UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

LADDY CURTIS VALENTINE and RICHARD ELVIN KING, on behalf of themselves and others similarly situated,	§	
Plaintiffs,	§	
v.	§	Civil Action No. 4:20-cv-1115
BRYAN COLLIER, in his official capacity, ROBERT HERRERA, in his official capacity, and TEXAS DEPARTMENT OF CRIMINAL JUSTICE,	§	
Defendants.	§	

PLAINTIFFS' EMERGENCY MOTION TO IDENTIFY SECOND COVID-19 CASE AT THE PACK UNIT

The Court should compel TDCJ to immediately identify the second inmate who contracted COVID-19 at the Pack Unit. Press reports and statements from Grimes County indicate the person is over seventy years old. However, without his identity, Plaintiffs cannot interview him or preserve his testimony. This presents an emergency for three reasons:

First, this victim likely has direct knowledge of critically important facts in this time-sensitive case. The virus has already killed one member of the putative class, highlighting the necessity of urgent action.

Second, this witness is at serious risk of hospitalization or even death from COVID-19, so he may only be capable of speaking to Plaintiffs' counsel (and potentially giving testimony) for a brief window of time.

Third, in light of the stay, Plaintiffs need to investigate relevant facts quickly, as TDCJ continues to refuse to protect the putative class.

Accordingly, the Court should compel TDCJ to identify this victim so that Plaintiffs have the opportunity to investigate before it is too late.

I. FACTUAL BACKGROUND

On April 17, 2020, Plaintiffs learned from press reports that a second inmate, who "is in his 70s," at the Pack Unit tested positive for COVID-19, and Plaintiffs immediately asked TDCJ to identify the victim. Ex. 1, Letter from J. Keville; Ex. 2, Kathleen Witte, KBTX, "Grimes County confirms another COVID-19 case at Pack Unit" (April 16, 2020). Grimes County's website confirmed this information (Ex. 8, Grimes County Office of Emergency Management, Immediate Press Release), as did TDCJ's website before that information was removed.

On April 22, 2020, TDCJ refused, without explanation, to identify the man. Ex. 3, Email from C. Vasquez.

As the Court is aware from the hearing testimony, TDCJ has not committed to conducting any form of contact tracing for confirmed cases. *See* Ex. 4, April 14, 2020 Hearing Transcript, p. 5:16–24 ("I do not have that information). If TDCJ will not test everyone at Pack, then the only other option is to conduct contact tracing. *See* Ex. 5, April 16, 2020 Hearing Transcript, p. 91:3–6. This critical witness can provide information to investigate what contact tracing (if any) has been performed after his positive test, as well as generally information about what steps TDCJ was taking to protect him and other inmates who shared his dormitory.

II. ARGUMENT

The Court should order immediate disclosure of the identity of the second COVID-19 case at the Pack Unit for at least three reasons.

First, the latest confirmed victim at the Pack Unit has unique knowledge necessary to evaluate who else might be at risk at Pack and what TDCJ has done, or failed to do, to protect this

second victim. He will know who else he has been in contact with—and from that, Plaintiffs can evaluate what contact tracing, if any, TDCJ has conducted by interviewing those people. He will know what other protective measures, if any, TDCJ provided to him, and may be uniquely positioned to have heard from TDCJ officials about their approach to the virus. According to TDCJ's position and the Fifth Circuit's disposition of the motion to stay, further evidence is necessary on the question of whether administrative remedies are unavailable, whether Defendants are subjectively aware of the risk, and whether the substantial risk of harm is not mitigated by Defendants' current practices. This victim is likely to have knowledge relevant to each of these questions—and, if they are all answered in the affirmative, then the Court will need to act quickly on the merits of Plaintiffs' complaint.

Second, the unfortunate reality is that this person is in his 70s and thus at much greater risk of permanent injury or death from COVID-19. *See* Ex. 5, April 16, 2020 Hearing Transcript, p. 12:7–25; Ex. 6, Centers for Disease Control and Prevention, "Groups at Higher Risk for Severe Illness" (April 17, 2020) *available at* https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/groups-at-higher-risk.html. This person has a statistical chance of death of at least 8.6%, and a 16.6% chance of needing hospitalization. Ex. 7, Robert Verity et al., *Estimates of the severity of coronavirus disease 2019* (The Lancet Mar. 30, 2020) pp. 5, 7. He may not survive long enough for conventional discovery, or even be in a position to answer questions by then if he is on a ventilator.

Third, the presence of a second COVID-19 case at the Pack Unit further corroborates Plaintiffs' evidence that the facility's residents are already communicating the disease. *See, e.g.*, *See* Ex. 5, April 16, 2020 Hearing Transcript, p. 90:13–20 ("this was sort of a tinderbox ready to catch fire. And I think now we know it has caught fire. … there is no way this is the only person

who has been infected."). Thus, Plaintiffs have a pressing and time-sensitive need for direct evidence to resolve the issues of available remedies, the effectiveness of Defendants' current measures, and Defendants' subjective awareness of the risk.

As, tragically, this problem is likely to recur, Plaintiffs ask the Court to order TDCJ to identify all Pack Unit inmates who test positive for COVID-19 within 48 hours of the positive test.

III. CONCLUSION

For the reasons set forth above, Plaintiffs respectfully request that the Court order TDCJ to immediately identify the second inmate who had a confirmed COVID-19 infection at the Pack Unit, by providing Plaintiffs' counsel the inmate's name and inmate identification number. Furthermore, the Court should order TDCJ to provide Plaintiffs' counsel the name and identification number of all future patients confirmed to have COVID-19 within 48 hours of diagnosis.

Dated: April 15, 2020

WINSTON & STRAWN LLP

By: /s/ John R. Keville

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Counsel for Plaintiffs

CERTIFICATE OF SERVICE

By my signature below, I certify that a true and correct copy of the foregoing has been served on all counsel of record through the Electronic Case Files System of the Southern District of Texas.

By /s/ Jeff Edwards
JEFF EDWARDS

CERTIFICATE OF CONFERENCE

By my signature below, I certify that Plaintiffs' counsel twice requested this relief. TDCJ indicated that it would refuse to provide the inmate's name.

By /s/ Jeff Edwards
JEFF EDWARDS

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April 17, 2020

VIA E-MAIL

Christin Cobe Vasquez
Law Enforcement Defense Division
P.O. Box 12548, Capitol Division
Austin, Texas 78711-2548

Re: ***Valentine, et. Al v. Collier, et al.*****, Civ. No. 4:20-cv-01115**

Dear Christin:

The press is reporting that a second inmate has tested positive for COVID-19 at the Pack Unit.[1] This was confirmed by the Grimes County Office of Emergency Management[2] and the TDCJ's COVID-19 Medical Action Center webpage.[3]

By the end of today, please provide us with this person's name, TDCJ number, and most recent housing assignment at the Pack Unit. Obviously, this person will be an important witness in any further proceedings and my team needs to speak with him as soon as possible.

We would also request that when any additional inmates at the Pack Unit test positive for COVID-19 that the above information be provided to us within 24 hours of the positive test.

We are available to confer today about this request. Thank you for your attention to this matter.

Sincerely,

John R. Keville

[1] Kathleen Witte, "Grimes County confirms another COVID-19 case at Pack Unit," KBTX-TV (Apr. 16, 2020) https://www.kbtx.com/content/news/Grimes-County-confirms-first-COVID-related-death-an-inmate-at-the-Pack-Unit-569711711.html.
[2] Press Release, Eighth and Ninth Confirmed Cases of COVID-19 in Grimes County, Grimes County Office of Emergency Management (Apr. 16, 2020), https://www.grimescountytexas.gov/page/open/2341/0/Grimes%20County%20Pack%20Unit%20Cases%20Press%20Release.pdf ("The second inmate in his 70's also tested positive for the virus and has been isolated from the inmate population.").
[3] COVID-19 Medical Action Center, TDCJ (Apr. 16, 2020 update), https://www.tdcj.texas.gov/covid-19/offender_mac.html.

Grimes County confirms another COVID-19 case at Pack Unit

By Kathleen Witte | Posted: Thu 7:03 PM, Apr 16, 2020

ANDERSON, Tex. (KBTX) - There are nine confirmed cases of COVID-19 in Grimes County.

One of those patients, an inmate at the Wallace Pack Unit near Navasota, died from complications due to the virus on April 11. The probable cause of death for Leonard Clerkly, 62, was pneumonia complicated by COVID-19, according to the Texas Department of Criminal Justice.

In a news release on Tuesday, TDCJ said "Preliminary autopsy results suggest a preliminary cause of death of viral pneumonia due to COVID-19 with other contributing factors. Like all in-custody deaths, this death is under investigation, and the cause of death is pending final autopsy results."

The second inmate who tested positive is in his 70s and has been isolated from the inmate population, according to the Grimes County Office of Emergency Management. Eleven other inmates were chosen to be tested based on their possible contact with the infected inmate. All were negative for the virus.

Clerkly had served 5 years, 7 months and 11 days of a life sentence for aggravated sexual assault of a child under 14 out of Tarrant County.

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RE: Valentine

Vasquez, Christin <Christin.Vasquez@oag.texas.gov>

Thu 4/23/2020 4:24 PM

To: Jeff Edwards <jeff@edwards-law.com>; Farrell, Jeffrey <Jeffrey.Farrell@oag.texas.gov>;

Cc: John Keville <JKeville@winston.com>; Brandon Duke <BDuke@winston.com>; Scott Medlock <scott@edwards-law.com>; Mike Singley <mike@edwards-law.com>; David James <david@edwards-law.com>; Rheams, James <James.Rheams@oag.texas.gov>;

Good afternoon Jeff,

I will work on getting the grievances.

With regard to the identity of the second offender who tested positive, we are not in a position to provide that information.

My apologies for failing to confer on the motion to exceed page limits. That was an oversight on my part.

Thanks.

