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COVID-Safe Awareness and Implications for Environmental Surface Testing in Australia

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Abstract: Around the world there is economic imperative to lift restrictions that were designed to reduce contagion from the SARS-CoV-2 virus that causes coronavirus disease (COVID-19). From a public health perspective, there is need for caution to mitigate against a rebound as interventions are eased. Suppression strategies extend beyond lockdowns and include education and infection control strategies. Because the virus is transmitted in the air or shed onto surfaces, there is considerable potential for interventions aimed at controlling either of these mechanisms. Face masks limit aerosol exposure, while high or low-touch surfaces can be physically cleaned or disinfected. The problem is that existing validation tests for cleaning are not specific for viruses. A solution to this which confirms the presence or absence of SARS-CoV-2 RNA is achieved using the polymerase chain reaction (PCR). It is proposed to use PCR swab tests, already used for clinical diagnosis, but for surface testing and cleaning validation or for monitoring and surveillance within the built environment and other infrastructures. In Australia, moves towards developing and maintaining a COVID-safe workplace are underway. This paper reports on a survey of Australians that assesses their knowledge and awareness of viral surface contamination and how this could be measured using PCR. The survey results show that knowledge and awareness about risks from surface environmental contamination is generally good, but accuracy about target types needs improvement. Survey respondents were worried about personal exposure to coronavirus in their day to day activities (55.4%) and considered that surface testing would increase consumer confidence about being COVID-safe (91%). Given the option, many would choose to test in their own home (79.7%) or in their workplace (91.5%); while if a business did not test, and subsequently the individual became sick, then many would take legal action against the business, management or company (14.6%). Considering the many unknowns about the SARS-CoV-2 virus, respondents wanted someone else to attend onsite to perform testing (44%); while most would likely pay more for an Airbnb or similar holiday rental if the business could demonstrate proof their COVID-safe cleaning procedures had been validated using periodic swab tests (80.8%). Overall, respondents thought that businesses should be able to document they are COVID-safe and that their indoor surfaces are not SARS-CoV-2 contaminated (79.3%); while users of childcare or schools would feel reassured if the service could promote that their cleaning protocols were validated with PCR swab data (43.6%). The top 10 business types that were considered to need this service were: gyms > hospitality > hotels > public transport > allied health and beauty > aged care > disability services > childcare > air travel/cruises > shops and general retail. In conclusion there was very positive support for workplace testing using molecular biology methods like quantitative reverse transcription polymerase chain reaction (RT-qPCR) environmental surface swabs.

Keywords: COVID, SARS-CoV-2, COVID-safe, surface contamination, cleaning, environmental surveillance, post pandemic, rapid online surveys, infectious disease outbreak, RT-qPCR

I. INTRODUCTION

Risk management for workplaces in the emerging post COVID-19 return-to-work era, must carefully consider the ways in which occupants move through, interact with, and use the urban built environment. Briefly, it is the transmission of the SARS-CoV-2 virus that causes COVID-19 illness. According to a recent paper [1] as at 30th April 2020, more than one third of the world population was locked down as part of a global containment strategy to minimize disease transmission. Central to phased re-opening, or the "exit strategy" [2], will be issues of personal space, individual freedom versus group compliance, and routine applications of infection control principles where a vaccine or treatment has yet to be developed or validated, and businesses are still reeling from economic disruption. Estimates of the economic impact in Australia suggest a contraction to the Gross Domestic Product (GDP) of 15% and massive government expenditure of the order of $300B [3]. In turn, the impact on employment by industry sector has recently been assessed with dire predictions for parts of the economy [4]. There are many models that consider how best to implement a return to work, but these must be seen in context of the broader economic impacts [5]-[9].

From a public health perspective, any controlled policy interventions like social distancing or strengthening public health and clinical capacity [10] or border controls [11], must be balanced by evidence about active disease suppression methods and address generally misunderstood issues like herd immunity [12].

