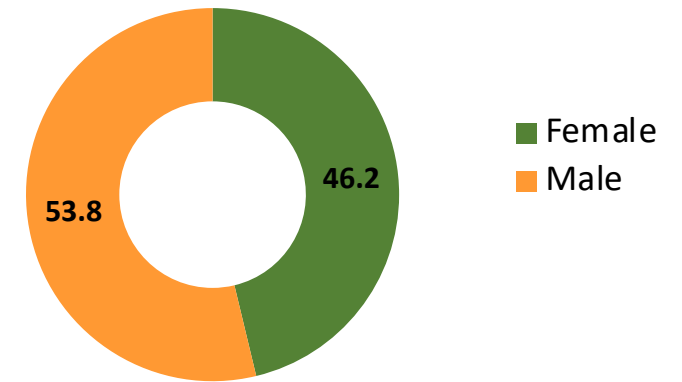New reported cases by day in the United States
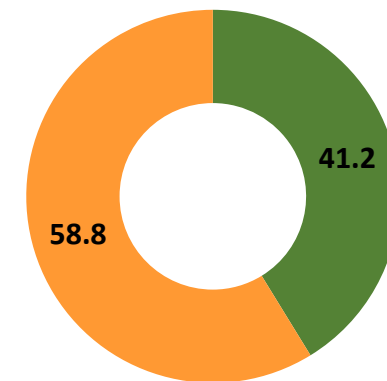
New reported deaths by day in the United States

By The New York Times   Updated June 14, 2020, 10:37 A.M. E.T.

Age & Sex distribution of COVID-19 cases admitted to hospitals, Iran

SIB system / June 15, 2020
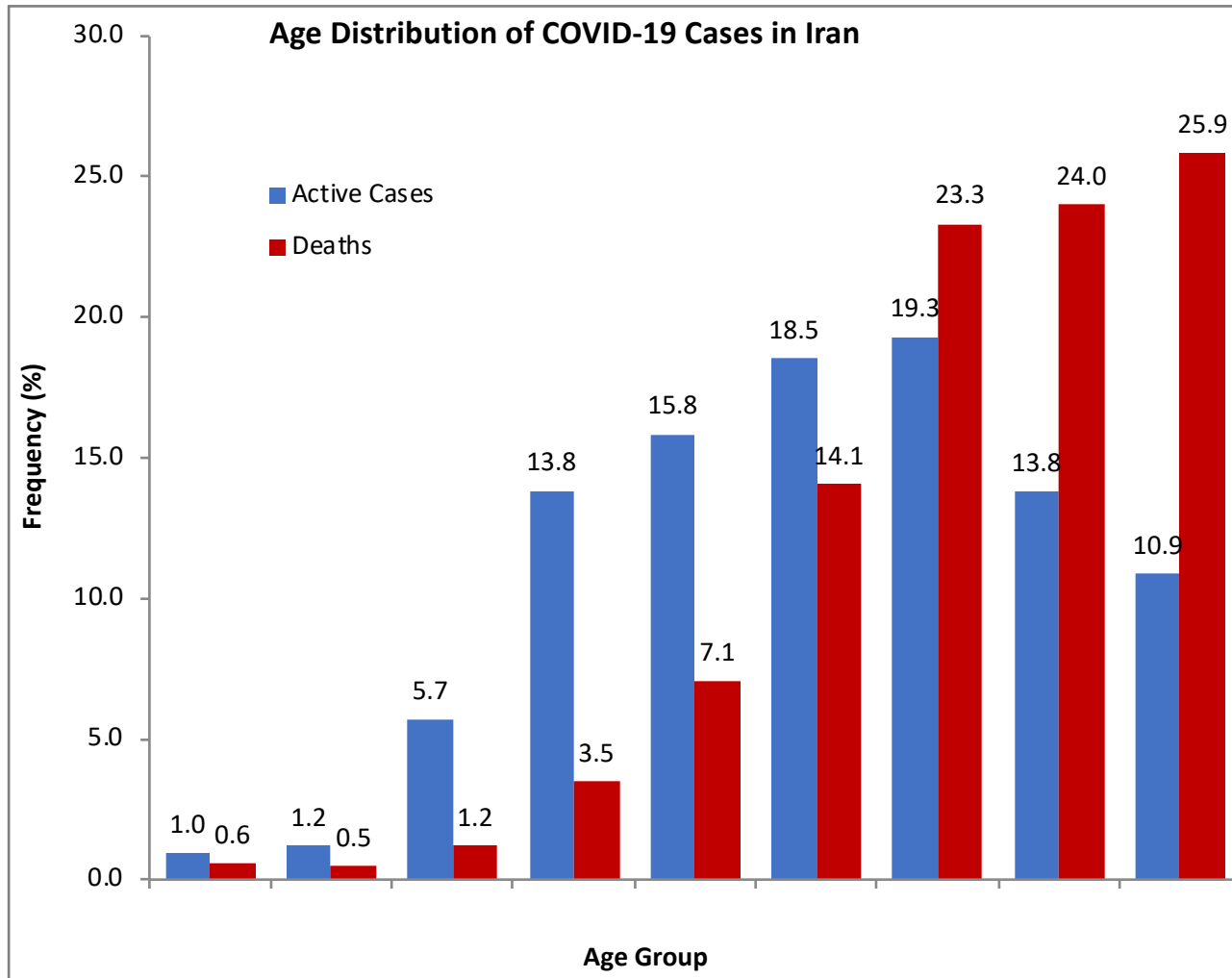
Laboratory Testing

- Expanding the network in all provinces of the country
  - More than 150 Labs
  - Testing capacity: 20,000 tests daily (Can increase to more than 2 folds)
- Training of network laboratories by Pasteur Institute of Iran
- Designing a diagnostic algorithm appropriate to the country's conditions
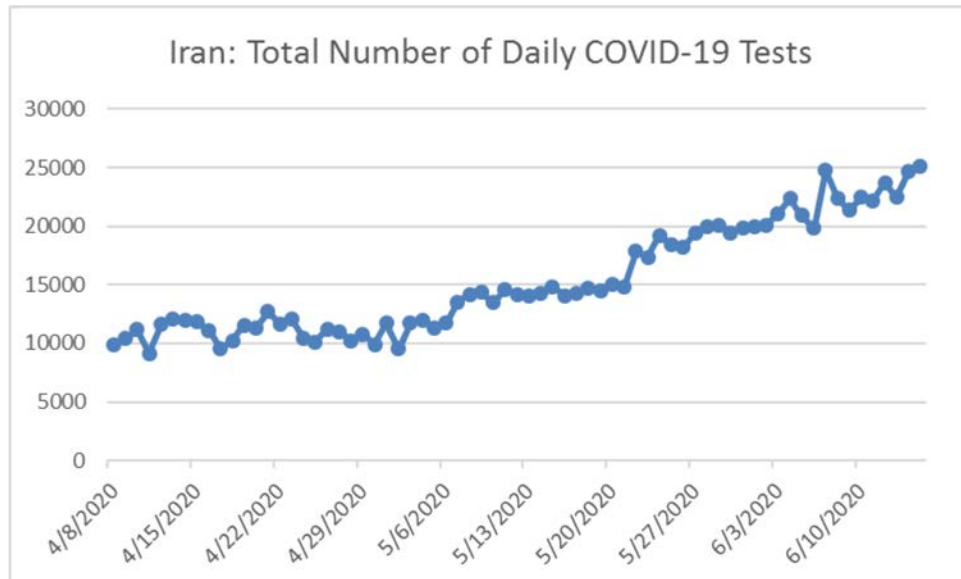
Total Positive: 195,000
Total Test: 1,320,000

Positivity rate: 15%

Iran: Total Number of Daily COVID-19 Tests

Priority for testing:

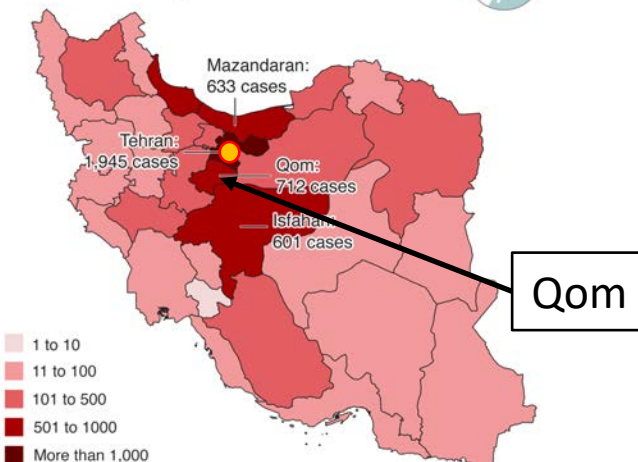- *PRIORITY 1:* Ensures optimal care options for all hospitalized patients, and lessen the risk of healthcare-associated infections
- *PRIORITY 2:* Ensures those at highest risk of complication of infection are rapidly identified and appropriately triaged
- *PRIORITY 3:* Ensures to rapidly identify the cases with mild symptoms and close contacts of the confirmed cases
- *NON-PRIORITY:* Individuals without symptoms