Sincerely,

Christin Cobe Vasquez
Assistant Attorney General
Law Enforcement Defense Division
Phone: (512) 475-4199
Fax: (512) 370-9996

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From: Jeff Edwards <jeff@edwards-law.com>
Sent: Thursday, April 23, 2020 3:06 PM
To: Vasquez, Christin <Christin.Vasquez@oag.texas.gov>; Farrell, Jeffrey <Jeffrey.Farrell@oag.texas.gov>
Cc: John Keville <JKeville@winston.com>; Brandon Duke <BDuke@winston.com>; Scott Medlock <scott@edwards-law.com>; Mike Singley <mike@edwards-law.com>; David James <david@edwards-law.com>
Subject: Valentine

Christin,

Would you please send over this afternoon the grievances from Valentine and King that you referenced at the hearing and in briefing.

In addition, you have still not provided us with the identity of the second inmate who tested positive for covid 19. Please provide us with this information as previously requested.

If for some reason, you are unwilling to provide us with this information by tomorrow morning, let me know so that we can take the issue to the Court.

Thank you.

Jeff

Sent from my iPhone

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Board Certified in Personal Injury Law
Texas Board of Legal Specialization

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

LADDY CURTIS VALENTINE, ET AL	*	4:20-CV-1115
	*	Houston, Texas
VS.	*	
	*	3:28 p.m.
BRYAN COLLIER, ET AL	*	April 14, 2020

TELEPHONE CONFERENCE

(ALL COUNSEL APPEARING TELEPHONICALLY)

BEFORE THE HONORABLE KEITH P. ELLISON
UNITED STATES DISTRICT JUDGE

APPEARANCES:

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713.250.5581

Proceedings recorded by mechanical stenography.
Transcript produced by computer-assisted transcription.

THE COURT: This is Ellison here.
CASE MANAGER: Okay, Judge.
THE COURT: Jessica, are you there?
LAW CLERK: Yes, I'm here, Judge.
03:28:20 CASE MANAGER: I remind everyone please state your name when you speak and please speak slowly for the court reporter.
THE COURT: Okay. As far as we know, is everyone who is supposed to be here accounted for?
03:30:11 Okay. Ms. Vasquez, you said we needed to confer, at least by teleconference. Why don't you go first.
MS. VASQUEZ: Yes, Your Honor. Thank you.
In the interest of transparency, we wanted
03:30:26 to notify the Court and the plaintiffs that on Saturday, April 11th, a offender at the Pack Unit was taken to a local hospital for emergency care where he consequently passed away. An autopsy was subsequently performed, and the finding of that autopsy was that he was tested
03:30:50 positive COVID-19. That autopsy is not final. It is still pending.
Given the nature of this lawsuit, everyone concerned about the defendants, we wanted to make the Court and the plaintiffs aware of the situation.
03:31:03 THE COURT: Well, your communication is in

the highest interest of the Bar, and we appreciate it. And please convey sympathy to the family.

Does anybody have any questions for Ms. Vasquez? Was the individual, was he in a compromised immune state?

03:31:22

MS. VASQUEZ: That is my understanding, Your Honor.

THE COURT: What was the problem: Diabetes, or hypertension, or something else?

MS. VASQUEZ: I can't say specifically, but I think something like that, yes.

03:31:29

(Simultaneous dialogue)

UNIDENTIFIED SPEAKER: I'm sorry, Jeff.

MR. KEVILLE: My first question was going to be what have we don't to kind of back trace who this individual was in contact with, where he was.

03:31:43

MS. VASQUEZ: Yes. He was housed on the A-Wing. His dorm is on medical restriction. All of the offender in that dorm have been within masks to wear. It's my understanding that all offenders at the Pack Unit who are 65 years and older are being given masks as well. Those are being laundered. I think they're going to be passed out today, is my understanding. The entire Pack Unit is on precautionary lockdown.

03:32:03

MR. KEVILLE: Can I ask one more,

03:32:31

Ms. Vasquez? This is John Keville.

What's the difference A-Wing being on medical restriction and the entire Pack Unit being on lockdown?

03:32:41 MS. VASQUEZ: Right. So lockdown means all traffic is limited, they're not going to chow, they're only going for medical emergencies, I believe.

And the difference between that and medical restriction is that some people on medical

03:33:01 restriction are having their temperatures checked by medical staff twice a day, and they have been given the masks to wear.

MR. EDWARDS: Your Honor, this is Jeff Edwards. May I ask a few questions of Ms. Vasquez?

03:33:20 THE COURT: Yes, you may.

MR. EDWARDS: Ms. Vasquez, is anything being done at the prison, in terms of contract tracing, to determine who, beyond his dorm, he may have had contact with, in particular correctional officers, medical

03:33:34 personnel, anywhere he eats, or anywhere he went, and do you have any information as to what the results of any investigation are?

MS. VASQUEZ: I do not have that information.

03:33:50 MR. EDWARDS: Is it considered important to

get that information?

MS. VASQUEZ: Jeff, I don't have that information at the time. I know that the investigation is ongoing. I know that the autopsy is still pending, I 03:34:06 believe there's an OIG investigation that's ongoing.

THE COURT: This is Ellison again.

Do you know what the statistics are for other TDCJ units around the State, how many cases of COVID have been identified, what loss of life has been suffered?

03:34:46 MS. VASQUEZ: I don't have that information yet.

(Simultaneous dialogue)

THE COURT: I hear a female voice. I can't identify whose it is. Go ahead. Please tell me who you 03:34:50 are.

MS. SCOFIELD: Judge Ellison this is Denise Scofield. I just wanted clarify. Who is being allowed or permitted to wear masks, who provided them, and why the limitation on who received masks at the unit?

03:35:16 MS. VASQUEZ: The information that I have is that offenders that were housed in the same dorm as the repeat offenders are given masks, and as to the remaining offenders, 65-year or older, is getting a mask.

THE COURT: It's a question of availability. 03:35:32 It really does seem like everyone ought to be masked.

CERTIFICATE

I, Johnny C. Sanchez, RMR, CRR, certify that as an Official Federal Court Reporter for the Southern District of Texas, Houston Division, I have transcribed the audio-recorded hearing of the foregoing entitled case to the best of my ability; that any inaudible designations are because of audio or telephonic interference that precluded me from understanding the words spoken; and that the foregoing typewritten matter contains a full, true and correct transcript of my understanding of the aforesaid proceedings as reported to the best of my skill and ability.

/s/_____

Johnny C. Sanchez, CRR, RMR

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

LADDY CURTIS VALENTINE, ET AL	*	4:20-CV-1115
	*	Houston, Texas
VS.	*	
	*	1:30 p.m.
BRYAN COLLIER, ET AL	*	April 16, 2020

TELEPHONIC EVIDENTIARY HEARING

BEFORE THE HONORABLE KEITH P. ELLISON
UNITED STATES DISTRICT JUDGE

APPEARANCES:

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THE COURT: Okay.

MR. KEVILLE: I believe we're ready for the plaintiffs, Your Honor.

THE COURT: Okay. Just for my benefit, I haven't heard everybody's state their name. Let's start off with appearance of counsel, beginning with plaintiff.

MR. KEVILLE: For the plaintiff, Your Honor, John Keville from Winston and Strawn.

MR. EDWARDS: Jeff Edwards and Mike Singley from Edwards Law (Simultaneous dialogue.

THE COURT: Sorry. I didn't hear that. We're still taking appearance from plaintiffs' counsel.

MR. DUKE: Yes. Brandon Duke from Winston and Strawn (Simultaneous dialogue).

THE COURT: I heard Mr. Duke. Who else? (Simultaneous dialogue) we're talking over each other. Let's finish with Winston Strawn, and then we'll do Edwards. Who else from Winston Strawn?

MS. SCOFIELD: Your Honor, this is Denise Scofield.

THE COURT: Thank you (Simultaneous dialogue).

MR. MURPHY: Michael Murphy --

THE COURT: Who? I heard a female voice.

MS. HOCKMAN: Yes, Your Honor. Corinne

confined area like the Pack Unit, can the disease spread even more quickly than in the general population?

A. Yes.

Q. And as the Judge mentioned, is an analogous situation like a nursing home or cruise ship?

01:38:05

A. Yes.

Q. And do you understand that the population of the Pack Unit is comprised largely of what are called at-risk individual?

01:38:18

A. It's my understanding from what I have seen, yes, that is accurate.

Q. And what's your definition of highly at-risk or at-risk individuals with respect to COVID-19?

A. That definitely changed to the point that any at-risk

01:38:35

individual for COVID-19 is anyone that has not been successfully socially distanced from people that may have the virus.

So at-risk for infection, it's purely (telephonic static) at-risk for getting ill with the

01:38:48

illness with the virus is not a hundred percent clear, but what we're seeing is people over the age of 65 with comorbid conditions are clearly more at risk, but we're seeing in our community that we're having people less than the age of 60 without comorbid conditions also becoming

01:39:07

very ill, and even dying from this disease.

So at-risk of spread are those that have not been able to socially distance their way away from people with it and the risk population to getting ill with the virus once obtained, is more widespread than what we first realized.

Q. And then in addition to becoming ill, do any group of individuals face or have a higher risk of increased or more severe consequences once being infected with COVID-19?

MS. VASQUEZ: Objection. Leading.

THE COURT: I'm going to deny the objection -- overrule the objection.

BY MR. DUKE:

A. The risk or why people with comorbid conditions that look like all people types of lung disease, asthma, COPD, heart disease, hypertension, diabetes, and clearly what we're seeing throughout the United States, there is a very much higher risk of communities of color, particularly African-Americans that can get this disease not only more frequently, but die more frequently once they get it.

So that clearly is a newly defined risk population for both infection, becoming ill, and death.

Q. Thank you. And then have you had a chance to review the list of measures that plaintiffs have requested be implemented with respect to the Pack Unit?

disproportionately affected by the virus?

DR. YOUNG: Yes. Absolutely.

THE COURT: Thank you. Sorry to interrupt.

MS. HOCKMAN: No problem, Your Honor. Thank you.

