APBN Rapid Brief White Paper

2019 Novel Coronavirus (SARS-CoV-2); Expected challenges and risks to blood safety

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Executive Summary

The novel coronavirus that emerged in 2019 (SARS-CoV-2) in China is a significant new public health threat in the Asia-Pacific region. Whilst there are considerable information gaps at this time, experience with similar respiratory coronaviruses (SARS-CoV and MERS-CoV) suggest that SARS-CoV-2 has the ability to impact significantly on blood supply through donor deferrals, illness, public health requirements of quarantine and reduced staff and donor availability. SARS-CoV-2 has not been confirmed as transfusion-transmissible, and viraemia has only been detected in unwell patients who would not be eligible to donate blood.

Options to decrease the risk of transfusion transmission of SARS-CoV-2 include exclusion of at risk donors, quarantine of blood components, pathogen reduction or testing. The appropriate risk reduction strategy needs to take into account the local epidemiology, risk of transfusion-transmission in the context of the overall burden of disease, the public health response, blood supply sufficiency, operational impacts and cost considerations. Given that the infectious risk to blood safety is theoretical, any precautionary exclusion of at risk donors should be regularly re-evaluated with further information as the epidemic progresses. On the other hand, blood product sufficiency due to decreased availability of donors is a significant potential or real risk where local transmission is widespread and blood services should consider the sufficiency risk early to enable preparedness and response.

Background

On 31 December 2019, Chinese authorities reported an outbreak of pneumonia of unknown aetiology in the city of Wuhan (Hubei province). Subsequently, Chinese scientists isolated and sequenced a novel coronavirus (CoV) that has been determined to be causative agent of the pneumonia outbreak.

The novel coronavirus has been designated SARS-CoV-2 (1) and classified as a clade within lineage B of the *Severe Acute Respiratory Syndrome-related Coronavirus* species, *Sarbecovirus* subgenus, *Betacoronvirus* genus and *Coronaviridae* family. SARS-CoV-2 is probably of bat origin, with sequence analysis suggesting that the virus is most closely related (96.2% sequence homology) to a bat coronavirus detected in bats from Yunnan Province (BatCoV RaTG13). SARS-CoV-2 isolates have demonstrated approximately 79.5% sequence homology with severe acute respiratory syndrome CoV (SARS-CoV) (2) (3) (4). Coronaviruses have a single-stranded positive-sense RNA genome (5). Research publications and dissemination of data from authoritative sources has been facilitated, so in this early phase of the epidemic information about the clinical features and epidemiology, as summarised below.

Incubation period and disease

The disease caused by SARS-CoV-2 is referred to as coronavirus disease 2019 (COVID-19). The mean incubation period for COVID-19 appears to be 5 to 6 days with a range from approximately 1 to 13 days (6, 7). An upper limit for the incubation period of fourteen days is currently used based on initial COVID-19 studies and data for the related viruses causing Severe Acute Respiratory Syndrome (SARS) (SARS-CoV) and Middle East Respiratory Syndrome (MERS) (MERS-CoV). Symptoms of reported cases of COVID-19 include fever, malaise, dry cough and shortness of breath, Other symptoms including abdominal symptoms such as diarrhoea are have also been observed (8). People of older age or having underlying disease are at a higher risk of developing severe symptoms and complications.

An initial analysis of 291 cases found 72% of patients were older than 40, 64% were male, and the people who died had underlying health conditions (9). In a report of 138 cases admitted to hospital in Wuhan with laboratory-confirmed infection, 54.3% were male, 46.4% had co-morbidities and the median age was 56 years (8). The most common symptoms at onset were fever (98.6%), fatigue (69.6%) and dry cough (59.4%). Dyspnoea (breathing difficulty) developed in 43% of patients with a median time from onset of symptoms of 5 days with 8 days to acute respiratory distress syndrome.

The proportion of asymptomatic infections is currently unknown but has been demonstrated to occur (10) and would be expected given that there have been reported cases of asymptomatic SARS-CoV infection (11). In addition, of all MERS-CoV cases reported to WHO up to August 2018 (n=2,228), 21% had no or mild symptoms. While this does not equate to an asymptomatic rate among all infections, it suggests that less than half of MERS-CoV cases are either asymptomatic or have very mild symptoms that are not recognised (12).