June 22, 2020

Iran - Patient ZERO

- Feb. 19: two cases in Qom, both reported death

- Feb. 20: two more cases in Qom, one in Arak

- Link to Wuhan's epidemic
  - Commercial Shoe Expedition
  - Several active Chinese construction companies
  - Iranian students in Wuhan Univ.
  - Religious leaders visited Wuhan in January
  - Several airlines with daily flights between China and Iran

Confirmed cases of coronavirus in Iran

Deaths: 237 reported   Cases: 7,161 reported

Mazandaran: 633 cases

Tehran: 1,945 cases

Qom: 712 cases

Isfahan: 601 cases

Qom

1 to 10
11 to 100
101 to 500
501 to 1000
More than 1,000

Source: IRNA, 9 Mar

BBC

National Committee on COVID-19 Epidemiology

- 46 (~daily) reports on COVID-19
- Daily Updates – Media Briefing

وزارت بهداشت، درمان وآموزش پزشکی
کمیته اپیدمیولوژی کووید ۱۹

تحقی | گزارش برگ‌ها | راهنماها | شواهد علمی | ارکان کمیته | صفحه اصلی

جستجوی مطالب پایگاه

کمیته اپیدمیولوژی کووید ۱۹ » گزارش برگ‌ها

گزارش برگ‌ها

- گزارش برگ نسخه ۲۴ خرداد ۹۹ (نسخه فارسی)(English Version)
- گزارش برگ نسخه ۱۷ خرداد ۹۹ (نسخه فارسی)(English Version)
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- گزارش برگ نسخه ۹ اردیبهشت ۹۹ (نسخه فارسی) (English Version)

