Australian Nursing & Midwifery Federation

ANMF EVIDENCE BRIEF

SUMMARY: MODELLING THE IMPACT OF COVID-19 IN AUSTRALIA TO INFORM TRANSMISSION REDUCING MEASURES AND HEALTH SYSTEM PREPAREDNESS[1]

Author: Dr Micah DJ Peters **Date:** April 8 2020

Question: What is the best available evidence regarding modelling the impact of COVID-19 in Australia to inform transmission reducing measures and health system preparedness?

***ALERT* Evidence regarding COVID-19 is continually evolving. This Evidence Brief will be updated regularly to reflect new emerging evidence but may not always include the very latest evidence in real-time.**

Key messages:

- Unmitigated, the COVID-19 epidemic would rapidly overwhelm capacity of Australia's health system.
- Case-targeted measures including isolation of those known to be infected, and quarantine of their close contacts, must remain an ongoing cornerstone of the public health response.
- Isolation and quarantine of close contacts is likely to become less feasible to maintain over time due to social and economic impacts and will reduce effective infection control.
- As public health response capacity is exceeded, greater constraint of disease spread via social and physical distancing will be essential to ensure that feasible levels of expansion in available health care can maintain ongoing system functions, including care of COVID-19 patients.
- COVID-19 clinics may effectively reduce impacts on primary care and ED services, facilitate appropriate testing, and reduce the overall consumption of personal protective equipment by cohorting likely infectious patients.
- Emergency department overflow expansion, encouraging and supporting home-based care, and early discharge to supported isolation facilities should be considered.
- Proxy indicators of compliance to social isolation and movement restrictions via analysis of transport and mobile phone data will be further investigated in Australia.
- Further monitoring and analysis of multiple epidemiological and clinical data streams will examine the impact of varying the intensity of measures over time, to inform the necessary conditions that would enable 'exit strategies' from current lockdown conditions in order to ensure maintenance of social and economic functioning over an extended duration.
- All infection control strategies buy time for further health system strengthening and sourcing of needed supplies and ensuring the health and wellbeing of health care workers in protected.

Summary

Background: COVID-19 (from 'severe acute respiratory syndrome coronavirus 2' (or 'SARS-CoV-2') is a newly discovered (novel) corona virus first identified in Wuhan, Hubei province, China in 2019 as the cause of a cluster of pneumonia cases.[2] Coronaviruses are similar to a number of human and animal pathogens including some of those which cause the common cold as well as more serious illnesses including severe acute respiratory syndrome (SARS/ SARS-CoV-1) and Middle East respiratory syndrome (MERS). Since discovery, COVID-19 has spread to many countries and was declared a pandemic by the World Health Organization (WHO) on 30 January 2020.[3] The first cases of COVID-19 were reported in Australia in late January with rapid increases in the number of cases over February into March particularly in some local areas especially in New South Wales (NSW).[4] Since the broad adoption of isolation and containment measures, the reported number of new cases has begun to slow.[4] The notion of 'flattening the curve' has emerged and refers to measures aimed at slowing the infection rate, protracting the emergence of new cases, and reducing the risk of a sharp spike of cases that would likely overwhelm the capacity of the existing health system resulting in considerable and widespread morbidity and mortality both due to COVID-19 infection and other causes.[5]

This Evidence Brief is a summary of the Australian COVID-19 modelling study authored by researchers at the Doherty Institute.[1] This modelling is based on preparedness scenarios to inform planning and aims to informs the Commonwealth Government's public health response actions taken to slow the spread and prepare the health system.

Methods

Disease transmission model

- Assumed reproduction number (R_0) of 2.53.
- Case doubling time of 6.4 days.
- Potential for pre-symptomatic transmission was assumed within 48 hours prior to symptom onset.
- The proportion of all infections severe enough to require hospitalisation modelled to be between 4.3 and 8.6 percent where requirement for critical care increases steeply with age.
- Distributions of mild cases presenting to primary care modelled to range from 30-45 percent at the lower range of the 'severe' spectrum, to 50-75 percent for the most extreme case.
- Cases not presenting to the health system were assumed 'undetected' and included those with mild or no symptoms.

Case-targeted public health interventions

- Cases isolated at the point of diagnosis (assumed 48 hours after symptom onset), limiting the effective infectious period and reducing infectiousness by 80 percent.
- Targeted quarantine of close contacts was implemented with a fixed number of temporary 'contacts' for each new infectious case.
- Most contacts assumed to remain uninfected and return to their original 'non-contact' status within 72 hours.
- 80 percent of identified contacts assumed to adhere to quarantine measures.
- Overall infectiousness of truly exposed and infected contacts was modelled to be halved by quarantine.