Human transmission routes

Most of the earliest reported cases of COVID-19 were associated with a seafood/animal market in Wuhan (13) suggesting that these patients were infected via zoonotic and/or environmental exposure. However, the earliest cases in the reported case series were not associated with the seafood market. Typically, emerging infections are zoonotic, with bats often implicated. There is now overwhelming evidence of human-to-human transmission of SARS-CoV-2 based on (i) infection in healthcare workers (at least 15 reported cases) (14), (ii) several reported family clusters(10) and (iii) cases without travel to the Hubei Province in China including a large outbreak of 174 cases as of 13/2/2020 on a cruise ship in Japanese territorial waters (15). There are reports that transmission via the respiratory route is possible in the pre-symptomatic early incubation (16, 17). However, there are also unverified reports that dispute the findings of Rothe et al (17), and state that the index patient did have symptoms (18). To carefully and conservatively assess the implications for the safety of the blood supply, this paper assumes that further spread of SARS-CoV-2 is through the human-to-human respiratory route. Key questions for impact assessment are not yet answered (19).

In addition to efficient human to human transmission, Munster et al note that disease severity is key, as if people do not have serious disease, infected people will not be effectively isolated and may work and travel. The role of super-spreaders in transmission of SARS-CoV-2 has yet to be fully determined.

Case numbers

This information will not stay relevant as the outbreak evolves. As at February 13rd 2020, there are 46,997 cases globally with 46,532 confirmed in China with 1,368 deaths. Outside of China there are 465 confirmed infections with 1 death.

Estimation of an overall case mortality rate is currently not possible given the asymptomatic/mildly symptomatic rate of infection is not known (and these cases would not be reported) and there is likely underreporting of symptomatic cases (20). However, it is clear the mortality rate is less than SARS-CoV and MERS-CoV.

Blood phase and potential for transfusion-transmission

The blood phase of SARS-CoV-2 infection has not been defined. Based on the related MERS-CoV, it would be expected that following SARS-CoV-2 infection, there would a relatively brief and low-level viraemic period. Reports of MERS-CoV cases from both the Middle East and Korea indicate that about 30% of cases have detectable viraemia at time of diagnosis (21, 22). In the study of Middle East MERS-CoV patients, about 50% showed detectable viraemia at or within the first week after diagnosis (21). Serum viral loads varied from 10^3 to 10^5 copies/mL in Middle East patients and $2x10^3$ to $1.7x10^4$ copies/mL in Korean patients. This is consistent with the study of the first 41 cases of COVID-19 to be admitted to hospital in Wuhan where SARS-CoV-2 RNA was detected in blood in only 6/41 (15%) of patients (13). In addition, in a study of a familial COVID-19 cluster, viral RNA was detected in the serum of 1 of 5 infected family members, who had symptoms (10).

For MERS-CoV infection, serum RNA levels decline as neutralising antibodies become detectable, between 10–20 days after symptom onset (23). This occurs with other viral infections as well, and would be expected to be demonstrated with SARS-CoV-2.

The transfusion-transmissibility of SARS-CoV-2 has not been determined. The primary risk to blood safety would be associated with infectious viraemic but asymptomatic donors, either acute infections prior to symptom onset or infections that do not result in symptoms. As noted, the blood phase of SARS-CoV-2 infections has not been defined, and the proportion of SARS-CoV-2 infections that result in symptoms is not known.

A pivotal point is that no respiratory virus, including SARS-CoV, MERS-CoV, and influenza viruses have ever been confirmed as transfusion-transmissible by any blood product.

Virus detection in blood has only been detected in symptomatic patients with COVID-19 to date. In the case of influenza, detection of viraemia, detected in a small proportion of unwell hospitalised patients, was an indicator of severe disease (24). Given this preliminary information, coupled with the fact that unwell people are not eligible to donate blood, it would be expected that any risk to blood safety would be from an asymptomatic or pre-symptomatic donor. For resultant transfusion-transmission, viraemia that remains infectious during blood collection and processing would need to occur. With other viruses including related coronaviruses such individuals would be considerably less likely to be viraemic and their viral load is much lower. Therefore, the risk of transfusion-transmission of SARS-CoV-2 on current information is theoretical.

What are the current and future challenges facing blood services?