This paper discusses one aspect of what is being called the 'new normal' by looking at how COVID-safe awareness can be practically applied within the built environment. In Australia, the national political response is to encourage businesses to develop and maintain their own COVID-safe workplaces by providing a roadmap towards a "COVID Safe Australia" [13]. Such recovery efforts are premised on two options: the elimination strategy and the controlled adaptation strategy but require (i) early detection and isolation, (ii) imposition of travel restrictions and (iii) a good degree of public trust, transparency and civic engagement [14]. Of most relevance to Australia, and the potential success of this roadmap, is the recent paper modelling various re-opening scenarios and how these would impact on reducing the impact of the SARS-CoV-2 pandemic [15].

A cautionary example for employers showed that a single sick employee in a South Korean call centre infected 97 others in two weeks [16]; while at one meat processing plant in Melbourne, Australia there has been a 57-person case cluster with the infection being transmitted to a further 13 close contacts [17]. There are two main pathways of transmission based on person-to-person direct contact spread or the second, being person-to-object or non-contact spread [18]-[20]. This second transmission pathway is well known from environmental microbiology and food handling, where contamination is spread from person or hand to object and then from object to person. This is often called fomite transmission. The persistence of coronavirus on various surfaces retains viability from hours to days depending on the material [21]-[22]; while surface roughness may influence the exposure probability [23]. Environmental cleaning is therefore a fundamental strategic method for reducing the risks from surface (or fomite) contaminants. Against SARS-CoV-2, the role of disinfection protocols cannot be underestimated [24]-[26]. However, the problem with cleaning is how to accurately validate the success of the clean? Even if visual evidence of dirt and debris is gone, how successful was the process, and how much chemical energy was (or should be) applied to sanitize or disinfect or sterilise the surface or areas in question? Various methods exist for performing cleaning validation. These span the gamut from isolated or periodic visual audits of cleaning tasks, risk assessments, risk management and policy development or revision and updating of existing procedures through to methods advisory, skills updates and training or verification.

With regard to SARS-CoV-2, the ultimate aim of environmental cleaning must be disinfection verification. To this end there are four approaches used to evaluate environmental hygiene apart from direct practice observation monitoring [27]. Most of these methods are designed to identify bacterial, fungal and antibiotic-resistant pathogens or biofilms. These use surrogate indicators to measure cleaning success and if required, implement educational intervention. They include: (i) ATP bioluminescence [28], (ii) swab or replicate organism detection and counting (RODAC) press-plate [29] or similar culture-based methods, (iii) tape lifts [30] or (iv) fluorescent or photoreactive inks, powders or gels [31]-[32]. ATP works by testing for the presence of a cell enzyme called adenosine triphosphate (ATP) that is present in both viable and non-viable organic debris, meaning that if it is present, then so must DNA-containing cell waste (the biological load). Petri plates assess cleanliness by culturing live cells or colonies from swabs or direct press plates. Tape lifts allow for microscopic examination of actual dust, debris or cell matter as seen at magnification; while evidence of poor cleaning or oversight can be made visible using inks, gels or powders that only become visible under ultraviolet light, and hence can be used to monitor that physical cleaning has occurred. However, all these methods use a proxy and don't verify anything with respect to the SARS-CoV-2 virus.