BY MS. HOCKMAN:

Q. Before I touch on specific guidance, I just want to go one step further from what the Judge asked.

Have you read the CDC guidance as it pertains to testing?

A. Yes.

Q. And do you believe that's sufficient in this case, given that there was a death this past weekend?

A. No. So I think really, you know, I think we knew when I first was retained in this case couple of weeks ago, that this was sort of a tinderbox ready to catch fire. And I think now we know it has caught fire.

It's clear that COVID-19 is in the Pack Unit. As someone said earlier, there is no way this is the only person who has been infected. My understanding is that the inmate who passed away did not leave the facility, was not transported.

So, clearly was imported, and other people can easily become sick with this.

Q. And so, you think that that, for example, is one

place where the CDC guideline is insufficient to protect this population?

A. Yes. I think especially regarding testing, we know that the appropriate public health response to infectious diseases is to test to do contact tracing, and to isolate people who are positive, even if they are asymptomatic.

Q. If contact tracing is not a viable option here, do you believe that everyone in prison should be tested?

A. Yes. Absolutely.

Q. Why is that important?

A. It's important for a lot of reasons: One is that we know there can be asymptomatic spread of this virus. So there could be people walking around without symptoms, or with very mild symptoms, who aren't presenting for a sick call for medical care, who can be walking around with the virus.

And so, in those people who are asymptomatic, I think it would be ideal to test everybody, and then if you have somebody who is a symptomatic positive, making sure that their quarantined, that they're isolated for at least two weeks.

Q. I'd like to now just circle back to a couple other aspects of the requested relief.

One of the things that we've discussed a lot today is access to an alcohol-based hand sanitizer.

CERTIFICATE

I, Johnny C. Sanchez, RMR, CRR, certify that as an Official Federal Court Reporter for the Southern District of Texas, Houston Division, I have transcribed the audio-recorded hearing of the foregoing entitled case to the best of my ability; that any inaudible designations are because of audio or telephonic interference that precluded me from understanding the words spoken; and that the foregoing typewritten matter contains a full, true and correct transcript of my understanding of the aforesaid proceedings as reported to the best of my skill and ability.

S/Johnny C. Sanchez, RPR, RMR, CRR

Centers for Disease Control and Prevention

Coronavirus Disease 2019 (COVID-19)

Groups at Higher Risk for Severe Illness

COVID-19 is a new disease and there is limited information regarding risk factors for severe illness. Based on currently available information and clinical expertise, **older adults and people of any age who have serious underlying medical conditions might be at higher risk for severe illness from COVID-19.**

We are learning more about COVID-19 every day; CDC will update the advice below as new information becomes available.

Reduce your risk of getting sick with COVID-19

- **Continue your medications** and do not change your treatment plan without talking to your doctor.
- **Have at least a 2-week supply** of prescription and non-prescription medications. Talk to your healthcare provider, insurer, and pharmacist about getting an extra supply (i.e., more than two weeks) of prescription medications, if possible, to reduce trips to the pharmacy.
- **Talk to your healthcare provider about whether your vaccinations are up-to-date.** People older than 65 years, and those with many underlying conditions, such as those who are immunocompromised or with significant liver disease, are recommended to receive vaccinations against influenza and pneumococcal disease.
- **Do not delay getting emergency care for your underlying condition** because of COVID-19. Emergency departments have contingency infection prevention plans to protect you from getting COVID-19 if you need care for your underlying condition.
- **Call your healthcare provider if you have any concerns** about your underlying medical conditions or if you get sick and think that you may have COVID-19. If you need emergency help, call 911.

Learn what else you can do as someone who may be at higher risk for severe illness, including staying home and away from other people as much as possible.

Actions you can take based on your conditions and other risk factors

Asthma (moderate-to-severe)

Moderate-to-severe asthma may put people at higher risk for severe illness from COVID-19.

Actions to take

- Follow your Asthma Action Plan.
- Keep your asthma under control.
- Continue your current medications, including any inhalers with steroids in them (“steroids” is another word for corticosteroids).
- Know how to use your inhaler.
- Avoid your asthma triggers.
- If possible, have another member of your household who doesn’t have asthma clean and disinfect your house for you. When they use cleaning and disinfecting products, have them:
  - Make sure that people with asthma are not in the room.
  - Minimize use of disinfectants that can cause an asthma attack.
  - Open windows or doors and use a fan that blows air outdoors.
  - Always follow the instructions on the product label

- Always follow the instructions on the product label.
- Spray or pour spray products onto a cleaning cloth or paper towel instead of spraying the product directly onto the cleaning surface (if the product label allows).

Why you might be at higher risk

COVID-19 can affect your respiratory tract (nose, throat, lungs), cause an asthma attack, and possibly lead to pneumonia and serious illness.

Chronic lung disease

Chronic lung diseases, such as chronic obstructive pulmonary disease (COPD) (including emphysema and chronic bronchitis), idiopathic pulmonary fibrosis and cystic fibrosis, may put people at higher risk for severe illness from COVID-19.

Actions to take

- Keep taking your current medications, including those with steroids in them ("steroids" is another word for corticosteroids).
- Avoid triggers that make your symptoms worse.

Why you might be at higher risk

Based on data from other viral respiratory infections, COVID-19 might cause flare-ups of chronic lung diseases leading to severe illness.

Diabetes

Diabetes, including type 1, type 2, or gestational, may put people at higher risk of severe illness from COVID-19.

Actions to take

- Continue taking your diabetes pills and insulin as usual.
- Test your blood sugar every four hours and keep track of the results.
- Make sure that you have at least a two-week supply of your diabetes pills and insulin.
- Follow the sick day guidelines for people with diabetes.

Why you might be at higher risk

People with diabetes whose blood sugar levels are often higher than their target are more likely to have diabetes-related health problems. Those health problems can make it harder to overcome COVID-19.

Serious heart conditions

Serious heart conditions, including heart failure, coronary artery disease, congenital heart disease, cardiomyopathies, and pulmonary hypertension, may put people at higher risk for severe illness from COVID-19.

Actions to take

- Take your medication exactly as prescribed. Continue angiotensin converting enzyme inhibitors (ACE-I) or angiotensin-II receptor blockers (ARB) as prescribed by your healthcare provider for indications such as heart failure or high blood pressure. This is recommended by current clinical guidelines.
- Make sure that you have at least a two-week supply of your heart disease medications (such as those to treat high cholesterol and high blood pressure).
- People with hypertension should continue to manage and control their blood pressure and take their medication as directed

directed.

Why you might be at higher risk

COVID-19, like other viral illnesses such as the flu, can damage the respiratory system and make it harder for your heart to work. For people with heart failure and other serious heart conditions this can lead to a worsening of COVID-19 symptoms.

Chronic kidney disease being treated with dialysis

Chronic kidney disease being treated with dialysis may increase a person's risk for severe illness from COVID-19.

Actions to take

- If you are on dialysis, you should NOT miss your treatments.
- Contact your dialysis clinic and your healthcare provider if you feel sick or have concerns.
- Plan to have enough food on hand to follow the KCER 3-Day Emergency Diet Plan [PDF – 8 pages] for dialysis patients in case you are unable to maintain your normal treatment schedule.

Why you might be at higher risk

Dialysis patients are more prone to infection and severe illness because of weakened immune systems; treatments and procedures to manage kidney failure; and coexisting conditions such as diabetes.

Severe obesity

Actions to take

- Take your medications for any underlying health conditions exactly as prescribed.

Why you might be at higher risk

Severe obesity increases the risk of a serious breathing problem called acute respiratory distress syndrome (ARDS), which is a major complication of COVID-19 and can cause difficulties with a doctor's ability to provide respiratory support for seriously ill patients. People living with severe obesity can have multiple serious chronic diseases and underlying health conditions that can increase the risk of severe illness from COVID-19.

People aged 65 years and older

Older adults, 65 years and older, are at higher risk for severe illness and death from COVID-19.

Actions to take

- Take your medications for any underlying health conditions exactly as prescribed.
- Follow the advice of your healthcare provider.
- Develop a care plan that summarizes your health conditions and current treatments.
- Prepare yourself to stay home for long periods using this checklist.

Why you might be at higher risk

Although COVID-19 can affect any group, the older you are, the higher your risk of serious disease. Eight out of 10 deaths reported in the U.S. have been in adults 65 years or older; risk of death is highest among those 85 years or older. The immune systems of older adults weaken with age, making it harder to fight off infections. Also, older adults commonly have chronic diseases that can increase the risk of severe illness from COVID-19.

People who live in a nursing home or long-term care facility

Many cases of COVID-19 in the U.S. have occurred among older adults living in nursing homes or long-term care facilities

Actions to take

- Carefully follow your facility's instructions for infection prevention.
- Notify staff right away if you feel sick.
- Ask your caretakers about the actions that are being taken at your nursing home or long-term care facility to protect you and your loved ones, including if and how they are limiting visitors.

Why you might be at higher risk

The communal nature of nursing homes and long-term care facilities, and the population served (generally older adults often with underlying medical conditions), put those living in nursing homes at higher risk of infection and severe illness from COVID-19.

Immunocompromised

Many conditions and treatments can cause a person to have a weakened immune system (immunocompromised), including cancer treatment, bone marrow or organ transplantation, immune deficiencies, HIV with a low CD4 cell count or not on HIV treatment, and prolonged use of corticosteroids and other immune weakening medications.

Actions to take

- If you are immunocompromised, continue any recommended medications or treatments and follow the advice of your healthcare provider.
- Call your healthcare provider if you have concerns about your condition or feel sick.

Why you might be at higher risk

People with a weakened immune system have reduced ability to fight infectious diseases, including viruses like COVID-19. Knowledge is limited about the virus that causes COVID-19, but based on similar viruses, there is concern that immunocompromised patients may remain infectious for longer than other COVID-19 patients.

Liver disease

Chronic liver disease, including cirrhosis, may increase risk for serious illness from COVID-19.

Actions to take

- Take your medications exactly as prescribed.