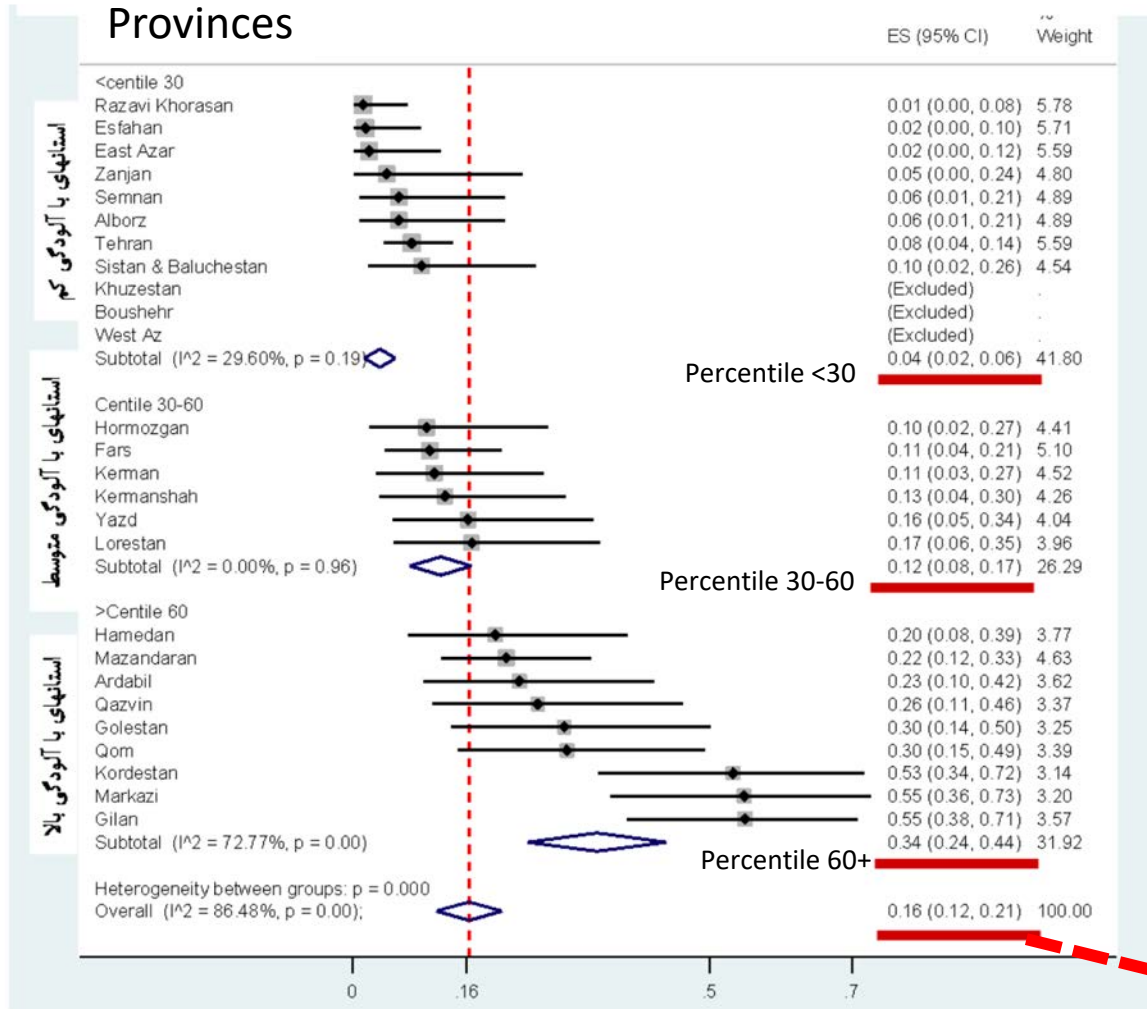http://corona.behdasht.gov.ir/

Public / NGOs Campaign

Food Package Support

Public / NGOs Campaign

Making Face Masks

Seroprevalence studies

% IgM or IgG Positive, among Blood Donors 15 May, 2020

National Average: 16%

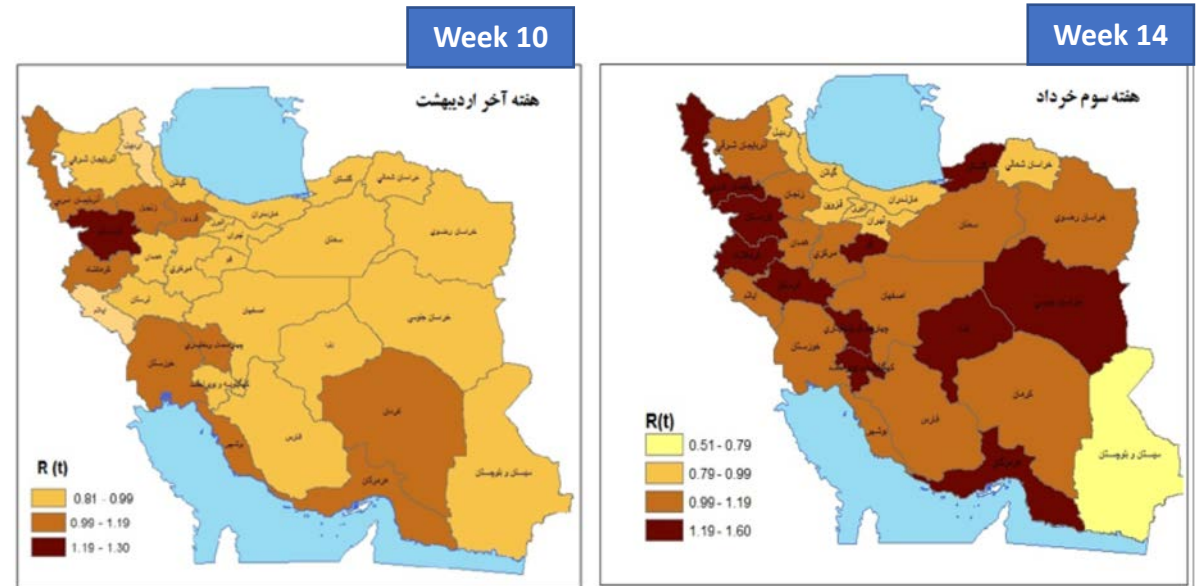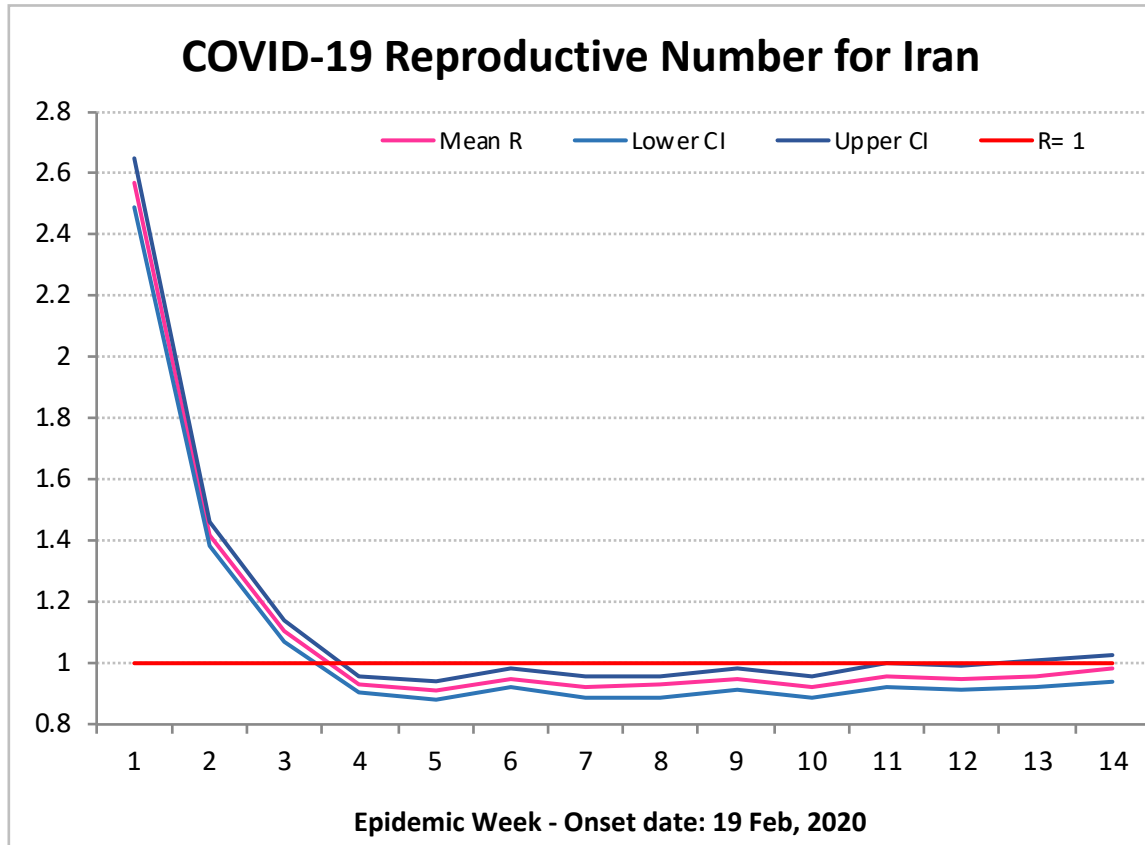## % IgM Positive among those tested positive for COVID-19 in Tehran - 15 May, 2020
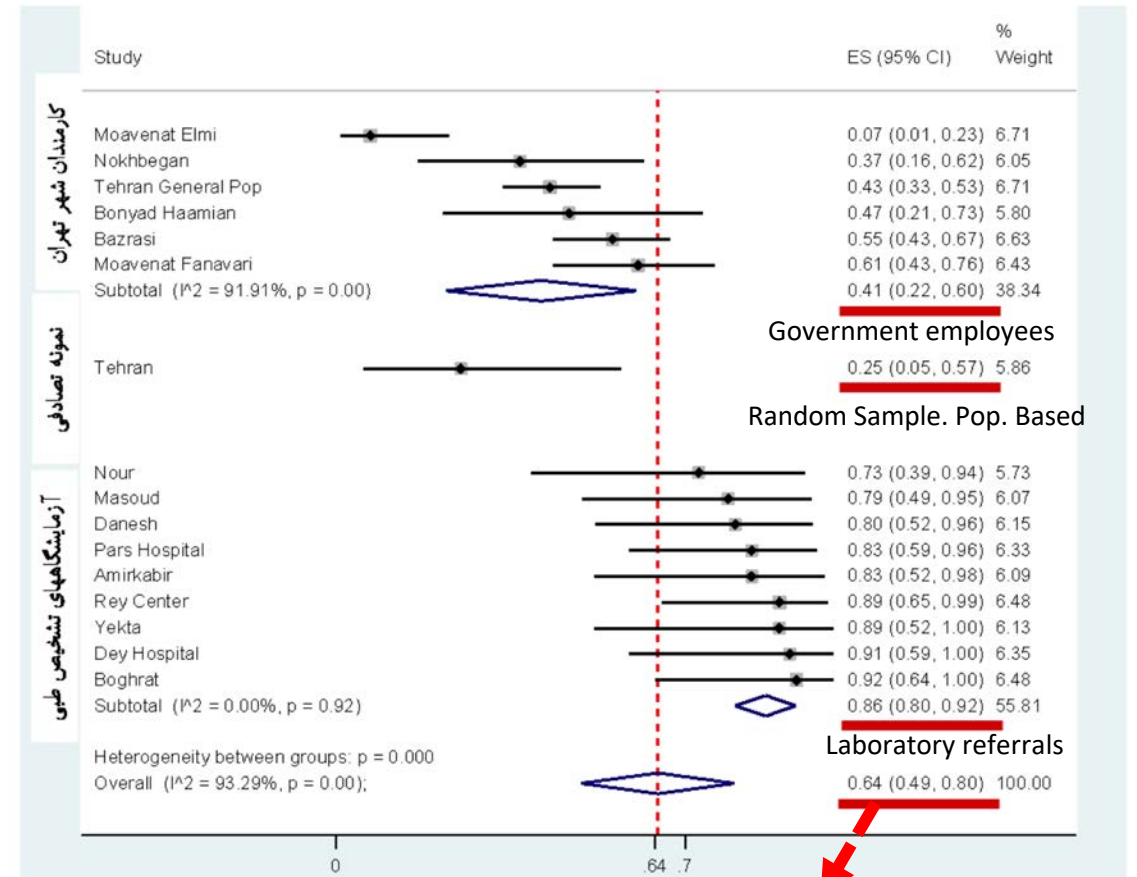
64% recent infection

Current Epicenters of COVID-19 in Iran

Reproductive number at time t in different provinces, Iran
Week 10 vs. week 14

COVID-19 Reproductive Number for Iran

Mean R — Lower CI — Upper CI — R= 1

Epidemic Week - Onset date: 19 Feb, 2020

Week 10

Week 14

هفته آخر اردیبهشت

هفته سوم خرداد

R (t)
- 0.81 - 0.99
- 0.99 - 1.19
- 1.19 - 1.30

R(t)
- 0.51 - 0.79
- 0.79 - 0.99
- 0.99 - 1.19
- 1.19 - 1.60

COVID-19 Epicenters   Both cases and deaths have increased in the past 3 days

Incidence category	Province	Analysis of recent epidemic curve by province (a province can experience one or more epidemic waves)
	Iran	The slight upward changes is seen.
High Incidence	Khuzestan	The province seems to be crossing a peak.
	Hormozgan	The trend is upward.
	Kermanshah	The slight upward changes is seen.
	Kurdistan	The province seems to be crossing a peak.
	Zanjan	The trend is upward.
	Lorestan	The trend is upward.
	East Azarbaijan	The province seems to be crossing a peak.
	West Azarbaijan	The province seems to be crossing a peak.
	Bushehr	The province seems to be crossing a peak.
	Ardabil	The data is controversial.

June 20, 2020   Situation Report on Coronavirus disease (COVID-19) in Iran

National Committee on COVID-19 Epidemiology and Iranian CDC - Ministry of Health and Medical Education, IR Iran
No. 46   Title: Analysis of epidemic trend by provinces of Iran (till June 19)

# Key Interventions Timeline in Iran for COVID-19

Closed

Suspending mass gathering for weekend religious events
Suspending conferences and social mass gatherings
Travel restrictions

Focus on community awareness and behaviors change
Est. national COVID-19 management committee

Ban on flights to Wuhan, China
Control of passenger importation from China

Suspending mass gathering for religious events
Restrictions on between-city travels
Scale-up of physical distancing (Phase 2)
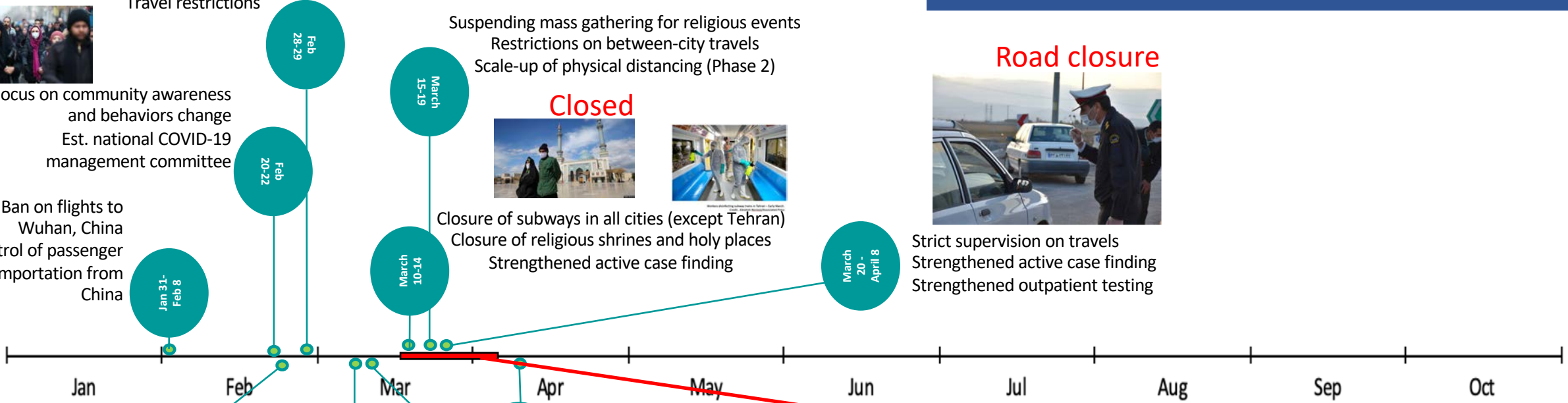
Closed