II. CONTEXT

There are media reports of lawyers looking at class actions and at workers' compensation claims over health and safety surrounding COVID-19 and this is anticipated to rise dramatically as consumers and businesses seek to recover and act on claims [33]-[34]. As the potential for litigation gathers pace, there is a need for accurate verification testing of common high and low-touch surfaces and other potentially cross-contaminated settled surfaces within the built environment. These include buildings used as workplaces, domestic homes and home offices as well as accommodation used for social housing, disability, aged care and mental health and other infrastructures. Quantifying environmental microorganisms and viruses using molecular methods is not new but is definitely different to the four methods discussed above. The quantitative polymerase chain reaction (qPCR) or real time (RT-qPCR) process is a technique for enumerating genetic material (DNA and RNA) in environmental or clinical samples. Measuring viruses on surfaces using RT-qPCR can help understand the role of fomites in disease transmission [35]. Similar to the use of pharyngeal swabs for COVID-suspect persons and for confirmation of diagnosis, the use of environmental swabs for measuring the presence or absence of the SARS-CoV-2 in situ serve a fundamental role in pro-active infection control in the built environment [36]. This approach has in fact recently been used with success to monitor wastewater treatment plants for evidence of the SARS-CoV-2 virus in Australia, which was confirmed by sequencing [37]. Although PCR does not tell you if the virus is infectious, it does map out hotspots and could provide early warning of superspreaders. A mini-review containing several examples of where PCR methods have been used to assess surface samples for SARS-CoV-2 in a range of building environments was reported on recently [18]. In these studies, checking for the presence or absence of viral RNA was used to define the extent and locations of environmental contamination caused by shedding from COVID-positive individuals at different stages of illness.

The context and motivation for environmental testing follows on from the economic and public health imperatives surrounding reopening.

Consider the scenario where on your return to work, you become infected with the virus? What would you do? Many businesses are hoping for some immunity from liability and personal injury lawsuits caused by employer or workplace negligence, recklessness or wilful disregard for safety as this relates to COVID-19 [38]. However, in the absence of sanctioned liability shields for business [39], there is a need for fine-grained methods to perform environmental surveillance. The aim with molecular testing in the environment is to provide quantitative data on the presence or absence of SARS-CoV-2. It is expected that such audit and monitoring assessments will assist business and the workforce in validating cleaning protocols and developing enhanced COVID-safe awareness.

This can be accomplished using qPCR swab testing [36],[40]. Prior to implementing PCR testing as a positive public health initiative, a rapid online survey was conducted to identify the existing knowledge and perceptions about environmental surface contamination and COVID-19 amongst the general public in Australia.

III. METHODS

A cross sectional online survey was conducted on the Prolific Academic survey platform (prolific.co). This platform allows fast responses from over 90,000 individuals who are available and is aimed at the behavioural, user and market research sectors. Researchers are required to pay participants a minimum of £5.00 equivalent to approximately $9.50-9.70 AUD p/h which depended on the daily exchange rate.

For this study, we chose to conduct several small pilot surveys to optimize question design. The first pilot of 20 persons polled the general US/UK pool. After feedback and results review a second pilot of 20 persons was polled from Australia only, which was our target market and from where we wanted information. This second pilot caused us to increase the time we estimated the survey to take and we again fine-tuned question and survey design.

Data from both pilots was not included in the final study. In Australia there were 1835 eligible participants and we chose a target sample size of 200 people. All participants were fluent in English. Survey design used Checkbox 7 with Australian hosting (checkbox.com) and was called from within Prolific.co. Results were collected during daytime hours from 10am – 2:30pm on 4th May 2020. There were 24 questions in total.

There were five categorical data questions that asked for rank ordered responses about perceived risks in different industries (a general workplace, gyms, aged care, allied health and beauty, childcare) as well as two that asked about perceived risks of selected materials or transmission risk probability that were background knowledge awareness questions. One additional categorical question asked about the likelihood of the respondent taking legal action or making another type of complaint if the workplace was perceived to be linked to COVID-19 illness.

There were two categorical list-picking questions designed to provide survey relief since to some extent they evaluated prior knowledge about general infection control and the cleaning of surfaces/objects against different types of businesses. Two interval data questions were used to assess awareness about how long the coronavirus remains viable in the air or on surfaces. One interval data question measured the cost respondents would be willing to pay for SARS-CoV-2 surface testing.