On 30th January 2020 the World Health Organization (WHO) declared that the outbreak of COVID-19 constituted a Public Health Emergency of International Concern (PHEIC). The Committee also noted it is still possible to interrupt virus spread, provided that countries put in place strong measures to detect disease early, isolate and treat cases, trace contacts, and promote social distancing measures commensurate with the risk (25). Consistent with the public health emergency declared, this paper addresses two potential phases of the epidemic to guide blood services:

1) A containment phase, where small clusters of human-to-human transmission have been detected in a country or region but this is not sustaining an ongoing community level outbreak. During the early containment phase aggressive contact tracing and quarantine measures implemented as part of the public health response may identify potential cases therefore community risk will be very low.
2) Sustained and widespread human-to-human transmission in a country or region

For this paper this represents a simplification of the transmission dynamics to facilitate blood service consideration. As noted in the human transmission section, key answers to allow an impact assessment including the proportion of mild or asymptomatic cases that may facilitate spread is unknown and will determine if containment is effective (19).

It is important for blood services to consider the blood safety infectious disease risk in the context of the public health risk and the risk to sufficiency.

1) Mitigate the potential for transfusion-transmission (the infectious risk)

As documented, the risk of transfusion-transmission is currently theoretical. Blood services have typically acted quickly with a new infectious agent, mitigating the risk before it occurs. Examples include the geographical deferrals implemented to mitigate the risk of variant CJD, prior to transfusion-transmission being demonstrated (26).

Geographical restrictions were implemented as a precaution in a number of countries, including for example in Australia in response to SARS-CoV for blood donation, despite no cases occurring in Australia based on WHO recommendations (27).

Whilst this precautionary approach mitigates any theoretical risk, in the event of sustained and widespread transmission the impact on donors and blood product sufficiency must be considered. The WHO guideline document for blood transfusion services in the event of a pandemic influenza outbreak states “The transmission of a respiratory virus by transfusion is very unlikely to result in an infection in the transfused patient although, in the most extreme cases where the blood donor is viraemic with a particularly high viral load, the possibility of transmission has to be considered; in these circumstances, however, the donor is unlikely to be well enough to donate” (28).

It is appropriate to consider the risk of theoretical risk transfusion-transmission in the context where donor deferral, which aims to protect the blood supply, may have a greater negative impact on sufficiency. This statement would also remain relevant in the event that transfusion-transmission has occurred but was rare in the total context of the burden of disease.

2) Mitigate the risk of staff and donor exposure to COVID-19

When there are actual cases in the community, the risk to other donors and staff is a risk that is proportional to the transmissibility of number of cases in the community, the strength of the public health response and what public health measures have been implemented by governments. Although the risk to staff and other donors may be mitigated by existing criteria for donors to be in good health, there is the possibility of transmission by those who are asymptomatic, those in the pre-symptomatic phase (17) or those with very mild symptoms. Blood services should therefore follow relevant public health guidelines such as public health contact tracing guidelines (for contact with a confirmed case) or quarantine requirements for travellers during the initial phase of containment. The residual risk to blood services in early containment with aggressive public follow up is likely negligible and additional risk mitigation is not likely required.

Once the epidemic moves into sustained community transmission, blood services should ensure that their strategies to prevent infection in staff are proportionate and evidence based. As blood donors are generally healthy, the context of blood collection should not be viewed in the same context of health-care workers dealing with sick patients. Precautions taken in the health care setting should not be applied to donor centres unless there is evidence of their effectiveness in community settings.

3) Mitigate the impact on the availability of blood donors and staff (sufficiency risk)

During the early phase of an epidemic when they are only a few cases, a more conservative precautionary deferral period for contacts of confirmed cases or history of travel will cover with more certainty any theoretical risk to blood safety, given that the epidemiology of the virus is highly uncertain. With a small number of cases and contacts, such precautionary deferrals are less likely to have a significant impact on sufficiency and therefore there may be pressure to implement precautionary deferrals, especially given the level of community anxiety.

During an epidemic or pandemic involving a respiratory virus, healthy uninfected donors are less available to donate blood if the outbreak affects many in the community, family and workplace. Overly precautionary deferrals for donors who have been COVID-19, who have a history of fever, who have travelled to an area with widespread transmission or who have been in contact with a confirmed case will have a significantly greater impact on regular blood donors. During the SARS-CoV epidemic in Beijing the unavailability of blood donors was caused by avoidance of public places and closing of workplaces and universities (29). During this outbreak, blood was required to be imported from other Chinese regions (29). In Singapore, donor attendance dropped by as much as 60% during the peak of the epidemic (30) with an additional 4% deferred from donating (31). In a containment phase, importation of blood products is possible but in the event of sustained widespread transmission, this is not a viable option.