Why you might be at higher risk

Severe illness caused by COVID-19 and the medications used to treat some severe consequences of COVID-19 can cause strain on the liver, particularly for those with underlying liver problems. People living with serious liver disease can have a weakened immune system, leaving the body less able to fight COVID-19.

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Estimates of the severity of coronavirus disease 2019: a model-based analysis

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Summary

Background In the face of rapidly changing data, a range of case fatality ratio estimates for coronavirus disease 2019 (COVID-19) have been produced that differ substantially in magnitude. We aimed to provide robust estimates, accounting for censoring and ascertainment biases.

Methods We collected individual-case data for patients who died from COVID-19 in Hubei, mainland China (reported by national and provincial health commissions to Feb 8, 2020), and for cases outside of mainland China (from government or ministry of health websites and media reports for 37 countries, as well as Hong Kong and Macau, until Feb 25, 2020). These individual-case data were used to estimate the time between onset of symptoms and outcome (death or discharge from hospital). We next obtained age-stratified estimates of the case fatality ratio by relating the aggregate distribution of cases to the observed cumulative deaths in China, assuming a constant attack rate by age and adjusting for demography and age-based and location-based under-ascertainment. We also estimated the case fatality ratio from individual line-list data on 1334 cases identified outside of mainland China. Using data on the prevalence of PCR-confirmed cases in international residents repatriated from China, we obtained age-stratified estimates of the infection fatality ratio. Furthermore, data on age-stratified severity in a subset of 3665 cases from China were used to estimate the proportion of infected individuals who are likely to require hospitalisation.

Findings Using data on 24 deaths that occurred in mainland China and 165 recoveries outside of China, we estimated the mean duration from onset of symptoms to death to be 17·8 days (95% credible interval [CrI] 16·9–19·2) and to hospital discharge to be 24·7 days (22·9–28·1). In all laboratory confirmed and clinically diagnosed cases from mainland China (n=70 117), we estimated a crude case fatality ratio (adjusted for censoring) of 3·67% (95% CrI 3·56–3·80). However, after further adjusting for demography and under-ascertainment, we obtained a best estimate of the case fatality ratio in China of 1·38% (1·23–1·53), with substantially higher ratios in older age groups (0·32% [0·27–0·38] in those aged <60 years *vs* 6·4% [5·7–7·2] in those aged ≥60 years), up to 13·4% (11·2–15·9) in those aged 80 years or older. Estimates of case fatality ratio from international cases stratified by age were consistent with those from China (parametric estimate 1·4% [0·4–3·5] in those aged <60 years [n=360] and 4·5% [1·8–11·1] in those aged ≥60 years [n=151]). Our estimated overall infection fatality ratio for China was 0·66% (0·39–1·33), with an increasing profile with age. Similarly, estimates of the proportion of infected individuals likely to be hospitalised increased with age up to a maximum of 18·4% (11·0–37·6) in those aged 80 years or older.

Interpretation These early estimates give an indication of the fatality ratio across the spectrum of COVID-19 disease and show a strong age gradient in risk of death.

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Introduction

As of March 25, 2020, 414 179 cases and 18 440 deaths due to coronavirus disease 2019 (COVID-19), caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), had been reported worldwide.[1] The epidemic began in mainland China, with a geographical focus in the city of Wuhan, Hubei. However, on Feb 26, 2020, the rate of increase in cases became greater in the rest of the world than inside China. Substantial outbreaks are occurring in Italy (69 176 cases), the USA (51 914 cases), and Iran (24 811 cases), and geographical expansion of the epidemic continues.

Clinical studies of hospitalised patients have shown that, at onset of COVID-19, patients frequently show symptoms associated with viral pneumonia, most commonly fever, cough, sore throat, myalgia, and fatigue.[2–6] The case definition adopted in China and elsewhere includes further stratification of cases as severe (defined as tachypnoea [≥30 breaths per min], oxygen saturation ≤93% at rest, or PaO_2/FiO_2 ratio <300 mm Hg) and critical (respiratory

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Research in context

Evidence before this study

We searched PubMed, medRxiv, bioRxiv, arXiv, SSRN, Research Square, Virological, and Wellcome Open Research for peer-reviewed articles, preprints, and research reports on the severity of coronavirus disease 2019 (COVID-19), using the search terms "coronavirus", "2019-nCoV", and similar terms, and "fatality", up to March 6, 2020. Several studies have estimated the case fatality ratio (the percentage of individuals with symptomatic or confirmed disease who die from the disease) and infection fatality ratio (the percentage of all infected individuals who die from the disease, including those with mild disease) of COVID-19 using a range of different statistical and modelling methods. Studies done solely in hospitalised patients report the highest fatality ratios (8–28%), representing the outcome for the most severely ill patients. Estimates of the population-level case fatality ratio from all case reports are in the range of 2–8%. Estimates of the infection fatality ratio averaged across all age-groups range from 0·2% to 1·6%, while estimates of the infection fatality ratio in the oldest age group (≥80 years) range from 8% to 36%. None of the identified studies had adjusted for differences in the denominator populations to obtain estimates that could be applied across populations. No other studies have estimated the proportion of infected individuals who will require hospitalisation.

Added value of this study

By synthesising data from across a range of surveillance settings, we obtained estimates of the age-stratified case fatality ratio and infection fatality ratio that take into account the different denominator populations in the datasets. Our underlying assumption, that attack rates (ie, the probability of becoming infected) do not vary substantially by age, is consistent with previous studies for respiratory infections. Under this assumption, differences in age patterns among cases in Wuhan versus those elsewhere in China would probably due to under-ascertainment of cases, given the different surveillance systems in place. Our results are consistent with this hypothesis, with cases in Wuhan seen in older individuals, who would have been identified through attendance at hospital, whereas cases elsewhere in China being younger overall, which would be explained by the policy of testing those with a travel history to Wuhan. After correcting for these biases, we found that estimates of the case fatality ratio from China are consistent with those obtained from early international cases. Our age-stratified estimates of the infection fatality ratio can be applied to any demography to give an estimate of the infection fatality ratio in older and younger populations. These estimates can be combined with estimates of the infection attack rate (approximately 80% for an unmitigated epidemic) to give rough projections of scale. Similarly, our estimates of the proportion of infections requiring hospitalisation can be combined with the infection attack rate to forecast health-care requirements.

Implications of all the available evidence

Our estimates of the case fatality ratio for COVID-19, although lower than some of the crude estimates made to date, are substantially higher than for recent influenza pandemics (eg, H1N1 influenza in 2009). With the rapid geographical spread observed to date, COVID-19 therefore represents a major global health threat in the coming weeks and months. Our estimate of the proportion of infected individuals requiring hospitalisation, when combined with likely infection attack rates (around 50–80%), show that even the most advanced health-care systems are likely to be overwhelmed. These estimates are therefore crucial to enable countries around the world to best prepare as the global pandemic continues to unfold.

failure requiring mechanical ventilation, septic shock, or other organ dysfunction or failure that requires intensive care).[7] According to the report from the WHO–China Joint Mission on COVID-19, 80% of the 55 924 patients with laboratory-confirmed COVID-19 in China to Feb 20, 2020, had mild-to-moderate disease, including both non-pneumonia and pneumonia cases, while 13·8% developed severe disease and 6·1% developed to a critical stage requiring intensive care.[8] In a study of clinical progression in 1099 patients,[4] those at highest risk for severe disease and death included people over the age of 60 years and those with underlying conditions, including hypertension, diabetes, cardiovascular disease, chronic respiratory disease, and cancer.

Assessing the severity of COVID-19 is crucial to determine the appropriateness of mitigation strategies and to enable planning for health-care needs as epidemics unfold. However, crude case fatality ratios obtained by dividing the number of deaths by the number of cases can be misleading.[9,10] First, there can be a period of 2–3 weeks between a person developing symptoms, the case subsequently being detected and reported, and observation of the final clinical outcome. During a growing epidemic, the final clinical outcome of most of the reported cases is typically unknown. Simply dividing the cumulative reported number of deaths by the cumulative number of reported cases will therefore underestimate the true case fatality ratio early in an epidemic.[9–11] This effect was observed in past epidemics of respiratory pathogens, including severe acute respiratory syndrome (SARS)[12] and H1N1[9] influenza, and as such is widely recognised. Thus, many of the estimates of the case fatality ratio that have been obtained to date for COVID-19 correct for this effect.[13–16] Additionally, however, during the exponential growth phase of an epidemic, the observed time lags between the onset of symptoms and outcome (recovery or death) are censored, and naive estimates of the observed times from symptom onset to outcome provide biased estimates of the actual distributions. Ignoring this effect tends to bias the estimated

case fatality ratio downwards during the early growth phase of an epidemic.

Second, surveillance of a newly emerged pathogen is typically biased towards detecting clinically severe cases, especially at the start of an epidemic when diagnostic capacity is low (figure 1). Estimates of the case fatality ratio can thus be biased upwards until the extent of clinically milder disease is determined.[9] Data from the epicentre of the outbreak in Wuhan have primarily been obtained through hospital surveillance and, thus, are likely to represent patients with moderate or severe illness, with atypical pneumonia or acute respiratory distress being used to define suspected cases eligible for testing.[7] In these individuals, clinical outcomes are likely to be more severe, so any estimates of the case fatality ratio will be higher. Elsewhere in mainland China and the rest of the world, countries and administrative regions alert to the risk of infection being imported via travel initially instituted surveillance for COVID-19 with a broader set of clinical criteria for defining a suspected case. These criteria typically included a combination of symptoms (eg, cough and fever) combined with recent travel history to the affected region (Wuhan, or Hubei province)[2,17]. Such surveillance is likely to detect clinically mild cases but, by initially restricting testing to those with a travel history or link, might have missed other symptomatic cases.