Three ordinal data questions were used to assess how people felt about their own personal exposure risk in different contexts; while two ordinal questions assessed the importance of business documentation surrounding COVID-safe surface hygiene; while the last ordinal question assessed the impact that fear from exaggerated claims about pets and COVID-19 could have on these results. Finally, there were five dichotomous nominal questions used to gauge the propensity for in-the-home versus workplace testing including one question assessing the likelihood of customers paying extra for specialized courier services used to maintain the cold chain if tests are supplied via mail order versus on-site assessments. A final dichotomous question related to the cost benefit of validated COVID-safe cleaning practices in the accommodation/tourism sector. For dichotomous questions with more than 3 responses, a 'maybe' was considered a 'yes' and was used to capture the negative mindset, while 'undecided', 'don't want to know', or 'neutral' was scored as a 'no'.

IV. RESULTS

From the 200-person sample size from Australia only, 188 valid results were submitted. Twelve persons failed to return completed surveys or withdrew from the study. The participant age range was 18-74 yrs. with an average of 31 yrs. The gender ratio was 57% male, 43% female. Student status was 66% versus 44%, non-students. Average time taken to complete the survey was 14.48 min. with a min/max range of 4.10/60.42 min.

1) *Q1. People can become infected from the virus that causes COVID-19 in various ways. From what you understand now about transmission, please rank order the following transmission pathways from most likely to least likely.*

RANK ORDER (1st to last):

1. Being within 1.5 metres of someone knowingly or unknowingly infected with COVID who coughs or sneezes
2. Touching a shopping trolley or hand basket at a supermarket
3. Using a public restroom
4. Remaining in isolation for longer than 14-days and only speaking to people over the telephone

2) *Q2. Imagine that a relative of yours is living at an aged care facility. Please rank your expectations about safety from most satisfied to least satisfied based on the following information provided about cleaning at the facility.*

RANK ORDER (1st to last):

1. Room hygiene and cleaning checked for the presence or absence of the SARS-CoV-2 virus using swab testing of a range of different surfaces
2. Rooms disinfected more carefully following protocols developed by Government or other appropriate health care advice
3. Rooms cleaned by cleaners just the same as usual
4. Rooms visually inspected for overall cleaning success e.g. it looks and smells ok

3) *Q3. Your gym has reopened following the easing of social distancing and they post a sign about their response to COVID-19. Please rank from most important to least important the following types of information about their cleaning practices.*

RANK ORDER (1st to last):

1. We take our cleaning seriously and regularly test our high-touch surfaces like gym equipment and other surfaces for the presence or absence of the SARS-CoV-2 virus. This type of surveillance helps us protect you and take fast action if the virus is detected
2. We take our cleaning seriously and now clean more than once per day
3. None of our gym members have told us they've had COVID-19 so we think we're ok
4. Thanks for coming back, we're glad to get on with business as usual

4) *Q4. Which items from the following list are most likely to be contaminated with the SARS-CoV-2 virus?*

Door handles or light switches - 8.4%
Lift buttons or escalator handrails or the ATM machine - 8.4%
Gym or sports equipment - 7.9%
Public transport doors, seats, handles - 7.9%
Money - 7.4%
Toilet seat and buttons - 6.9%
Sink and tapware near toilet - 6.5%
Mobile phone or phone charger - 6.1%
Computer keyboard and mouse or printer - 6.1%
Staff break room/kitchenette/canteen - 5.2%
Countertops - 5.1%
Furniture - desks, chairs, etc. - 4.2%
Kitchen utensils or cutlery - 4.1%
Toys - 3.7%
Ventilation ducts, air vents, heating or cooling system - 2.8%
Food or food containers - 2.6%
Mail or boxed goods - 2.3%

Take away coffee cup - 1.9%
New clothing at a store - 1.6%
Carpets or curtains - 1.1%

5) *Q5. Rank the following surfaces from most likely to least likely to show or retain SARS-CoV-2 virus.*
RANK ORDER (1st to last):
1. Stainless steel
2. Plastic
3. Cardboard
4. Copper
5. Wood
6. Fabric

6) *Q6. How long can SARS-CoV-2 remain viable in the air?*
Less than 1hr - 22.3%
Between 1 - 3 hrs - 37.8%
More than 3 hrs but less than 12 hrs - 18.6%
About 1 day - 4.3%
Between 1 -5 days - 5.9%
More than 5 days - 1.1%
14 days or more - 1.1%
Don't know - 9%