Clinical pathway model

- Half of available consulting and admission capacity across all sectors and services modelled to be available to COVID-19 patients.
- Mild cases modelled to present to primary care until capacity is exceeded.
- Severe cases modelled to access the hospital system through ED and triaged from there to a ward or ICU bed according to need, if available.
- Assumption that 60 percent of all infections requiring ICU admission occur in individuals aged 70 years and over.
- As wards reach capacity, ED ability to triage drops due to bed block resulting in medical assessment being missed for some patients who need care. Some may access primary care.
- Model factors in repeat presentations within and between primary and tertiary care and progression from ward to ICU.

Critical care capacity expansion

- Assumption that half of currently available ICU beds would be available to COVID-10 patients.
- Three capacity-expansion scenarios modelled assuming routine models of care for patient triage and assessment within the hospital system:
  - Total ICU capacity expansion to 150% of baseline, doubling the number of beds available to treat COVID-19 patients (2 x ICU cap).
  - Total ICU capacity expansion to 200% of baseline, tripling the number of beds available to treat COVID-19 patients (3 x ICU cap).
  - Total ICU capacity expansion to 300% of baseline, increasing by fivefold the number of beds available to treat COVID-19 patients (5 x ICU cap).
- A theoretical alternative clinical pathway with constraints on bed numbers but double the capacity to assess severe cases presenting to hospital was also considered (COVID-19 clinics).

Social distancing measures

- Effectiveness of broad social (e.g. widespread social distancing interventions) and case-focussed measures (e.g. isolation of cases and contacts) of infection control are difficult to assess due to simultaneous implementation.
- Limiting infection spread/R0 by 25 percent (reducing R_0 to 1.9) and 33 percent (reducing R_0 to 1.69) through social distancing was overlaid on existing case-focussed interventions.
- Reproduction number in each scenario further reduced by additional quarantine and isolation measures.
- Simulations assume ongoing application of measures of fixed effectiveness, which is unlikely to be consistently achievable over time.

Findings

- Unmitigated COVID-19 outbread expected to dramatically exceed the capacity of the Australian health system over a prolonged period.
- Case isolation and contact quarantine alone would be insufficient to keep clinical requirements of COVID-19 cases within plausibly achievable expansion of health system capacity.
- Case isolation and contact quarantine applied at the same level of effective coverage throughout the epidemic can potentially substantially reduce transmission, lower peak incidence, and reduce the total number of cases (flatten the curve).
- Epidemic scenarios with higher clinical severity are likely than lower severity scenarios to be more effectively delayed due to enhanced presentation and identification.
- If mitigated, the epidemic is likely to result in increased utilisation of the healthcare system due to improved capacity to access care.
- Increasing the number of ICU beds available to patients with COVID-19 reduces the period where ICU capacity is anticipated to be exceeded, potentially by over half.
- Quarantine and isolation increases duration of ICU capacity exceedance.
- Unmet care needs remain in both mitigated and unmitigated scenarios.
- Total ICU capacity expansion to 300% of baseline, increasing by fivefold the number of beds available to treat COVID-19 patients (5 x ICU cap) results in dramatic reduction of the period and peak of excess demand and 20-40 percent of people who need critical care receiving it.
- True requirement for services not accurately reflected by the model due to blocks in assessment pathways resulting from ED and ward overload are an upstream constraint on incident ICU admissions.
- The COVID-19 clinic scenario results in high levels of unmet clinical need for both ward and critical care beds given baseline bed capacity.
- If ICU beds available to COVID-19 patients are doubled, between 10 and 30 percent of those who require critical care receive it.
- The duration of ICU exceedance remains substantial in the case of transmission reduction of 25 percent via distancing measures, but this exceedance is far less degree than if following case targeted strategies only.
- Transmission reduction of 33 percent makes treatment of all cases achievable in the majority of simulations if three to fivefold ICU bed capacity can be achieved.

Limitations

- Uncertainties regarding COVID-19's disease pyramid.
- Lack of evidence regarding determinants of disease severity.
- Assumption that half of available bed capacity is available for COVID-19 patients.
- Lack of factoring in of health workforce absenteeism and availability.
- Lack of factoring in of medical resource supply shortages

References

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