Closure of subways in all cities (except Tehran)
Closure of religious shrines and holy places
Strengthened active case finding

Road closure

Strict supervision on travels
Strengthened active case finding
Strengthened outpatient testing

Timeline markers: Jan 31- Feb 8 | Feb 20-22 | Feb 23-24 | Feb 28-29 | March 1-4 | March 5-10 | March 10-14 | March 15-19 | March 20 - April 8 | April 9

Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct

Holding the competitions without watchers
Closure of cinemas, theaters and concerts
Closure of schools and universities

Closed

Cancelling sport competitions
Closure of some business units in epicenters
Closure of parks and promenades

Closed

Closure of historical & tourism sites in Shiraz & Isfahan
Strict limitations on new-year travels

Start of the Stepwise relaxation of lockdowns
Smart social distancing & cancellation of between-city travels
Strengthened early case finding and isolation

Testing

Nowruz Lockdown

The streets of Tehran are mostly deserted as panicky residents stick to their homes for fear of COVID-19. Credit...Arash Khamooshi for The New York Times

Forecast COVID-19 trend and future waves in Iran

- **With no vaccine**, non-pharmaceutical interventions (NPI) play a key role in mitigating the pandemic.
- In **Iran**, the daily number of cases declined for a few weeks in April, but now we see a second wave of the epidemic.
- **Study aim:** model COVID-19 infections and deaths under the current NPI and two counterfactual scenarios.

CoMo model

- Age structured SEIR model

- Infected compartments stratified by symptoms, severity, treatment seeking and access
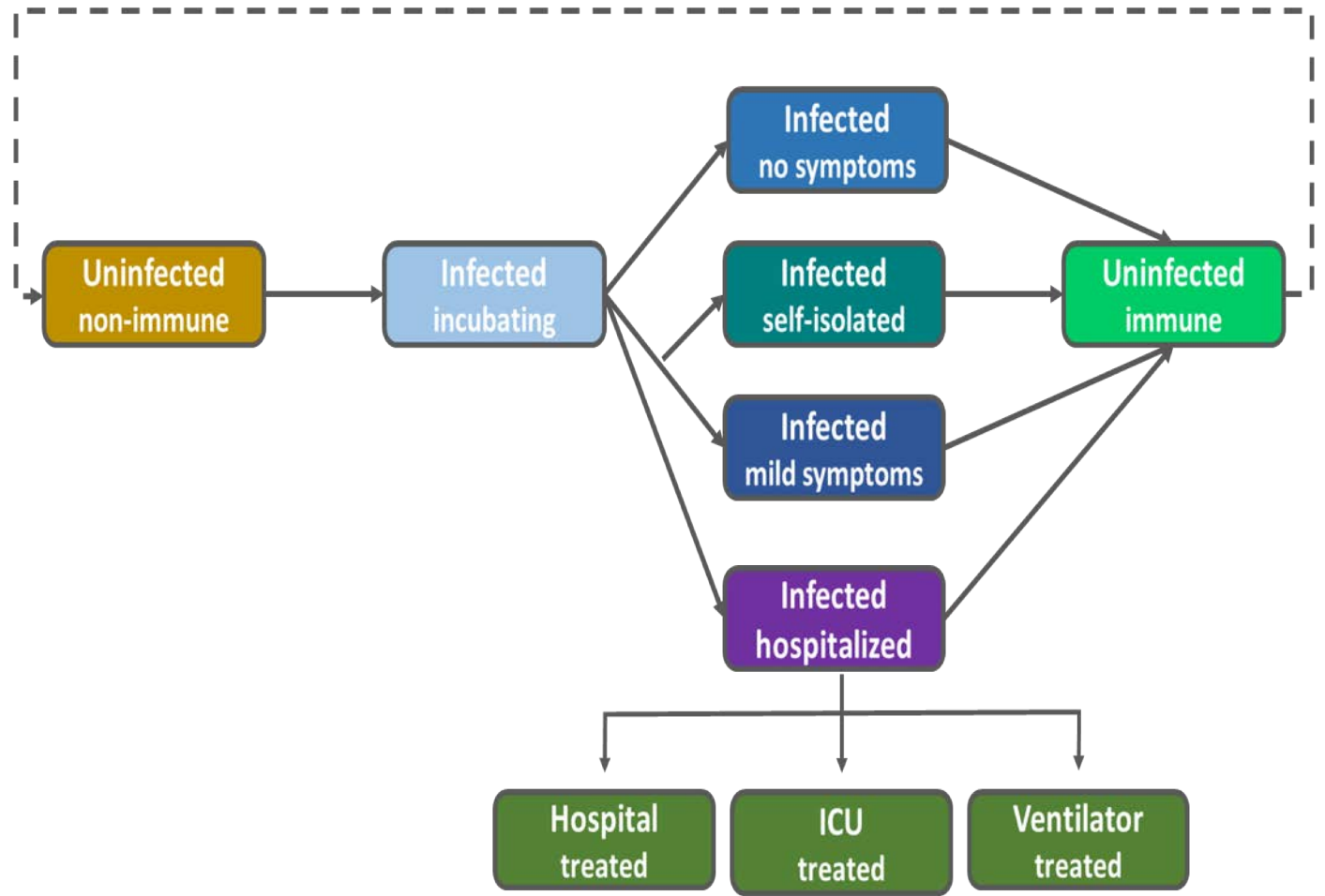
Source: CoMo Consortium

Model Inputs / Parameters

Iran - contact rates matrix (all locations = home + work + school + other)
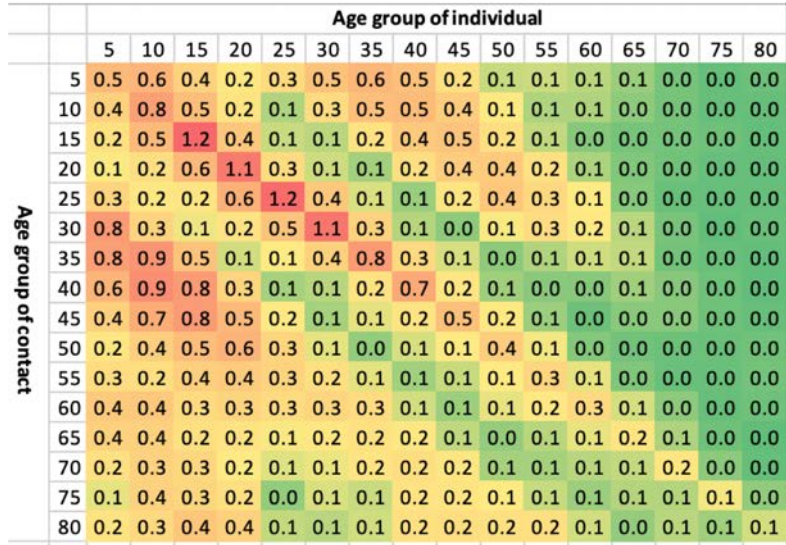Contact rate = the number of other people that a person encounters per day

							Age group of individual									
		5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
Age group of contact	5	2.13	1.15	0.62	0.40	0.74	1.22	1.33	1.02	0.54	0.29	0.31	0.24	0.14	0.09	0.05	0.04
	10	0.98	7.76	1.49	0.47	0.35	0.87	1.15	1.10	0.83	0.34	0.21	0.18	0.13	0.08	0.04	0.03
	15	0.41	2.41	9.42	1.18	0.58	0.56	0.68	0.90	0.95	0.51	0.25	0.12	0.07	0.07	0.05	0.04
	20	0.25	0.62	3.88	13.57	2.14	1.08	0.68	0.86	0.95	0.83	0.41	0.16	0.08	0.05	0.03	0.02
	25	0.54	0.44	0.57	4.25	7.10	2.91	1.47	0.96	0.82	1.00	0.63	0.34	0.11	0.05	0.05	0.04
	30	1.16	0.67	0.34	1.28	3.52	5.04	2.29	1.32	0.91	0.74	0.71	0.39	0.16	0.06	0.03	0.02
	35	1.08	1.52	1.07	0.64	1.33	2.23	2.86	1.62	1.00	0.62	0.52	0.38	0.19	0.07	0.04	0.03
	40	0.84	1.39	1.14	0.71	0.72	1.32	1.54	2.10	1.23	0.64	0.41	0.25	0.18	0.10	0.05	0.02
	45	0.51	0.94	1.15	1.19	0.79	0.93	1.13	1.16	1.53	0.75	0.46	0.17	0.13	0.08	0.05	0.02
	50	0.29	0.64	0.73	1.32	0.70	0.69	0.71	0.74	0.73	0.87	0.46	0.19	0.08	0.04	0.04	0.04
	55	0.33	0.63	0.83	1.03	0.84	0.96	0.70	0.57	0.67	0.67	0.69	0.35	0.12	0.05	0.03	0.04
	60	0.53	0.73	0.56	0.69	0.58	0.91	0.81	0.53	0.49	0.40	0.47	0.53	0.21	0.09	0.04	0.03
	65	0.43	0.45	0.30	0.39	0.33	0.49	0.52	0.50	0.34	0.24	0.23	0.27	0.30	0.13	0.05	0.02
	70	0.26	0.42	0.34	0.18	0.23	0.31	0.41	0.39	0.31	0.15	0.15	0.18	0.16	0.26	0.08	0.03
	75	0.13	0.38	0.35	0.32	0.13	0.24	0.21	0.34	0.34	0.25	0.19	0.14	0.17	0.16	0.21	0.09
	80	0.23	0.32	0.48	0.40	0.14	0.15	0.21	0.29	0.30	0.29	0.28	0.14	0.08	0.12	0.09	0.13