7) *Q7. How long can SARS-CoV-2 remain viable on surfaces?*
Less than 1hr - 1.6%
Between 1 - 3 hrs - 4.8%
More than 3 hrs but less than 12 hrs - 16.5%
About 1 day - 12.8%
Between 1 -5 days - 48.4%
More than 5 days - 6.4%
14 days or more - 1.6%
Don't know - 8%

8) *Q8. To promote COVID-safe awareness, your workplace determines that it will implement improved hygiene and cleaning practices.*
Just tell the regular cleaners to be aware that the virus could be anywhere and to clean carefully - 1.4%
Improve your cleaning practices by using spot swab checks that test for the presence or absence of the SARS-CoV-2 virus on surfaces - 22%
Print out more signs telling people to wash their hands after eating - 4.1%
Tell people to stop shaking hands - 8.5%
Tell people to not come to work if they feel sick - 20%
Revise any policies and procedures for cleaning with specific reference to COVID-19 harm minimisation - 24.8%
Implement regular hygiene monitoring and environmental surveillance for pathogens like SARS-CoV-2 - 19.1%

9) *Q9. How likely are you to come into contact with SARS-CoV-2 virus contamination on surfaces in your day-to-day activities?*
Not likely - 25%
Somewhat - 37.2%
Neutral - 19.1%
Likely - 18.1%
Very likely - 0.5%

10) *Q10. How likely are you to come into contact with SARS-CoV-2 virus contamination just by breathing (in the airspace) in your day-to-day activities?*

Not likely - 35.6%
Somewhat - 38.3%
Neutral - 14.4%
Likely - 11.2%
Very likely - 0.5%

11) *Q12. Imagine you are the operator of a retail shop, hairdressing or allied health and beauty business like a nail salon or tattoo parlour, would any of the following help you better promote your business as being hygiene-aware?*

RANK ORDER (1st to last):
1. We regularly test our building/shop/salon for the presence for the SARS-CoV-2 virus
2. We ask all our clients if they have had COVID-19 or know anyone who has. If the answer is positive, we move them on as quickly as possible
3. We tell people we're hoping for a vaccine and its business as usual
4. We hope no one asks

12) *Q13. Are you worried about coming into contact with the SARS-CoV-2 virus in your day-to-day activities?*

Not at all - 12.8%
Rarely - 31.9%
Sometimes - 37.8%
Often - 13.3%
I worry all the time - 4.3%

13) *Q14. You have the option to accurately measure the presence or absence of the SARS-CoV-2 virus on surfaces in your home. Is this something you would be interested in?*

Yes - 53.2%
No - 20.2%
Maybe - 26.5%

14) *Q15. You have the option to accurately measure the presence or absence of the SARS-CoV-2 virus on surfaces in your workplace. Is this something you would be interested in?*

Yes - 79.8%
No - 7.4%
Maybe - 11.7%
Don't want to know - 1.1%

15) *Q16. Visual surveillance after cleaning costs nothing but is not very scientific. The use of molecular testing methods is more accurate but costs more for the inspection, sampling, lab work, and report preparation. You're the boss and the ultimate responsibility for the welfare of your staff, clients, and stakeholders' rests with you - how much would you be willing to pay for on-site surface testing and reporting?*

Between $100 - $200 per surface test (minimum 10 surfaces); Total cost: $1000 - $2000 per site - 42.4%
Between $200 - $300 per surface test (minimum 7 surfaces); Total cost: $1400 - $2100 per site - 19.3%
About $300 or a bit more per surface test (minimum 5 surfaces); Total cost: $1500 per site - 11.7%
In addition to the above, there is a personal protective equipment charge for the assessor of $100 and a call out fee of $400 per site inspection - 26.6%

16) *Q17. If you could do your own testing, without waiting for someone to attend on-site, would you be willing to do the swab sampling yourself and send it to a lab using a medical or specialized courier company?*