The challenge for blood services is how to manage sufficiency risk in the context of blood safety and public health risks. It is important to note that there is a great deal of concern in the communities, fuelled by mainstream and social media postings, including information that is not accurate. Travel restrictions have already been introduced in various countries, associated with associated economic impact in terms of reduced tourism, trade and education. Widespread community quarantine can impact transportation for donors and potentially blood components.

It is important for blood services to assess the impact on donation numbers and to take early measures to mitigate any decrease in donor attendance. Such measures could include ramping up appointments for whole blood and component donation. A proactive communication strategy with donors directly and via mainstream and social media is likely to be very important in mitigating the risk of sufficiency (particularly reduced supply of fresh components). Donor transportation should be considered to facilitate attendance and minimise travel associated community exposure through the respiratory route.

4) Manage the demand for blood and blood components (sufficiency risk)

In the containment phase, the demand for blood components may not change appreciably. In the event of widespread and sustained transmission, it would be expected that emergency epidemic/pandemic plans will be activated as health authorities prioritise their health-care resources.

Patient blood management and cessation of elective surgery will contribute to decreased demand, but sepsis may increase requirements and significant reductions will not be possible in areas such as trauma, cancer patients, hereditary haemolytic anaemias and childbirth. Some trauma associated product demand may reduce as an outcome of any local quarantine activities such as a reduction in transport. Thus whilst blood services may have a role in gatekeeping of products, the expected major role a blood service will play is through supply continuity. Donor recruitment and facilitation of donation, donation component prioritisation and other efforts to increase supply are key challenges in the event of a supply shortage.

5) Manage potential critical materials and equipment of supply shortages

In the early containment phase this is unlikely to be a significant issue. However, if travel and trade is impacted because of ongoing travel restrictions, quarantine requirements, social distancing and border control measures, this has the potential to impact on supply of critical material used in blood component manufacture. Blood services should consider this impact early.

What potential measures are available to reduce the risk to the blood supply?

1) Exclusion of at-risk donors

Early recommendations for donor exclusion that have not experienced or have limited secondary cases or are in the containment phase are varied. The European Centre for Disease Prevention and Control notes, given the unknown epidemiology, that a precautionary deferral based on SARS-CoV and MERS-CoV is used (32):

- 28 days (twice the maximum incubation period[1]) after possible exposure to a confirmed case or after returning from China or an area with presumed ongoing community transmission (i.e. a 28-day travel restriction)
- Recovering patients should be deferred for at least 28 days after symptom resolution due to the current uncertainty about persistence of viraemia or vial shedding in body fluids.

AABB notes that there is no data or precedent suggesting risk of transfusion-transmission (33) and therefore no action is recommended by blood collection establishments. They have documented approaches, rather than recommendations, including:

- Voluntary travel deferrals, using a 28 day period (twice the maximum incubation period[2])
- Combination of deferrals relating to illness and contact and enhanced education.

[1] If at significant risk of transfusion-transmission, any donor deferral should consider both an incubation period and a potential viraemic period as if a viraemic period is longer than the incubation period, doubling of the incubation period will not provide adequate protection.
[2] If at significant risk of transfusion-transmission, any donor deferral should consider both an incubation period and a potential viraemic period as if a viraemic period is longer than the incubation period, doubling of the incubation period will not provide adequate protection.

Blood services should follow the public health advice in their region. For example, if a country or region is currently in the containment phase and the public health advice is recommending or enforcing quarantine for travel to an affected area, then collecting blood from a potential donor in quarantine would not be recommended. However, specific blood service action may not be required, as the public health response may be adequate to prevent at risk people from donating blood (i.e. public health advice to people at risk would include self-quarantine or they may be in monitored or enforced quarantine and that is not compatible with attempting to donate blood).

During the containment phase, blood services may elect to implement precautionary deferrals. However, these are not specifically recommended. Instead, the response should be flexible and proportionate. Overly precautionary deferrals may contribute to misunderstanding in the community about transmission risk. Blood services, as respected institutions in a community, must ensure that their messaging and actions are proportionate and evidence based, whilst noting that a degree of caution may be necessary given the epidemiology knowledge gaps.

In the event of sustained widespread local transmission, the expected sufficiency risk is greater than the blood safety risk and therefore any donor restrictions should be constantly re-evaluated, refined and altered to best fit the local requirements.