RED color intensities indicate more likely events

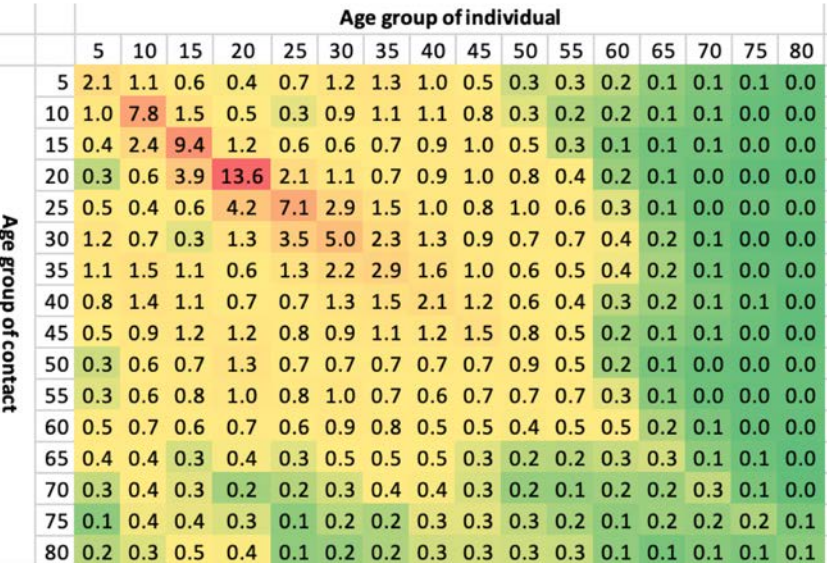Prem K et al PLOS Computational Biology 2017

Iran - contact rates matrix
home, school, work, other

Home
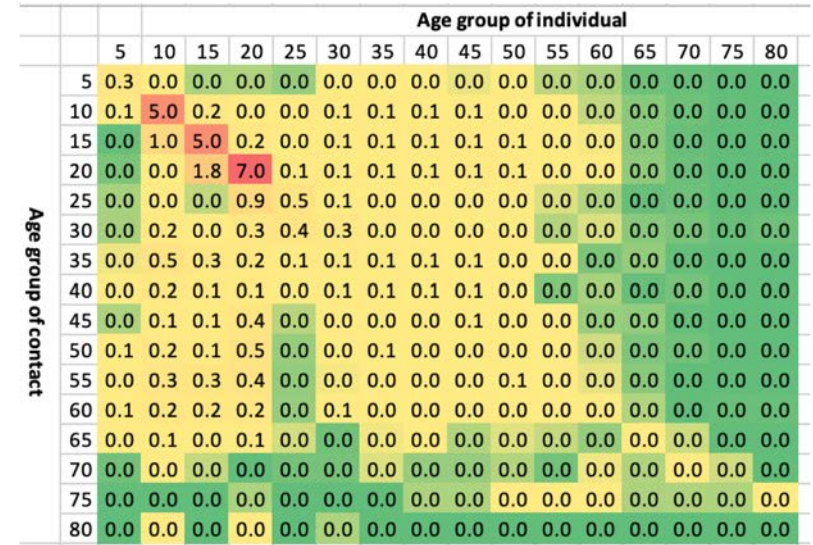
School

All locations

Work

Other

RED color intensities indicate more likely events
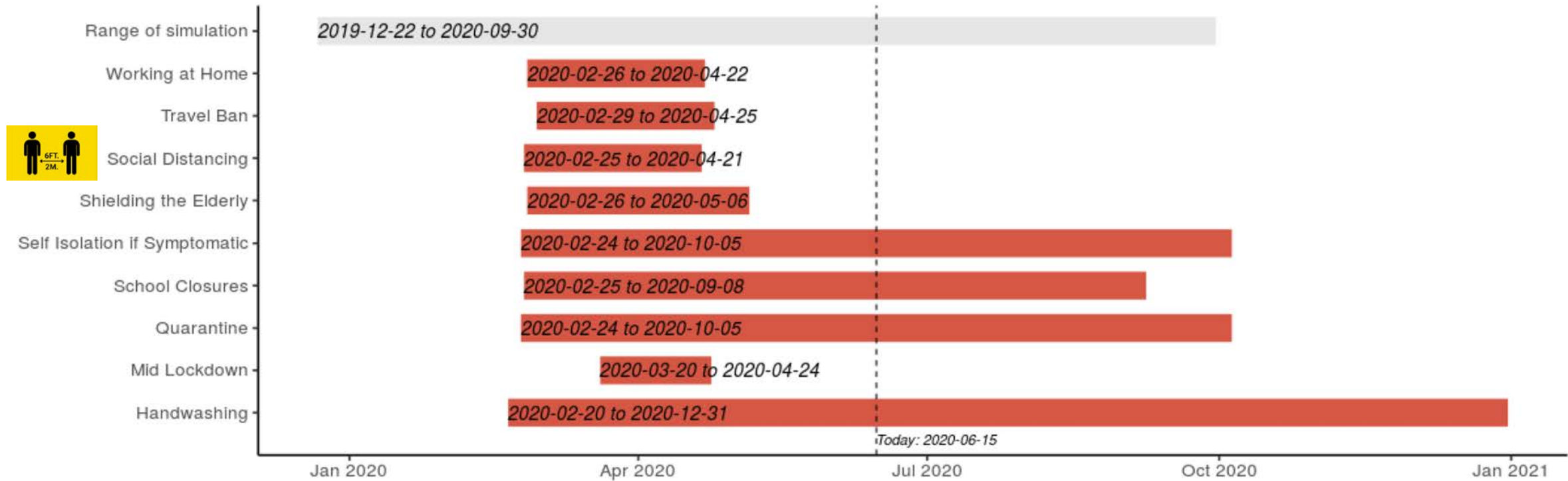
Prem K et al PLOS Computational Biology 2017
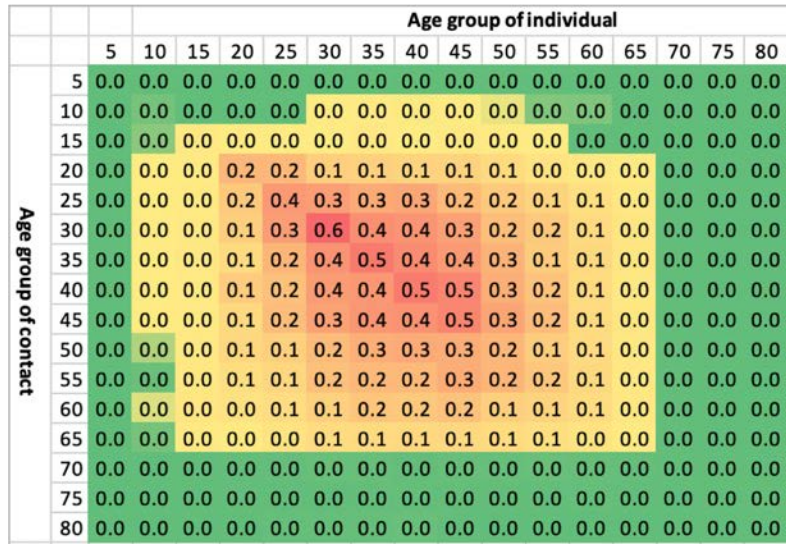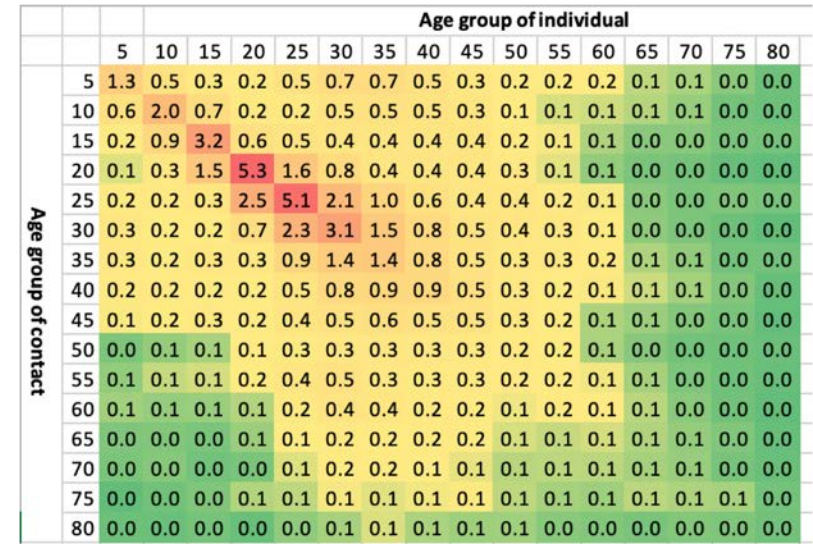
Model Parameters