Here we attempt to adjust for these biases in data sources to obtain estimates of the case fatality ratio (proportion of all cases that will eventually lead to death) and infection fatality ratio (the proportion of all infections that will eventually lead to death) using both individual-level case report data and aggregate case and death counts from mainland China, from Hong Kong and Macau, and international case reports. By adjusting for both underlying demography and potential under-ascertainment at different levels of the severity pyramid (figure 1), these estimates should be broadly applicable across a range of settings to inform health planning while more detailed case data accrue.

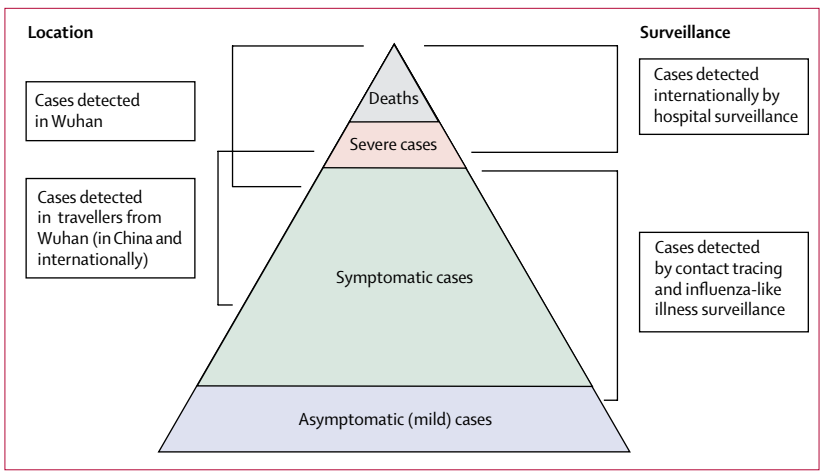

Figure 1: **Spectrum of COVID-19 cases**
At the top of the pyramid, those meeting the WHO case criteria for severe or critical cases are likely to be identified in the hospital setting, presenting with atypical viral pneumonia. These cases will have been identified in mainland China and among those categorised internationally as local transmission. Many more cases are likely to be symptomatic (ie, with fever, cough, or myalgia), but might not require hospitalisation. These cases will have been identified through links to international travel to high-risk areas and through contact-tracing of contacts of confirmed cases. They might also be identified through population surveillance of, for example, influenza-like illness. The bottom part of the pyramid represents mild (and possibly asymptomatic) cases. These cases might be identified through contact tracing and subsequently via serological testing.

Methods

Individual-level data on early deaths from mainland China

We identified information on the characteristics of 48 patients who died from COVID-19 in Hubei, reported by the National Health Commission and the Hubei Province Health Commission website up to Feb 8, 2020. We recorded the following data elements, where available: sex, age, date of symptom onset, date of hospitalisation, and date of death. Of the 48 cases, neither the date of symptom onset nor the date of report was available for 13 cases. We also removed eight cases with onset before Jan 1, 2020, or death before Jan 21, 2020, and three deaths after Jan 28, 2020, which were the dates consistent with reliable reporting of onset and death in this setting, respectively, considering the onset-to-death times (including early onsets creates a bias towards long onset-to-death times, reflecting under-ascertainment of deaths early on). This left 24 deaths, which we used to estimate the onset-to-death distribution.

Individual-level data on cases outside mainland China

We collated data on 2010 cases reported in 37 countries and two special administrative regions of China (Hong Kong and Macau), from government or ministry of health websites and media reports, until Feb 25, 2020. We recorded the following information where available: country or administrative region in which the case was detected, whether the infection was acquired in China or abroad, date of travel, date of symptom onset, date of hospitalisation, date of confirmation, date of recovery, and date of death. We used data from 165 recovered individuals with reported recovery dates and reported or imputed onset dates to estimate the onset-to-recovery distribution, after excluding 26 recoveries without appropriate information on dates of recovery, report, or locality. We used data on 1334 international cases to obtain estimates of the case fatality ratio, not including cases without dates of report.

Data on aggregate cases and deaths in mainland China

Data on 70 117 PCR-confirmed and clinically diagnosed cases by date of onset in Wuhan and elsewhere in China from Jan 1 to Feb 11, 2020, were extracted from the WHO–China Joint Mission report.[8] Over this period a total of 1023 deaths were reported across China, with these data available disaggregated into 10-year age bands between 0–9 years and 70–79 years old, and a further age

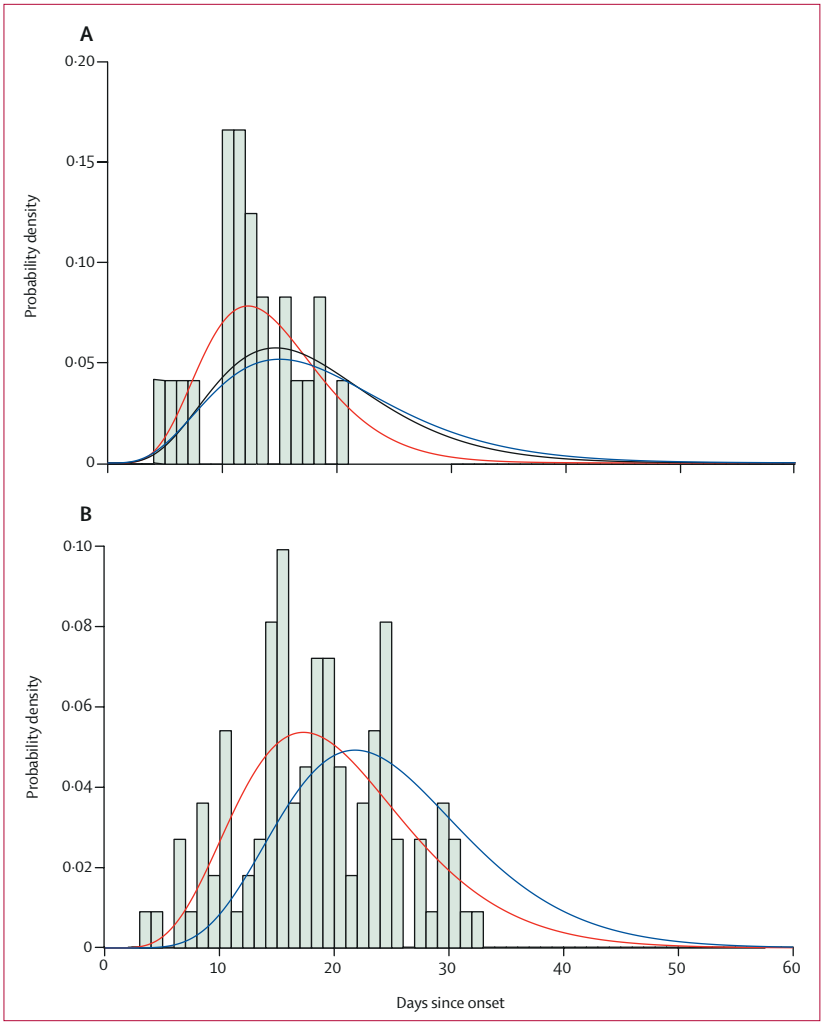

Figure 2: **Onset-to-death and onset-to-recovery distributions**
(A) Onset-to-death data from 24 cases in mainland China early in the epidemic. (B) Onset-to-recovery data from 169 cases outside of mainland China. Red lines show the best fit (posterior mode) gamma distributions, uncorrected for epidemic growth, which are biased towards shorter durations. Blue lines show the same distributions corrected for epidemic growth. The black line (panel A) shows the posterior estimate of the onset-to-death distribution following fitting to the aggregate case data.

For the **data and code used in this study** see https://github.com/mrc-ide/COVID19_CFR_submission

band for those aged 80 years or older.[7] Using collated data on daily reported deaths obtained each day from the National Health Commission regional websites, we estimated that 74% of deaths occurred in Wuhan and the remainder outside Wuhan. Additionally, the most recent available cumulative estimates (March 3, 2020) of 80 304 confirmed cases and 2946 deaths within China were extracted from the WHO COVID-19 Situation Report (number 43).[1]

See Online for appendix

An earlier preprint of a subset of these cases up to Jan 26, 2020 reported the age distribution of cases categorised by severity for 3665 cases.[18] Under the China case definition, a severe case is defined as tachypnoea (≥30 breaths per min) or oxygen saturation 93% or higher at rest, or PaO_2/FiO_2 ratio less than 300 mm Hg.[7] Assuming severe cases to require hospitalisation (as opposed to all of the patients who were hospitalised in China, some of whom will have been hospitalised to reduce onward transmission), we used the proportion of severe cases by age in these patients to estimate the proportion of cases and infections requiring hospitalisation.

Data on infection in repatriated international Wuhan residents

Data on infection prevalence in repatriated expatriates returning to their home countries were obtained from government or ministry of health websites and media reports. To match to the incidence reported in Wuhan on Jan 30, 2020, we used data from six flights that departed between Jan 30 and Feb 1, 2020, inclusive.

Data on cases and deaths on the *Diamond Princess* cruise ship

In early February 2020 a cruise liner named the *Diamond Princess* was quarantined after a disembarked passenger tested positive for the virus. Subsequently all 3711 passengers on board were tested over the next month. We extracted data on the ages of passengers onboard on Feb 5, 2020, the dates of positive test reports, which were available for 657 out of 712 PCR-confirmed cases, and the dates of ten deaths among these cases from the reports of the Japan Ministry of Health, Labour and Welfare[19] and international media.

Demographic data

Age-stratified population data for 2018 were obtained from the National Bureau of Statistics of China.[20] According to these data, the population of Wuhan in 2018 was approximately 11 million people.

Statistical analysis overview

All analyses were done with R software (version 3.6.2), with Bayesian Marko-Chain Monte Carlo via the package drjacoby (version 1.0.0).[21] Data and code are available online at GitHub.

Estimation of time intervals between symptom onset and outcome

In estimating time intervals between symptom onset and outcome, it was necessary to account for the fact that, during a growing epidemic, a higher proportion of the cases will have been infected recently (appendix p 7).Therefore, we re-parameterised a gamma model to account for exponential growth using a growth rate of 0·14 per day, obtained from the early case onset data (appendix p 6). Using Bayesian methods, we fitted gamma distributions to the data on time from onset to death and onset to recovery, conditional on having observed the final outcome. Missing onset dates were imputed on the basis of dates of report, where available.