Yes - courier charges their own extra fee - 55.9%

No - I want someone to do it for me - 20.7%
Undecided - 23.4%

17) *Q18. If the option was available to test any building or business for the presence of the SARS-CoV-2 virus residue and the business/management/company didn't take advantage of this and subsequently, you became sick from COVID-19, what would be your response when you recover?*

Take legal action against the business/management/company - 14.6%
Assume it was just bad luck and you could have picked the virus up anywhere - 18.1%
Make a complaint under OH&S - 35.6%
Tell the business/management/company that you think they should lift their game and you could have died or infected someone else who could have died - 31.6%

18) *Q19. You need to put your child or children back into kindergarten, childcare or school, which of the following would offer you reassurance about the service delivery?*

The service is just happy to be open again and is very welcoming when you arrive - 2.4%
The service has prominent signage and materials promoting hand washing and hand sanitiser - 15.4%
Because the service knows that high touch surfaces can transmit the virus, they promote the fact that they validate cleaning using spot swab checks (hygiene audits/environmental cleaning surveillance) to confirm there is no SARS-CoV-2 virus present - 43.6%
The service regularly reviews and communicates the results from hygiene audits and makes regular changes to improve cleaning practices if required - 38.6%

19) *Q20. When social distancing restrictions are lifted and businesses reopen, which business types most need to validate that their surface cleaning is likely to be successful against SARS-CoV-2.*

Gyms - 9.6%
Hospitality - restaurants, cafes, bars, pubs - 9.5%
Public transport - 9.1%
Aged care - 9%
Air travel or cruises - 8.2%
Childcare, kindergartens, schools, universities - 8.1%
Medical - 8.1%
Disability care or services - 7%
Allied health and beauty - e.g. nail salons, waxing, tattoos, saunas, massage - 6.8%
Hotels - accommodation - 6.6%
Shops and general retail - 5.4%
Transport, postal and warehousing - 3.5%
Corporate offices - 2%
Public administration and safety - 1.9%
Rental, hiring and real estate services - 1.4%
Arts and recreation services - 1%
Manufacturing, factories or mining - 0.7%
Construction and trades - 0.7%
Wholesale trade - 0.7%
Agriculture, forestry and fishing - 0.6%

20) *Q21. If you could validate your building surfaces as NOT showing the presence of the SARS-CoV-2 virus using environmental surveillance, do you think this would help to increase consumer confidence about being COVID-safe?*

Yes - environmental surveillance would help - 75%
No - environmental surveillance would not help - 9%
Maybe - 16%

21) *Q22. Would you pay more for an Airbnb (or similar) holiday or short-term rental that could demonstrate COVID-safe cleaning practices and that had also been periodically validated using swab testing for the SARS-CoV-2 virus?*

Yes - 43.6%
No - 19.1%
Maybe - 37.2%

22) *Q23. How important is it to you that businesses should be able to document they are COVID-safe and that their indoor surfaces are not SARS-CoV-2 contaminated?*

Not important - 4.8%
Somewhat important - 11.2%
Neutral - 16%
Important - 42.6%
Very important - 25.5%

23) *Q24. There have been reports of pet cats and dogs and even a tiger from the zoo becoming sick with the SARS-CoV-2 virus. When you think about pets including companion/therapy dogs, how concerned are you that they could transfer the virus indoors to household carpets, rugs, pet bedding, beds, or other furniture?*

Very concerned - 3.7%
Concerned - 10.1%
Neutral - 17%
Somewhat concerned - 33.5%
Not concerned - 35.6%