Hospitalization Parameters	Unit	Value	Source
Maximum number of hospital beds	Beds	100,437	MOH.lr
Maximum number of ICU beds	Beds	5,790	MOH.lr
Maximum number of ventilators	Ventilators	4,650	MOH.lr
Probability of dying when hospitalized (oldest age class)	%	42	MOH.lr
Probability of dying when admitted to ICU (oldest age class)	%	60	MOH.lr
Probability of dying when ventilated (oldest age class)	%	86	MOH.lr
Duration of hospitalised infection	Days	4	MOH.lr
Duration of ICU infection	Days	5	MOH.lr
Duration of ventilated infection	Days	3	MOH.lr

Non-pharmaceutical interventions

Timeline

Range of simulation	2019-12-22 to 2020-09-30
Working at Home	2020-02-26 to 2020-04-22
Travel Ban	2020-02-29 to 2020-04-25
Social Distancing	2020-02-25 to 2020-04-21
Shielding the Elderly	2020-02-26 to 2020-05-06
Self Isolation if Symptomatic	2020-02-24 to 2020-10-05
School Closures	2020-02-25 to 2020-09-08
Quarantine	2020-02-24 to 2020-10-05
Mid Lockdown	2020-03-20 to 2020-04-24
Handwashing	2020-02-20 to 2020-12-31

Today: 2020-06-15

Jan 2020   Apr 2020   Jul 2020   Oct 2020   Jan 2021

Non-pharmaceutical interventions	Start date	Duration	Coverage	Adherence	Efficacy	Home contacts inflation	Out-home contacts deflation
Lockdown, Mid	3/20/20	5w					
Self-Isolation if Symptomatic	2/24/20	32w	90%	80%	---	---	---
Screening/Contact-Tracing (Overdisp.=2, Contacts = 4)	2/24/20	32w	75%	---	---	---	---
Social Distancing	2/25/20	8w	40%	50%	---	---	---
Handwashing	2/20/20	45w	---	---	5%	---	---
Working at Home	2/26/20	8w	60%	---	50%	10%	---
School Closures	2/25/20	28w	---	---	85%	20%	---
Shielding the Elderly (age = 60+)	2/26/20	10w	80%	---	82%	---	---
Travel Ban	2/29/20	8w	---	---	50%	---	---
Voluntary home quarantine (Avr. Days = 14, Days with Max Coverage = 2)	2/24/20	32w	50%	---	---	20%	60%

Persian New Year Effect

- Mid Lockdown
- 20 March (5 weeks)

New year preparation
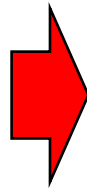
Road closure in Iran

Choose One Lockdown:

	Low	Medium	High
Self-isolation coverage	50	75	95
Social distancing coverage	25	75	95
Hand hygiene coverage	5	5	5
Work from home coverage	25	50	75
School closure efficacy	0	85	85
Cocoon coverage	90	90	90
Travel ban efficacy	0	0	95
Quarantine coverage	0	25	90

🔒 Mid Lockdown

Start Date:

2020-03-20

Duration of Lockdown:

5 weeks   52 weeks

Baseline Visual Fit

Counterfactual Scenarios

Interventions	Baseline	Scenario 1	Scenario 2
lockdown	Med. 20March-24April	X	X
Self-isolation if symptomatic	✓	✓	
Coverage	90%	90%	
Adherence	80%	80%	X
Duration of intervention	24Feb-5Oct	24Feb-5Oct	
Additional to self-isolation: Screening	✓	✓	
Coverage	75%	75%	X
Duration of intervention	24Feb-5Oct	24Feb-5Oct	
Social Distancing	✓	✓	
Coverage	50%	50%	
Adherence	50%	50%	X
Duration of intervention	25Feb-21April	25Feb-21April	
Handwashing	✓	✓	✓
Efficacy	5%	5%	5%
Duration of intervention	20Feb-31Dec	20Feb-31Dec	20Feb-31Dec
Working at home (Home C. infl. 10%)	✓		
Coverage	60%	X	X
Efficacy	50%		
Duration of intervention	26Feb-22April		
School Closure (Home C. infl. 20%)	✓		
Efficacy	85%	X	X
Duration of intervention	25Feb-8Sep		
Shielding the Elderly	✓	✓	
Coverage	80%	80%	
Efficacy	82%	82%	X
Duration of intervention	26Feb-6Jun	26Feb-6Jun	
Voluntary quarantine (Home C. infl. 20%, Other C. Dec. 60%)	✓	✓	
Coverage	50%	50%	
Days in isolation	14	14	X
Duration of intervention	24Feb-5Oct	24Feb-5Oct	
Travel Ban 50% (29Feb-25Apr)	✓	✓	X

Parameters for intervention scenarios included in the model

Baseline	Scenario 1	Scenario 2

55.2%
of the population infected during the range of simulation.

67.4% (12.2%)
of the population infected during the range of simulation.

87.6% (32.4%)
of the population infected during the range of simulation.

18,184
Covid-19 **attributable** deaths during the range of simulation.

19,415 (1,230)
Covid-19 **attributable** deaths during the range of simulation.

32,650 (14,465)
Covid-19 **attributable** deaths during the range of simulation.

18,208
Covid-19 **reported** deaths during the range of simulation.

19,445 (1,236)
Covid-19 **reported** deaths during the range of simulation.

32,705 (14,496)
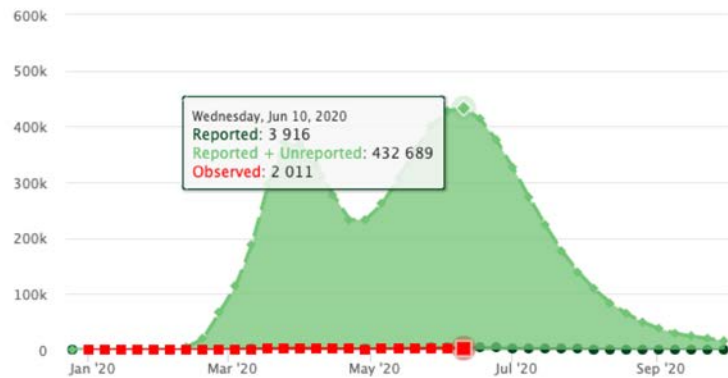Covid-19 **reported** deaths during the range of simulation.

⬤ 👁 Display all days

You can either display only one data point per week i.e. Wednesday (Default) or display all days in the plots/tab   ple (Slower).   le (Slower).
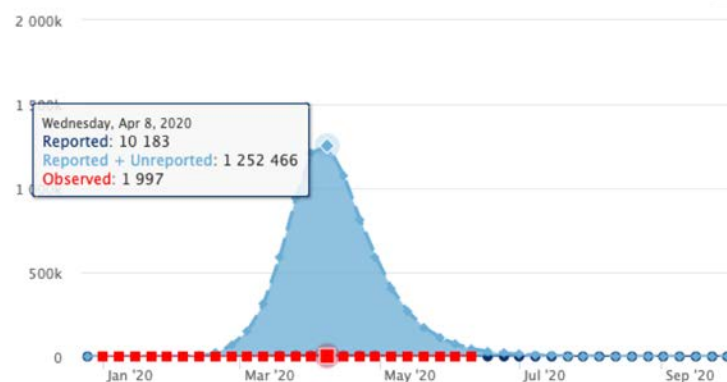Either way, we display daily data.