	Deaths	Laboratory-confirmed cases*	Case fatality ratio			Infection fatality ratio†
			Crude	Adjusted for censoring	Adjusted for censoring, demography, and under-ascertainment‡	
Overall	1023	44 672	2·29% (2·15–2·43)	3·67% (3·56–3·80)	1·38% (1·23–1·53)	0·657% (0·389–1·33)
Age group, years						
0–9	0	416	0·000% (0·000–0·883)	0·0954% (0·0110–1·34)	0·00260% (0·000312–0·0382)	0·00161% (0·000185–0·0249)
10–19	1	549	0·182% (0·00461–1·01)	0·352% (0·0663–1·74)	0·0148% (0·00288–0·0759)	0·00695% (0·00149–0·0502)
20–29	7	3619	0·193% (0·0778–0·398)	0·296% (0·158–0·662)	0·0600% (0·0317–0·132)	0·0309% (0·0138–0·0923)
30–39	18	7600	0·237% (0·140–0·374)	0·348% (0·241–0·577)	0·146% (0·103–0·255)	0·0844% (0·0408–0·185)
40–49	38	8571	0·443% (0·314–0·608)	0·711% (0·521–0·966)	0·295% (0·221–0·422)	0·161% (0·0764–0·323)
50–59	130	10 008	1·30% (1·09–1·54)	2·06% (1·74–2·43)	1·25% (1·03–1·55)	0·595% (0·344–1·28)
60–69	309	8583	3·60% (3·22–4·02)	5·79% (5·20–6·34)	3·99% (3·41–4·55)	1·93% (1·11–3·89)
70–79	312	3918	7·96% (7·13–8·86)	12·7% (11·5–13·9)	8·61% (7·48–9·99)	4·28% (2·45–8·44)
≥80	208	1408	14·8% (13·0–16·7)	23·3% (20·3–26·7)	13·4% (11·2–15·9)	7·80% (3·80–13·3)
Age category (binary), years						
<60	194	30 763	0·631% (0·545–0·726)	1·01% (0·900–1·17)	0·318% (0·274–0·378)	0·145% (0·0883–0·317)
≥60	829	13 909	5·96% (5·57–6·37)	9·49% (9·11–9·95)	6·38% (5·70–7·17)	3·28% (1·82–6·18)

Crude case fatality ratios are presented as mean (95% confidence interval). All other fatality ratios are presented as posterior mode (95% credible interval). Estimates are shown to three significant figures. Cases and deaths are aggregate numbers reported from Jan 1 to Feb 11, 2020.[8] Crude case fatality ratios are calculated as the number of deaths divided by the number of laboratory-confirmed cases. Our estimates also include clinically diagnosed cases (a scaling of 1·31 applied across all age-groups, as the breakdown by age was not reported for clinically diagnosed cases), which gives larger denominators and thus lower case fatality ratios than if only laboratory-confirmed cases were included. *Values do not include the clinically diagnosed cases included in our estimates. †Obtained by combining estimates of case fatality ratios with information on infection prevalence obtained from those returning home on repatriation flights. ‡Accounts for the underlying demography in Wuhan and elsewhere in China and corrects for under-ascertainment.

Table 1: **Estimates of case fatality ratio and infection fatality ratio obtained from aggregate time series of cases in mainland China**

Estimation of case fatality ratio, infection fatality ratio, and proportion hospitalised from aggregated case data

Estimates of the distribution of times from onset-to-death were used to project the expected cumulative number of deaths given the onsets observed in Wuhan and outside Wuhan, assuming a uniform attack rate across age groups. Using the age-distribution of the population, we obtained an estimate of the expected number of infections in each age group. Under-ascertainment was estimated in and outside of Wuhan by comparing the number of observed cases by age to this expected distribution, assuming perfect ascertainment in the 50–59 age group as this group had the highest number of detected cases relative to population size. We also did a sensitivity analysis assuming a differential attack rate by age (appendix p 9). For Wuhan, we added scaling to account for further under-ascertainment compared with outside of Wuhan. These steps gave us the expected age-distribution of cases.

For a given onset-to-death distribution, we obtained a modelled estimate of the cumulative number of deaths by age under an age-dependent case fatality ratio (fitted relative to the case fatality ratio in the oldest age group, which represented the highest crude case fatality ratio). This estimate was compared with the observed deaths by age using a Poisson likelihood. These data were then jointly fitted alongside the most recent age-aggregated cumulative deaths and cases in mainland China. Given that the numbers of observed cases and deaths have dropped substantially following a peak in late January, the ratio of current cumulative cases to current number of deaths, once corrected for under-ascertainment, should provide a good estimate of the final case fatality ratio.[11]

To estimate the infection fatality ratio we fitted to data on infection prevalence from international Wuhan residents who were repatriated to their home countries. Our age-stratified case fatality ratio and infection fatality ratio model was jointly fitted to the case data and infection prevalence data with use of Bayesian methods, using our previous estimate of the onset-to-death distribution as a prior. Full mathematical details are provided in the appendix (p 8).

Assuming a uniform attack rate by age groups, we used the demography-adjusted under-ascertainment rates calculated above to obtain an estimate of the proportion of infected individuals who would require hospitalisation.

To independently validate our infection fatality ratio estimate, we analysed data from the outbreak on the *Diamond Princess* cruise liner taking the dates of reported positive tests as a proxy for onset date. We calculated the expected proportion of deaths observed until March 25, 2020, given the onset times and estimated onset-to-death distribution (appendix p 13).

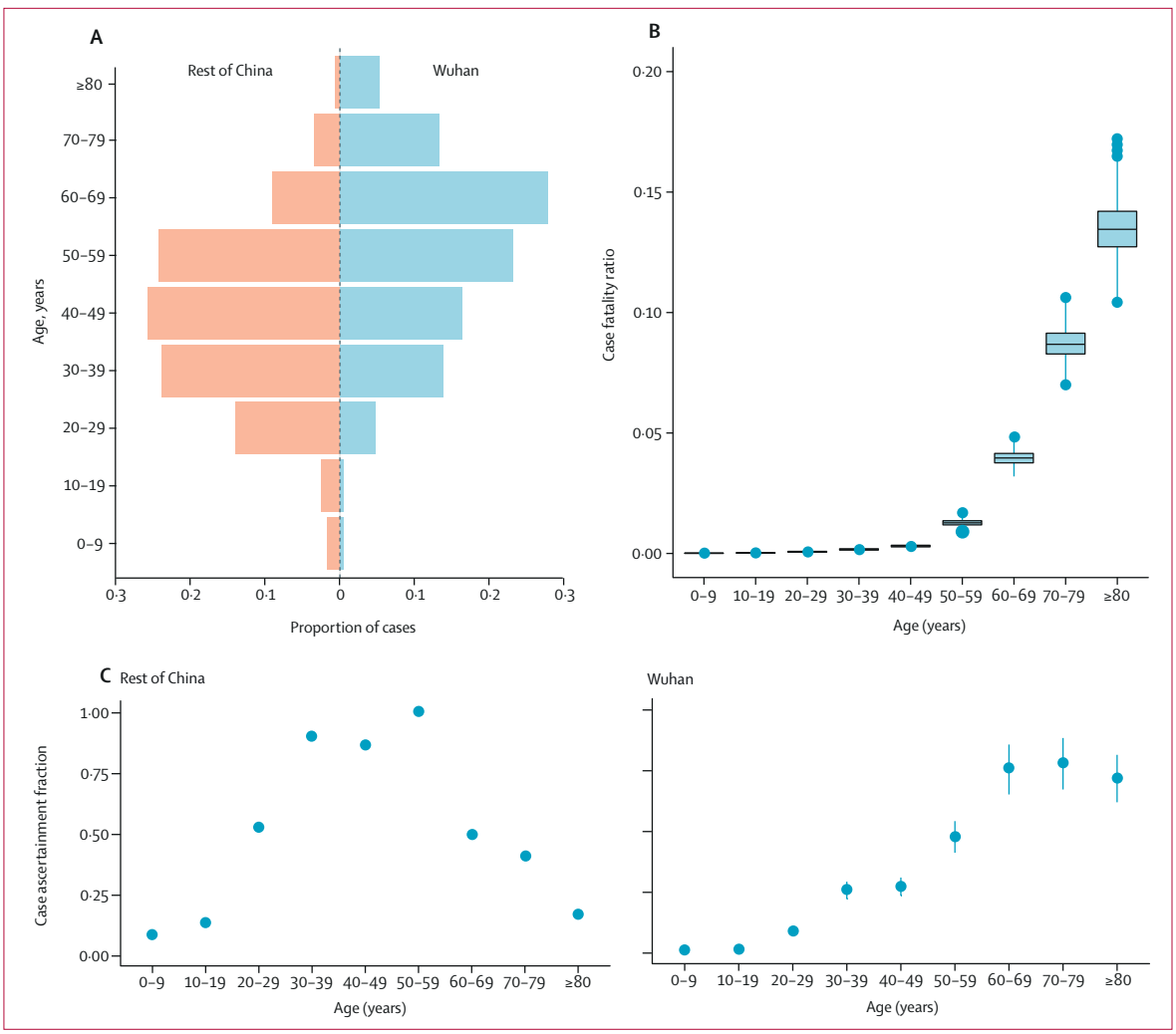

Figure 3: **Estimates of case fatality ratio by age, obtained from aggregate data from mainland China**
(A) Age-distribution of cases in Wuhan and elsewhere in China. (B) Estimates of the case fatality ratio by age group, adjusted for demography and under-ascertainment. Boxes represent median (central horizontal line) and IQR, vertical lines represent 1·5 × IQR, and individual points represent any estimates outside of this range. (C) Estimated proportions of cases ascertained in the rest of China and in Wuhan relative to the 50–59 years age group elsewhere in China. Error bars represent 95% CrIs.