Systems should be in place for donors to report a post-donation illness or contact with a case that is confirmed post donation, and for recall of blood and blood components. Notification of the clinician should be considered and will potentially provide further information about the transfusion-transmission risk of SARS-CoV-2. However, blood services should carefully consider the risk of a transfusion recipient being classified as a ‘confirmed contact’ and the resultant public health action that it could trigger. Adequate risk communication is vital to ensure public health precautions are not implemented for transfusion recipients in the absence of a definitive onward transmission risk.

Systems should also be in place to enable re-entry of a blood donor who has recovered from COVID-19, with a suitable deferral period post recovery that is adequate to cover the infectious period with 100% certainty. This ensures there is no risk to staff, other donors and recipients. This will also support the option for collection of convalescent plasma, should there be demand and suitable systems in place to support production and supply of this blood component. At the time of writing, the post-recovery deferral period should be no shorter than 28 days.

2) Quarantine or withholding of components prior to issue

During the containment phase, the expected donor loss is not significant enough to initiate quarantine of components (to address the potential risk of donors becoming symptomatic post donation). Those at greatest risk such as confirmed contacts of cases may be in physical quarantine, and not attending a blood donor centre.

Quarantine of components in the event of widespread sustained transmission is a potential option to maintain sufficiency of red cells and plasma. However, in the absence of confirmed transfusion-transmission risk, quarantine could negatively affect sufficiency. In addition, given the similarity with other respiratory pathogens, it would be difficult for blood services to implement a suitable quarantine system. Quarantine of platelet donations would also not be possible, given the short shelf life of platelets.

3) Pathogen reduction of blood components

Pathogen reduction technology (PRT) is available for platelets and plasma but not for red cells. PRT has been demonstrated to be effective against SARS-CoV for platelets and plasma (34). However, the cost-benefit of introducing PRT for SARS-CoV-2 is expected to be low, given that transfusion transmission has not been demonstrated for SARS-CoV-2 or similar coronaviruses and that current donor criteria further reduces a theoretical risk. PRT is likely not to have a significant contribution in reducing SARS-CoV-2 transmission risk, apart from one of reassurance.

It is important to be aware of the risks involved in introducing PRT during epidemic/pandemic, in particular: (35)

- High cost
- Lack of automation
- Damage to the product especially platelets resulting in sufficiency issues and higher dosing requirements in patients
- Work health and safety issues to manufacturing staff with a large scale manual process for all components
- Lack of availability of PRT for red cells

4) Testing of the blood supply

Given that SARS-CoV-2 is a new infectious agent, there is little information on the applicability and validity of any test as a screening test for asymptomatic blood donors, although it will probably be most effective by nucleic acid testing (NAT). Serology testing will not be as useful in screening asymptomatic or pre-symptomatic donors during the acute phase of infection, as they will not have formed detectable antibodies. NAT testing is costly, and the experience in the USA of introducing NAT testing in certain regions for ZIKA virus is informative – just over 4 million donations were screened by ID-NAT, with 8 reactive donations identified at a cost of $5.3 million US dollars (36).

As transfusion-transmission has not been demonstrated and there is no licensed test that can be scaled up to screen blood donors, options for testing are premature. Testing for SARS-CoV-2 is also not consistent with blood safety measures taken for other respiratory transmitted viral illnesses in which transfusion transmission remains theoretical, including influenza.

What is the best approach to selecting an appropriate risk reduction strategy?

Factors for consideration

Any risk reduction strategy needs to take into consideration the extent of the presence of the virus in the country or geographical area and the blood donor population. In addition, the initial public health response such as quarantine of cases and contacts in a region may result in any theoretical risk being so low that any blood safety measures would do little further to decrease the risk. Risk communication is a vital public health tool. For the emerging SARS-CoV-2 epidemic it is vital that blood services consider their response to the epidemic carefully. An overly precautionary response early, given the theoretical blood safety risk, may contribute to community misinformation on the risk and make it more difficult to sustain the blood supply if sustained community transmission has occurred. A precautionary approach may be acceptable if it has the ability to be flexible and change with emerging evidence and a changing epidemiology.

Blood services should ensure they have access to updated surveillance information and are connected with relevant government and international networks, in order to keep informed of changing epidemiology and emerging evidence. They should be prepared to move quickly in response to changes in their area, such as transition from a containment phase to a community transmission phase. Blood sufficiency is likely to be a significant risk as the situation changes. Emergency response or pandemic plans should be prepared and activated where required.