Focus on:
◯ Observed   ◯ Predicted Reported   ⬤ Predicted Reported + Unreported

Baseline Cases

Wednesday, Jun 10, 2020
Reported: 3 916
Reported + Unreported: 432 689
Observed: 2 011

Future Scenarios Cases

Wednesday, Apr 8, 2020
Reported: 10 183
Reported + Unreported: 1 252 466
Observed: 1 997

Future Scenarios Cases

Wednesday, Mar 25, 2020
Reported: 20 618
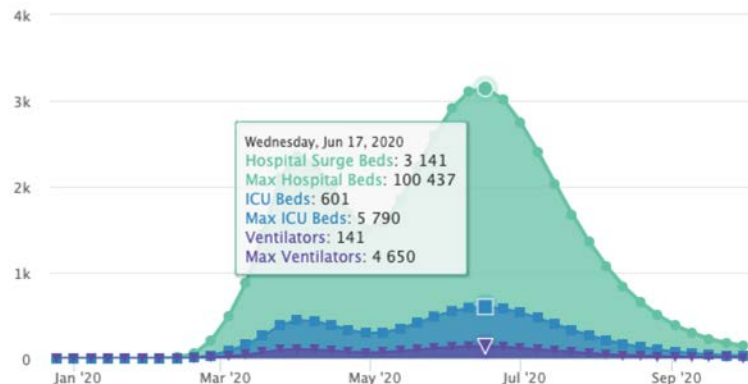Reported + Unreported: 2 575 352
Observed: 2 206
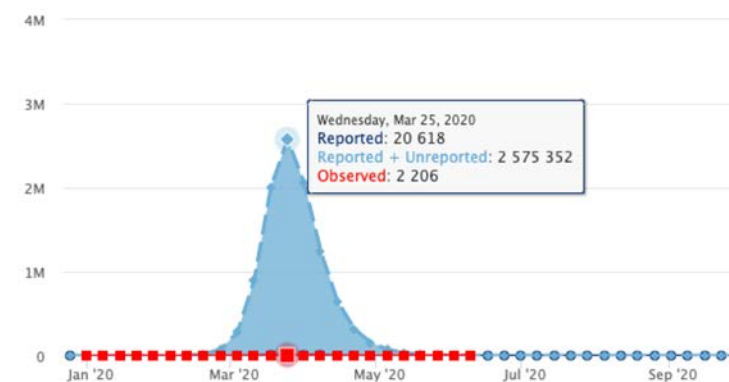
What if we had no "Lockdown", no "School closure" and no "Working at home"

What if we had no intervention but "handwashing"

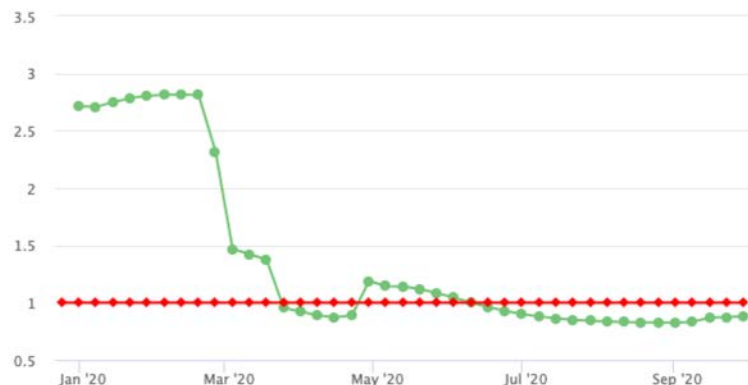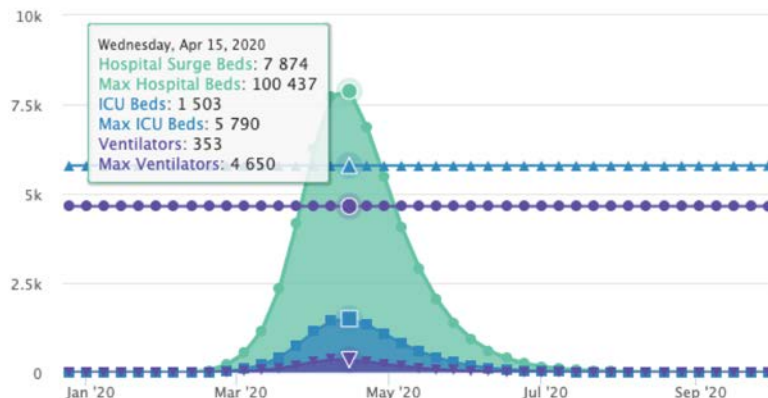| Baseline | Scenario 1 | Scenario 2 |

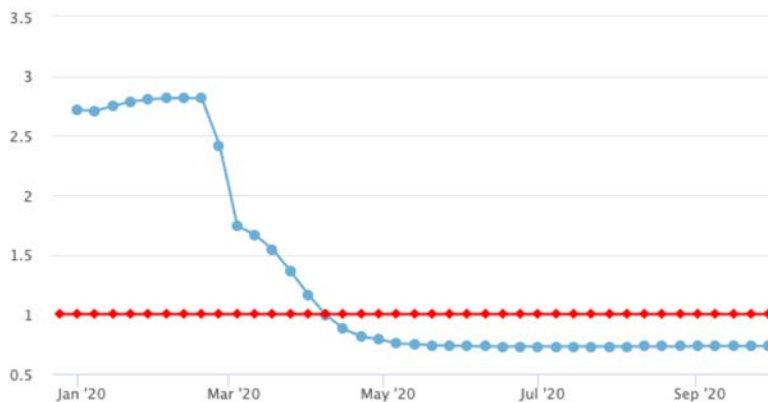○ No Focus ○ Hospital Beds ○ ICU Beds ○ Ventilators

Baseline Hospital Occupancy

Wednesday, Jun 17, 2020
Hospital Surge Beds: 3 141
Max Hospital Beds: 100 437
ICU Beds: 601
Max ICU Beds: 5 790
Ventilators: 141
Max Ventilators: 4 650

Future Scenarios Hospital Occupancy

Wednesday, Apr 15, 2020
Hospital Surge Beds: 7 874
Max Hospital Beds: 100 437
ICU Beds: 1 503
Max ICU Beds: 5 790
Ventilators: 353
Max Ventilators: 4 650

Future Scenarios Hospital Occupancy

Wednesday, Apr 1, 2020
Hospital Surge Beds: 17 821
Max Hospital Beds: 100 437
ICU Beds: 3 338
Max ICU Beds: 5 790
Ventilators: 810
Max Ventilators: 4 650

Baseline R_t

Future Scenarios R_t
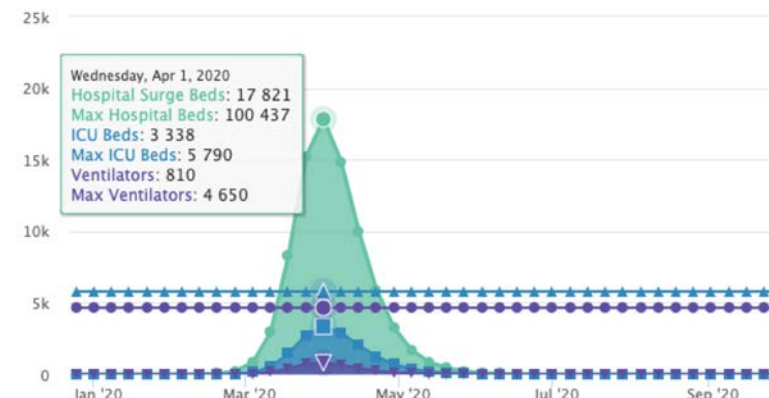
Future Scenarios R_t

Main results

	Baseline	What if we had no "Lockdown", no "School closure" and no "Working at home" Scenario 1	What if we had no intervention but "handwashing" Scenario 2	Averted (Baseline vs. S2)
% Pop. Infected	55.20%	67.40%	87.60%	
COVID-19 Deaths	18,185 (63% in 60+ years)	19,415	32,650	14,465
IFR (%)	0.04%	0.03%	0.04%	
Total Infections	45,816,000	55,942,000	72,708,000	26,892,000

The infection fatality rate of COVID-19 inferred from seroprevalence data (Preprint – 8 June 2020)
John P.A. Ioannidis
https://doi.org/10.1101/2020.05.13.20101253

Infection fatality rates (IFR):
- Overall: 0.02% to 0.86% (**Median 0.25%**)
- Among people <70 years old: 0.01% to 0.23% (**Median 0.04%**)