Estimation of case fatality ratio from individual case data

We used parametric and non-parametric methods[11,22] to estimate the case fatality ratio in cases reported outside of mainland China using individual-level data. Cases in which the outcome was unknown were treated as censored observations. For parametric and non-parametric analyses, missing onset dates were multiply imputed using information on the onset-to-report distribution, and unreported recoveries were imputed using onset-to-outcome distributions and country summary data. The parametric models were fitted to the data using Bayesian methods (appendix p 12).

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

In the subset of 24 deaths from COVID-19 that occurred in mainland China early in the epidemic, with correction for bias introduced by the growth of the epidemic, we estimated the mean time from onset to death to be 18·8 days (95% credible interval [CrI] 15·7–49·7; figure 2) with a coefficient of variation of 0·45 (95% CrI 0·29–0·54). With the small number of observations in these data and given that they were from early in the epidemic, we could not rule out many deaths occurring with longer times from onset to death, hence the high upper limit of the credible interval. However, given that

	Parametric		Non-parametric	
	n	Case fatality ratio	n	Case fatality ratio
Overall	585	2·7% (1·4–4·7)	1334	4·1% (2·1–7·8)
Travel versus local transmission				
Travellers to mainland China	203	1·1% (0·4–4·1)	208	2·4% (0·6–8·5)
Local transmission	382	3·6% (1·9–7·2)	387	3·8% (1·7–8·2)
Age group, years				
<60	360	1·4% (0·4–3·5)	449	1·5% (0·6–3·9)
≥60	151	4·5% (1·8–11·1)	181	12·8% (4·1–33·5)

Parametric estimates are presented as posterior mode (95% credible interval), and were obtained using the gamma-distributed estimates of onset-to-death and onset-to-recovery. Non-parametric estimates are presented as maximum likelihood estimate (95% confidence interval) and were obtained using a modified Kaplan-Meier method.[11,23] Note that due to missing data on age and travel status, numbers in the stratified analysis are lower than for the overall analysis. In addition, the parametric method requires a correction for the epidemic growth rate, and these estimates were therefore obtained from the subset of data for which the travel or local transmission and age was known.

Table 2: **Estimates of case fatality ratio obtained from individual-level data on cases identified outside of mainland China**

	Severe cases	All cases	Proportion of infected individuals hospitalised
0–9 years	0	13	0·00% (0·00–0·00)
10–19 years	1	50	0·0408% (0·0243–0·0832)
20–29 years	49	437	1·04% (0·622–2·13)
30–39 years	124	733	3·43% (2·04–7·00)
40–49 years	154	743	4·25% (2·53–8·68)
50–59 years	222	790	8·16% (4·86–16·7)
60–69 years	201	560	11·8% (7·01–24·0)
70–79 years	133	263	16·6% (9·87–33·8)
≥80 years	51	76	18·4% (11·0–37·6)

Proportions of infected individuals hospitalised are presented as posterior mode (95% credible interval) and are adjusted for under-ascertainment and corrected for demography. Estimates are shown to three signficant figures. We assumed, based on severity classification from a UK context, that cases defined as severe would be hospitalised.

Table 3: **Estimates of the proportion of all infections that would lead to hospitalisation, obtained from a subset of cases reported in mainland China[22]**

the epidemic in China has since declined, our posterior estimate of the mean time from onset to death, informed by the analysis of aggregated data from China, is more precise (mean 17·8 days [16·9–19·2]; figure 2).

Using data on the outcomes of 169 cases reported outside of mainland China, we estimated a mean onset-to-recovery time of 24·7 days (95% CrI 22·9–28·1) and coefficient of variation of 0·35 (0·31–0·39; figure 2). Both these onset-to-outcome estimates are consistent with a separate study in China.[23]

Case fatality ratios were estimated from aggregate data on cases and deaths in mainland China (table 1). A large proportion of the cases, including all of those early in the epidemic, were reported in Wuhan, where the local health system was quickly overwhelmed. As a result, the age distribution of cases reported in Wuhan differed to that in the rest of China (figure 3A). Reported cases in Wuhan were more frequent in older age groups, perhaps reflecting higher severity (and therefore prioritisation for hospitalisation in Wuhan), while cases outside of Wuhan might also show a bias in terms of the relationship between age and travel. Adjusting for differences in underlying demography and assuming no overall difference in the attack rate by age, we estimated high under-ascertainment of cases in younger age groups both inside and outside of Wuhan (figure 3C, D). Furthermore, we estimated a higher level of under-ascertainment overall in Wuhan compared with outside of Wuhan (figure 3C). Accounting for this under-ascertainment, we estimated the highest case fatality ratio (13·4% [11·2–15·9%]) in the 80 years and older age group (figure 3B, table 1), with lower case fatality ratios associated with lower age groups, and the lowest in the 0–9 years age group (0·00260% [0·000312–0·0382]).

In cases reported outside of mainland China, we estimated an overall modal case fatality ratio of 2·7% (95% CrI 1·4–4·7) using the parametric model (table 2). In those who reported travel to mainland China (and would therefore have been detected in the surveillance system), we estimated an overall modal case fatality ratio of 1·1% (0·4–4·1), and in those without any reported travel to China (therefore detected either through contact tracing or through hospital surveillance), we estimated a case fatality ratio of 3·6% (1·9–7·2) using the parametric model. The estimated case fatality ratio was lower in those aged under 60 years of age (1·4% [0·4–3·5]) compared with those aged 60 years and over (4·5% [1·8–11·1]). Similar estimates were obtained using non-parametric methods (table 2).

In international Wuhan residents repatriated on six flights, we estimated a prevalence of infection of 0·87% (95% CI 0·32–1·9; six of 689). Adjusting for demography and under-ascertainment, we estimate an infection fatality ratio of 0·66% (95% CrI 0·39–1·33). As for the case fatality ratio, this is strongly age-dependent, with estimates rising steeply from age 50 years upwards (table 1). The demography-adjusted and under-ascertainment-adjusted proportion of infected individuals requiring hospitalisation ranges from 1·1% in the 20–29 years age group up to 18·4% in those 80 years and older (table 3). Using these age-stratified infection fatality ratio estimates, we estimate the infection fatality ratio in the *Diamond Princess* population to be 2·9%. Given the delay from onset of symptoms to death, we would expect 97% of these deaths to have occurred by March 25, 2020, giving an estimate of the current infection fatality ratio of 2·8%, compared with the empirical estimate of 1·4% (95% CI 0·7–2·6; ten of 712).

Discussion

From an extensive analysis of data from different regions of the world, our best estimate at the current time for the

case fatality ratio of COVID-19 in China is 1·38% (95% CrI 1·23–1·53). Although this value remains lower than estimates for other coronaviruses, including SARS[24] and Middle East respiratory syndrome (MERS),[25] it is substantially higher than estimates from the 2009 H1N1 influenza pandemic.[26,27] Our estimate of an infection fatality ratio of 0·66% in China was informed by PCR testing of international Wuhan residents returning on repatriation flights. This value was consistent with the infection fatality ratio observed in passengers on the *Diamond Princess* cruise ship up to March 5, 2020, although it is slightly above the upper 95% confidence limit of the age-adjusted infection fatality ratio observed by March 25 (of 712 confirmed cases, 601 have been discharged, ten have died, and 11 remain in a critical condition). This difference might be due to repatriation flight data slightly underestimating milder infections, or due to cruise passengers having better outcomes because of a potentially higher-than-average quality of health care.

Our estimates of the probability of requiring hospitalisation assume that only severe cases require hospitalisation. This assumption is clearly different from the pattern of hospitalisation that occurred in China, where hospitalisation was also used to ensure case isolation. Mortality can also be expected to vary with the underlying health of specific populations, given that the risks associated with COVID-19 will be heavily influenced by the presence of underlying comorbidities.

Our estimate of the case fatality ratio is substantially lower than the crude case fatality ratio obtained from China based on the cases and deaths observed to date, which is currently 3·67%, as well as many of the estimates currently in the literature. The principle reason for this difference is that the crude estimate does not take into account the severity of cases. For example, various estimates have been made from patient populations ranging from those with generally milder symptoms (for example international travellers detected through screening of travel history)[13] through to those identified in the hospital setting.[14,15]

It is clear from the data that have emerged from China that case fatality ratio increases substantially with age. Our results suggest a very low fatality ratio in those under the age of 20 years. As there are very few cases in this age group, it remains unclear whether this reflects a low risk of death or a difference in susceptibility, although early results indicate young people are not at lower risk of infection than adults.[28] Serological testing in this age group will be crucial in the coming weeks to understand the significance of this age group in driving population transmission. The estimated increase in severity with age is clearly reflected in case reports, in which the mean age tends to be in the range of 50–60 years. Different surveillance systems will pick up a different age case mix, and we find that those with milder symptoms detected through a history of travel are younger on average than those detected through hospital surveillance. Our correction for this surveillance bias therefore allows us to obtain estimates that can be applied to different case mixes and demographic population structures. However, it should be noted that this correction is applicable under the assumption of a uniform infection attack rate (ie, exposure) across the population. We also assumed perfect case ascertainment outside of Wuhan in the age group with the most cases relative to their population size (50–59-year-olds); however, if many cases were missed, the case fatality ratio and infection fatality ratio estimates might be lower. In the absence of random population surveys of infection prevalence, our adjustment from case fatality ratio to infection fatality ratio relied on repatriation flight data, which was not age specific. The reported proportion of infected individuals who were asymptomatic on the *Diamond Princess* did not vary considerably by age, supporting this approach, but future larger representative population prevalence surveys and seroprevalence surveys will inform such estimates further.