Suggested risk reduction strategies

As with any blood safety decision, implementing any strategy to reduce SARS-CoV-2 risk needs to take into consideration transfusion-transmissibility, level of community circulation (i.e. containment vs sustained and widespread), blood supply sufficiency, operational impacts and its cost effectiveness in reducing disease morbidity in relation to the overall health situation in the country, especially in countries with limited resources.

Containment phase

During the containment phase, blood services may elect to implement precautionary travel, contact and case deferrals. However, these should not be considered a recommendation given there is no definitive transfusion-transmission risk and the public health action in a particular area may have decreased the general transmission risk to a level where adding the deferral will not increase blood safety and may impact sufficiency.

Blood is a highly regulated environment and there is a risk that any precautionary deferral is then difficult to rescind. Blood services should ensure early communication with their regulators and public health officials with an aim of a proportionate and flexible approach and any risk reduction strategy should not be rigid or difficult to remove and update.

Sustained and widespread transmission

Where sustained and widespread transmission is occurring, the focus would move to crisis management and is expected to be documented in existing pandemic and business continuity plans. Sustaining the blood supply, focussing on essential activities, ensuring donors and staff can donate and work in a flexible environment that is as low risk as possible. Blood services should ensure their plans consider:

1) Epidemic and risk assessment surveillance of blood safety

Two key indicators of severity are:

a) Transmission severity: numbers and routes of transmissions, using indicators such as the reproductive number and the community attack rate. This needs to take into account the method of spread, is it spread by airborne, droplet, contact or vehicle methods, as more information becomes known.

b) Clinical Severity: monitoring severity of symptoms using indicators such as the mortality rate, number and proportion of hospitalisations and ICU admissions. As further cases occur, information about COVID-19 will be refined, in particular the percent mortality estimation is likely to fall as the number of asymptomatic and mild cases is determined.

Results of this risk assessment should guide the specific response as per Table 1.

Table 1. Adjusting key responses in light of information about transmissibility and severity

Transmissibility	Severity	Key responses
High	Low	Inventory control, mitigating staff absenteeism
Low	High	Communications, convalescent plasma consideration
High	High	Rationing product, communications, managing absenteeism, convalescent plasma consideration
Low	Low	Communications

2) Donor deferral and recall

Decisions on donor deferral and recall or any changes will be based on changing epidemiology and should be an ongoing process taking into account new information.

- Issue instructions and education for staff as required and update regularly.
- Monitor donor deferrals, recalls and surveillance data on community attack rates to estimate impact on supply.

- If product insufficiency results due to donor deferrals, consider relaxing the epidemic deferral criteria based on a risk assessment.
- Donor deferrals for cases, contacts and geographical risk should be aligned with the public health response but proportionate to the risk of transfusion transmission versus the risk to sufficiency.
- In the event of donor triggered lookback, the need to have ability to undertake nucleic acid test (NAT) and possibly serology on archived specimen.

3) Inventory and product demand surveillance and response

Inventory should be managed through existing plans and processes.

4) Communication

A communication strategy specific to the changing SARS-CoV-2 epidemiology should ensure employees, donors, and other external stakeholders are informed. Communications will relate to specific actions to ensure the safety and reliability of the blood supply and the safety of staff and donors. Any communication should be consistent both internally and with government messaging. Relevant stakeholders may include:

- Internal
  - Management including disaster/pandemic committees
  - Key donor and product safety committees
  - Donor centre staff
  - Media and marketing staff
  - Medical staff
  - Manufacturing staff
  - Laboratory staff
  - Transportation staff
  - Any other key groups
- External
  - Donors
  - Regulators
  - Key clinical advisory bodies and groups
  - Mainstream media
  - Social media

5) Staff and Donor shortages

The impact on staff and donor levels taking into account illness, quarantine, risk perception and caring for relatives should guide actions. Strategies may include:

- Reorganise workflow to maximise available skill sets.
- Temporarily relocate and redeploy staff where required.
- Direct management of operating hours and facilities in response to staff availability including closing sites, extending/reducing opening hours at functioning sites.