The effect of large-scale anti-contagion policies on the COVID-19 pandemic
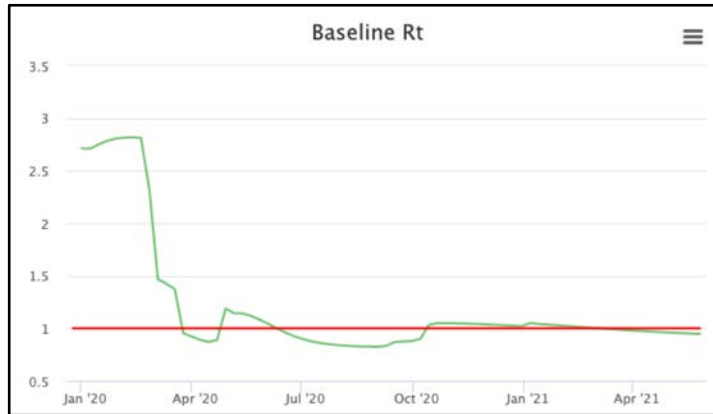
- Ongoing anti-contagion policies have already substantially reduced the number of COVID-19 infections observed in the world today. In Iran till 22 March, 2020:
  - **5 million** confirmed cases averted
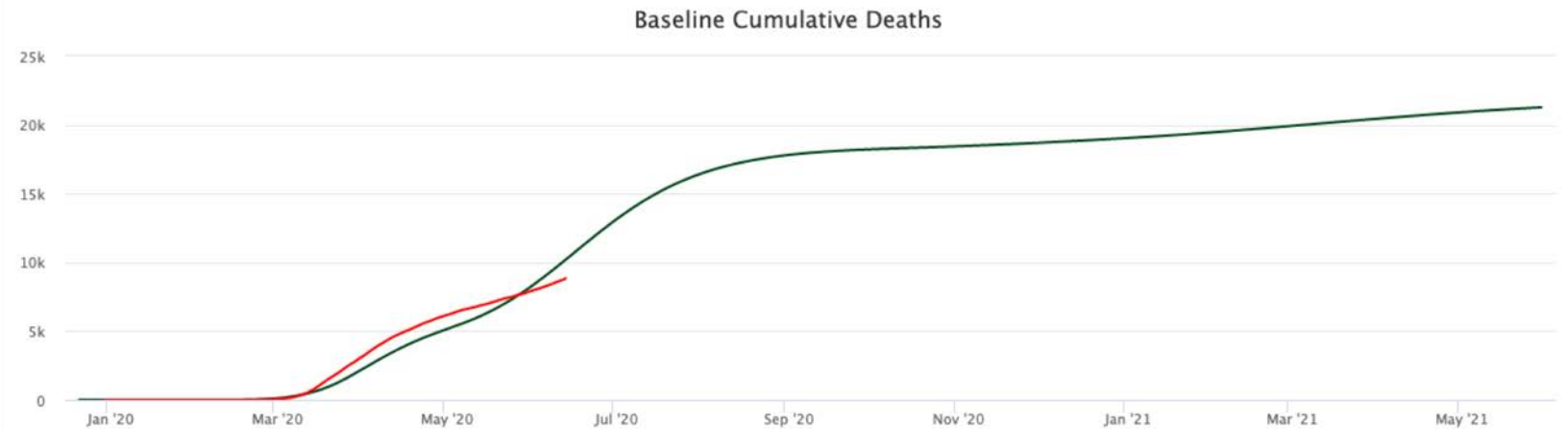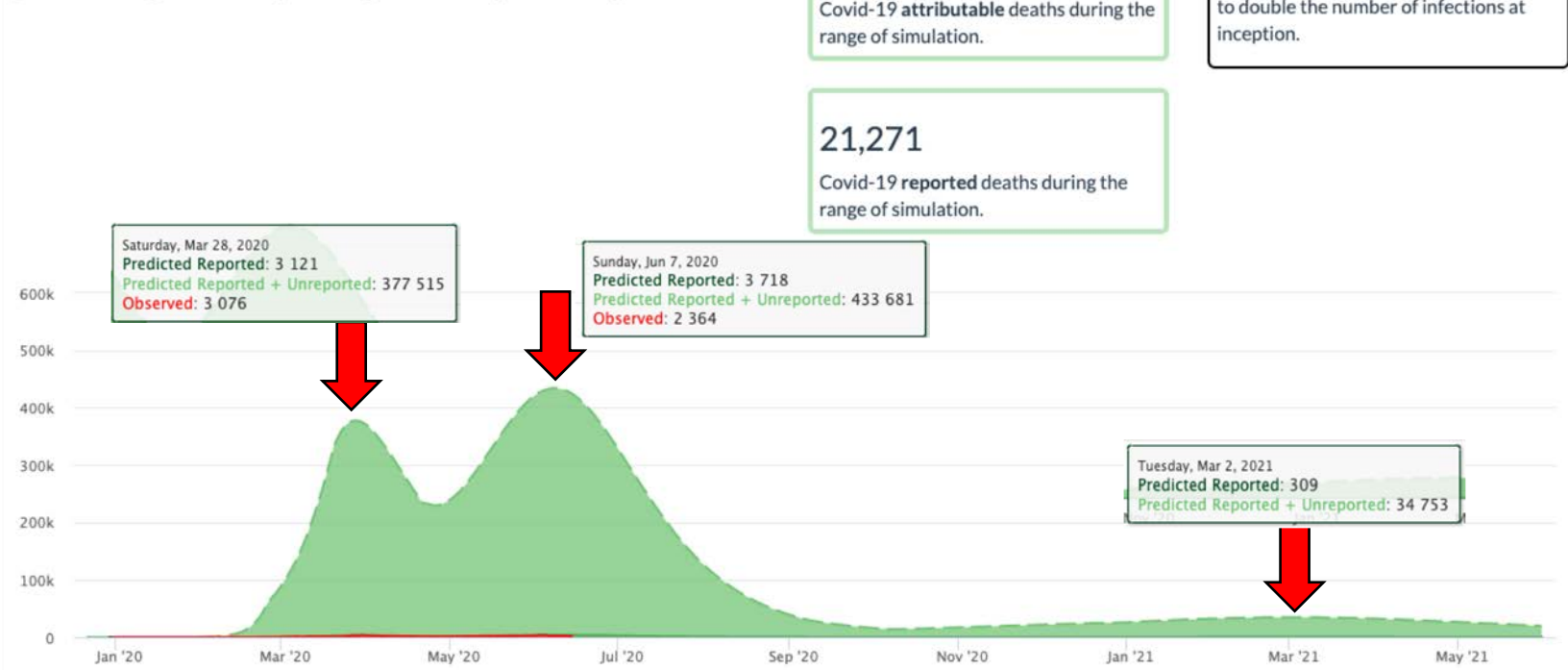 - **54 million** total infections averted
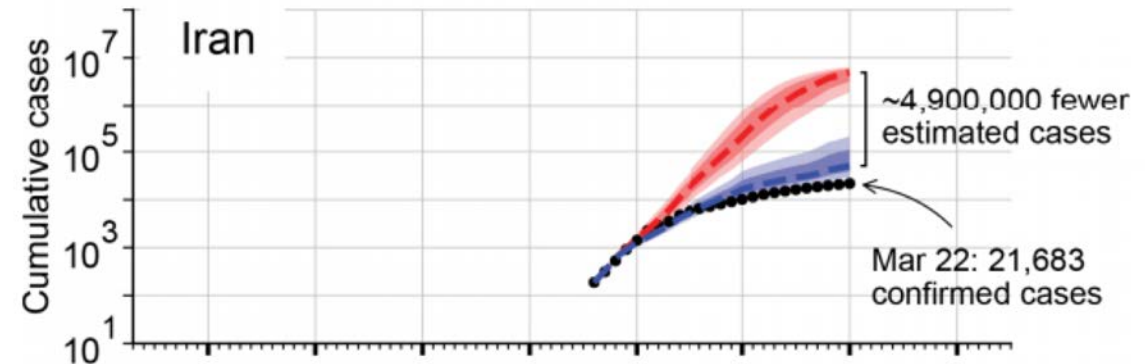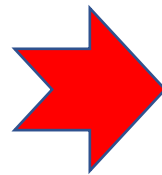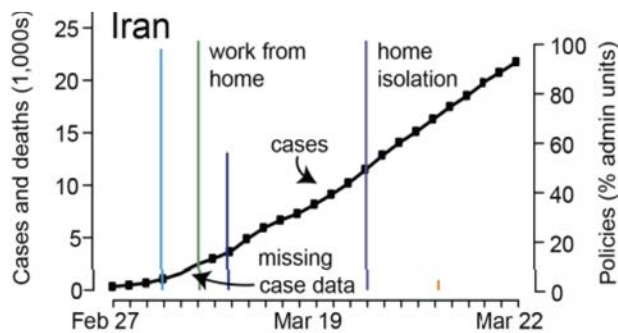
Baseline
(Simulation till first of June 2021)

Herd Immunity?

Focus on:
○ Observed   ○ Predicted Reported   ● Predicted Reported + Unreported

21,244
Covid-19 **attributable** deaths during the range of simulation.

21,271
Covid-19 **reported** deaths during the range of simulation.

3.7 days
to double the number of infections at inception.

Saturday, Mar 28, 2020
Predicted Reported: 3 121
Predicted Reported + Unreported: 377 515
Observed: 3 076

Sunday, Jun 7, 2020
Predicted Reported: 3 718
Predicted Reported + Unreported: 433 681
Observed: 2 364

Tuesday, Mar 2, 2021
Predicted Reported: 309
Predicted Reported + Unreported: 34 753

Conclusion

- Iran's non-pharmaceutical interventions strategy that started as early as Feb 24 might have prevented 28 million infections and about 15,000 deaths

- However the interventions were not long and rigid enough to prevent from the second and third wave of the epidemic.

- Slower and more gradual release of interventions is required to prevent future waves of the epidemic.

COVID-19 taught us a lesson (hopefully) we will never forget:

While busy with tweets, politics ... a deadly virus was spreading around the World ...

Together, we will overcome COVID-19

Thank you for listening ☺

Special thanks to my colleagues:
- Dr. Sana Eybpoosh, PhD
- Dr. Hamid Sharifi, PhD

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