Much of the data informing global estimates of the case fatality ratio at present are from the early outbreak in Wuhan. Given that the health system in this city was quickly overwhelmed, our estimates suggest that there is substantial under-ascertainment of cases in the younger age groups (who we estimate to have milder disease) by comparison with elsewhere in mainland China. This under-ascertainment is the main factor driving the difference between our estimate of the crude case fatality ratio from China (3·67%) and our best estimate of the overall case fatality ratio (1·38%). The case fatality ratio is likely to be strongly influenced by the availability of health-care facilities. However surprisingly, although health-care availability in Wuhan was stretched, our estimates from international cases are of a similar magnitude, suggesting relatively little difference in health outcome. Finally, as clinical knowledge of this new disease accrues, it is possible that outcomes will improve. It will therefore be important to revise these estimates as epidemics unfold.

The world is currently experiencing the early stages of a global pandemic. Although China has succeeded in containing the disease spread for 2 months, such containment is unlikely to be achievable in most countries. Thus, much of the world will experience very large community epidemics of COVID-19 over the coming weeks and months. Our estimates of the underlying infection fatality ratio of this virus will inform assessments of health effects likely to be experienced in different countries, and thus decisions around appropriate mitigation policies to be adopted.

Contributors

NMF and ACG conceived the study with input from RV, LCO, ID, PW, and CW. RV, LCO, and ID led the analysis of individual-case data for the international cases and estimation of the onset-to-outcome distributions, with input from CAD, ACG, and NMF. RV, PW, CW, and PGTW led the analysis of the China data, with input from ACG and NMF. NI coordinated management of the team, including the data collation and processing.

NI and GC-D undertook the extraction of the international case data. HT undertook the extraction of flight repatriation data, with input from NI and AD. HF led the extraction of the China mainland data from national and regional websites with input from HW, YW, and XX. JTG developed the code for the non-parametric model. ACG produced the first draft of the manuscript. All authors contributed to the final draft.

Declaration of interests

LCO reports grants from WHO outside of the submitted work. CAD reports grants from the UK Medical Research Council and from the National Institute for Health Research during the conduct of the study. NMF reports grants from the UK Medical Research Council and the UK National Institute for Health Research during the conduct of the study, and grants from Gavi, the Vaccine Alliance, Janssen Pharmaceuticals, and the Bill and Melinda Gates Foundation outside of the submitted work. All other authors declare no competing interests.

Data sharing

All data and code used in this study are available in a GitHub repository.

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References

1 WHO. Coronavirus disease 2019 (COVID-19) situation report—43. March 3, 2020. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200303-sitrep-43-covid-19.pdf?sfvrsn=2c21c09c_2 (accessed March 5, 2020).

2 Chan JFW, Yuan S, Kok KH, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet* 2020; **395:** 514–23.

3 Chen N, Zhou M, Dong X, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet* 2020; **395:** 507–13.

4 Guan WJ, Ni ZY, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med* 2020; published online Feb 28. DOI:10.1056/NEJMoa2002032.

5 Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020; **395:** 497–506.

6 Li Q, Guan X, Wu P, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med* 2020; published online Jan 29. DOI:10.1056/NEJMoa2001316.

7 Novel Coronavirus Pneumonia Emergency Response Epidemiology Team. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. *Zhonghua Liu Xing Bing Xue Za Zhi* 2020; **41:** 145–51 (in Chinese).

8 WHO. Report of the WHO-China Joint Mission on coronavirus disease 2019 (COVID-19). Feb 28, 2020. https://www.who.int/publications-detail/report-of-the-who-china-joint-mission-on-coronavirus-disease-2019-(covid-19) (accessed March 26, 2020).

9 Garske T, Legrand J, Donnelly CA, et al. Assessing the severity of the novel influenza A/H1N1 pandemic. *BMJ* 2009; **339:** b2840.

10 Lipsitch M, Donnelly CA, Fraser C, et al. Potential biases in estimating absolute and relative case-fatality risks during outbreaks. *PLoS Negl Trop Dis* 2015; **9:** e0003846.

11 Ghani AC, Donnelly CA, Cox DR, et al. Methods for estimating the case fatality ratio for a novel, emerging infectious disease. *Am J Epidemiol* 2005; **162:** 479–86.

12 Donnelly CA, Ghani AC, Leung GM, et al. Epidemiological determinants of spread of causal agent of severe acute respiratory syndrome in Hong Kong. *Lancet* 2003; **361:** 1761–66.

13 Jung S, Akhmetzhanov AR, Hayashi K, et al. Real-time estimation of the risk of death from novel coronavirus (COVID-19) infection: inference using exported cases. *J Clin Med* 2020; **9:** E523.

14 Mizumoto K, Kagaya K, Chowell G, Yoshida-Nakaadachi-cho U. Early epidemiological assessment of the transmission potential and virulence of 2019 novel coronavirus in Wuhan City: China, January–February, 2020. *medRxiv* 2020; published online March 13. DOI:10.1101/2020.02.12.20022434 (preprint).

15 Famulare M. 2019-nCoV: preliminary estimates of the confirmed-case-fatality-ratio and infection-fatality-ratio, and initial pandemic risk assessment. Feb 19, 2020. https://institutefordiseasemodeling.github.io/nCoV-public/analyses/first_adjusted_mortality_estimates_and_risk_assessment/2019-nCoV-preliminary_age_and_time_adjusted_mortality_rates_and_pandemic_risk_assessment.html (accessed March 26, 2020).

16 Wu P, Hao X, Lau EHY, et al. Real-time tentative assessment of the epidemiological characteristics of novel coronavirus infections in Wuhan, China, as at 22 January 2020. *Euro Surveill* 2020; **25:** 1–6.

17 Xu XW, Wu XX, Jiang XG, et al. Clinical findings in a group of patients infected with the 2019 novel coronavirus (SARS-Cov-2) outside of Wuhan, China: retrospective case series. *BMJ* 2020; **368:** m606.

18 Yang Y, Lu Q, Liu M, et al. Epidemiological and clinical features of the 2019 novel coronavirus outbreak in China. *medRxiv* 2020; published online Feb 21. DOI:10.1101/2020.02.10.20021675 (preprint).

19 Government of Japan. Ministry of Health, Labour and Welfare. 2020. https://www.niid.go.jp/niid/en/2019-ncov-e.html (accessed March 26, 2020).

20 National Bureau of Statistics of China. China statistical yearbook 2018. http://www.stats.gov.cn/tjsj/ndsj/2018/indexeh.htm (accessed Feb 14, 2020).

21 Verity R, Winskill P. drjacoby. https://mrc-ide.github.io/drjacoby/index.html (accessed March 26, 2020).

22 Griffin J, Ghani A. CASEFAT: Stata module for estimating the case fatality ratio of a new infectious disease. Boston College of Economics. May 7, 2009. https://ideas.repec.org/c/boc/bocode/s454601.html (accessed March 26, 2020).

23 Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet* 2020; published online March 11. https://doi.org/10.1016/S0140-6736(20)30566-3.

24 Lau EHY, Hsiung CA, Cowling BJ, et al. A comparative epidemiologic analysis of SARS in Hong Kong, Beijing and Taiwan. *BMC Infect Dis* 2010; **10:** 50.

25 Lessler J, Salje H, Van Kerkhove MD, et al. Estimating the severity and subclinical burden of middle east respiratory syndrome coronavirus infection in the Kingdom of Saudi Arabia. *Am J Epidemiol* 2016; **183:** 657–63.

26 Riley S, Kwok KO, Wu KM, et al. Epidemiological characteristics of 2009 (H1N1) pandemic influenza based on paired sera from a longitudinal community cohort study. *PLoS Med* 2011; **8:** e1000442.

27 Kwok KO, Riley S, Perera RAPM, et al. Relative incidence and individual-level severity of seasonal influenza A H3N2 compared with 2009 pandemic H1N1. *BMC Infect Dis* 2017; **17:** 337.

28 Bi Q, Wu Y, Mei S, et al. Epidemiology and transmission of COVID-19 in Shenzhen China: analysis of 391 cases and 1,286 of their close contacts. *medRxiv* 2020; published online March 19. DOI:10.1101/2020.03.03.20028423 (preprint).

For the **GitHub repository for this study** see https://github.com/mrc-ide/COVID19_CFR_submission

THE GRIMES COUNTY OFFICE OF EMERGENCY MANAGEMENT

FOR IMMEDIATE RELEASE: 16 April 2020, 2:00 pm

Eighth and Ninth Confirmed Cases of COVID-19 in Grimes County

Grimes County has been notified by the Department of State Health Services of two more confirmed cases of COVID-19. The first case is a 62-year-old male inmate from the Pack Unit who died with his probable cause of death being pneumonia complicated by COVID-19. The second inmate in his 70's also tested positive for the virus and has been isolated from the inmate population. Eleven other inmates determined to have possibly come into contact with either confirmed case have been tested for the virus and were negative.

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION

LADDY CURTIS VALENTINE and RICHARD ELVIN KING, on behalf of themselves and others similarly situated,	§	
Plaintiffs,	§	
v.	§	Civil Action No. 4:20-cv-1115
BRYAN COLLIER, in his official capacity, ROBERT HERRERA, in his official capacity, and TEXAS DEPARTMENT OF CRIMINAL JUSTICE,	§	
Defendants.	§	

ORDER GRANTING PLAINTIFFS' EMERGENCY MOTION TO IDENTIFY SECOND COVID-19 CASE AT THE PACK UNIT

The Court, having considered Plaintiffs' Emergency Motion to Identify Second COVID-19 Case at the Pack Unit, any response, all argument and evidence presented, and all applicable law, the Court GRANTS the motion in its entirety.

Defendants are hereby ORDERED to disclose to Plaintiffs' counsel the name and TDCJ number of the second inmate who was assigned to the Pack Unit when a test showed he had contracted COVID-19 within 24 hours of this order.

Defendants are also ORDERED to, during the pendency of this litigation, disclose the name and TDCJ number of each inmate that tests positive for COVID-19 while assigned to the Pack Unit. Defendants shall provide this information within 48 hours of receiving each positive test result.

IT IS SO ORDERED.

SIGNED this _____ day of _____, 2020.

_____

KEITH P. ELLISON
UNITED STATES DISTRICT COURT JUDGE