- Reallocation of remote working capabilities using technology where required (this may be critical if a quarantine requirement is directed by a government and staff are unable to attend their regular place of work).
- Increased use of volunteers, call for alumni staff and increased working hours or flexibility.
- Staff segregation and limiting non-essential staff contact including meetings.
- Follow updated public health guidelines for contact tracing for staff. For example, in the containment phase, confirmed contacts of a case may be advised to self-quarantine. Australian contact tracing guidelines(37) acknowledge the gaps in the understanding of infectivity and acknowledge that it is still likely that cases become infectious from onset of symptoms. However, given the infectivity knowledge gaps, as at 17th February 2020, the guidelines are using a 24 hour period before symptom onset for contact tracing. Similar to the 2009 influenza pandemic, if sustained transmission occurs, quarantine requirements may change and not be required for well people. In the event of staff exposure, excessively precautionary contact restrictions should not occur unless they are specifically recommended by local public health requirements.

6) Critical Material and Equipment shortages

Prolonged border closures, travel restrictions, quarantine requirements and social distancing measures introduced as public health measures or because resources subsequently are refocused on infection prevention and health care may decrease the global supply chain of essential materials and equipment required for blood donation. Blood services should consider this risk early including goods that may be sourced, manufactured or transit through an epidemic area or goods that may be in increased demand due to increased use because of the epidemic e.g. hand sanitiser. Steps to mitigate the risk to ensure any critical equipment shortages are minimised is vital.

7) Infection Control

Infection control manoeuvres should be consistent with national and state communicable disease control guidelines for COVID-19 for communities. Blood collection centres are not acute medical care facilities so general public guidelines rather than hospital guidelines should be followed.

Enhanced communication about basic infection control should be considered for reinforcing:

- Hand hygiene: this is appropriate for all modes of transmission including airborne, droplet and contact. Consider enhanced handwashing/alcohol hand rub use by ensuring easy availability at all donor centres in common areas.
- Cough etiquette: appropriate for all modes of transmission.
- Avoid close contact with sick people.
- Staff and donor messaging to stay at home if they are unwell or (if public health contact tracing guidelines dictate) have contact with someone unwell with COVID-19.

Enhanced infection control would not normally be required unless on specific advice of public health and/or infection control personnel:

- Additional personal protective equipment such as P2/N95 masks, additional gloves and gowns for collection of blood is not currently considered necessary as blood services collect from people who are well and are not front line health care workers.
- If blood services provide transfusion testing for patients who may have COVID-19 then personal protective equipment as per standard laboratory practices are recommended (38). Blood services should ensure processes remain consistent with any updated advice.
- Specific quarantine instructions/exclusion policies for staff may need to be introduced for staff at high risk of contracting the epidemic agent e.g. confirmed contacts of the disease on advice of public health units in conjunction with local blood service infection control experts.
- Enhanced environmental cleaning would not normally be required, but may be recommended to decrease the risk of exposure or in the situation that a suspected case was present at a blood service.

Infection Control advice should be based on government recommendations and it is recognised that there are regional differences.

8) Staff safety considerations

Consideration should be given to additional risk management for staff who have planned travel.
While the risk of staff becoming infected during travel to countries with SARS-CoV-2 may be low, given the rapidly evolution and significant uncertainties, organisations should give consideration to postponing business related staff travel.

This decision making should consider the proximity of the travel destination to the epicentre, volume of travel from the country to China and other endemic areas, local surveillance and health care systems and the ability of the country to detect and contain disease if local transmission or case presentation occurs.

There is also the potential risk of countries implementing travel and quarantine restrictions while the staff member is travelling.

Blood services should follow formal travel advice issued by governments but additional precautions in the context of non-essential travel could be considered.

Conclusions

Given SARS-CoV-2 is a novel infectious agent there are significant gaps in the epidemiology that would enable an accurate assessment of the risk. Whilst the risk of transfusion-transmission cannot be excluded with certainty, widespread transfusion-transmission of a respiratory virus from well donors is unlikely in the context of current knowledge. Therefore, blood services should consider their local context. If blood services elect to implement precautionary travel and other deferrals such as contact with a COVID-19 case they should ensure these are flexible and responsive to epidemiology changes, rather than being fixed. During the containment stage of the epidemic, given the low blood safety risk, members are not advised that they must implement specific deferrals, as the risk is low and variable, although many have chosen to do this. Blood product sufficiency due to decreased availability of donors is a significant potential or real risk where local transmission is widespread and blood services should consider the sufficiency risk early to enable preparedness and response.

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