V. INTERPRETATION

A. 55.4% of respondents were worried about coming into contact with SARS-CoV-2 in their day-to-day activities.
B. 50% of respondents thought it likely that they would be exposed to SARS-CoV-2 by breathing in the air in their day-to-day activities.
C. 55.8% of respondents thought it likely that they would be exposed to SARS-CoV-2 from surfaces in their day-to-day activities.
D. 91% of respondents thought that surface testing validation using PCR swabs would likely increase consumer confidence about being COVID-safe.
E. 79.7% of respondents want the option to test for the presence or absence of SARS-CoV-2 in the home.
F. 91.5% of respondents want the option to test for the presence or absence of SARS-CoV-2 in the workplace.
G. 56% of respondents want to do their own testing even if this involves a surcharge for a specialized lab courier.
H. 44% of respondents want someone to attend onsite to do the surface assessments.
I. 79.3% of respondents thought that businesses should be able to document they are COVID-safe and that their indoor surfaces are not SARS-CoV-2 contaminated.
J. 80.8% of respondents would likely pay more for an Airbnb or similar holiday rental if they could demonstrate proof their COVID-safe cleaning procedures had been validated using periodic swab tests.
K. 14.6% of respondents would take legal action against the business, management or company if that business had not taken advantage of testing for SARS-CoV-2 residue and they subsequently became sick from COVID-19.
L. 43.6% of respondents who have a need to place their children into childcare, kindergarten or school would feel reassured if the service could promote that their cleaning protocols were validated with PCR swab data.
M. 47.3% of respondents thought that their pet cat or dog could potentially transfer SARS-CoV-2 to household surfaces or furniture.
N. Cleaning validation stratified into a top 10 of business types ranked in order of priority: gyms > hospitality > hotels > public transport > allied health and beauty > aged care > disability services > childcare > air travel/cruises > shops and general retail.

VI. DISCUSSION & CONCLUSION

Of the rank order questions, the most significant findings were for gyms, allied health and beauty and aged care facilities where respondents thought that hygiene and cleaning should be validated using PCR swab testing for the presence/absence of the SARS-CoV-2 virus. Visual inspection only and even twice per day cleaning were not ranked highly where there was the potential to directly assess for the coronavirus. General knowledge about direct droplet spread transmission was in good agreement with known health care facts; although the assessment of surface type and its' ability to show or retain virus was not in agreement with the literature. For example, people considered that stainless steel would be the surface on which the virus lasted longest, followed by plastic. Improved health messaging around at-risk high touch surfaces should show a better correspondence with the literature where: plastic > stainless steel > cardboard > copper [41]. As more experiments and reviews emerge in the literature [42]-[44], surveillance of the most probable surfaces will define the taxonomy of suspect virus fomites in the built environment and allow for more targeted education for infection control and monitoring. Persistence in the air was generally answered correctly by 37.8% of persons at less than or equal to 3-hrs if we accept the findings of van Doremalaen et al. [41]. However, other studies show that the virus is remarkably persistent in the air but there is awareness by less than 6% of those surveyed that the virus can maintain replication-competence in the air for at least 16-hrs [45]. Interestingly our data for the percentage of people who were worried about coming into contact with the virus in their day-to-day activities or simply breathing in the air (55.4% and 50% respectively) was in close agreement to another survey from Australia that found that 50% of respondents felt COVID-19 would 'somewhat' affect their health if infected [46]. Similarly, 55.8% of respondents in our survey considered they would come into contact with the coronavirus on surfaces, but only 6.4% thought it could remain viable for more than 5-days; despite new research showing that SARS-CoV-2 remains stable on environmental surfaces for up to 7-days and for several hours in feces and 3-4 days in urine [47].

The current study has limitations that should be taken into account, where all participants were recruited online, and therefore may not be representative of the general population. Despite this, the current results provide important and timely information on the Australian public response to the transmission risks of the SARS-CoV-2 virus and their relationship with current and intended risk management initiatives around cleaning for a COVID-safe workplace. As well, these results add to what is known about how Australians perceive the likelihood and severity of risk and worry about the coronavirus and utility of various health protective behaviours, including vaccination intentions [48].

The easiest way to assess cleaning success is to carefully monitor the actual cleaning process, but at scale this is impractical. The closest rival to molecular testing is ATP swabs, but since the coronavirus is not 'alive' like other microbial pathogens, ATP testing won't measure anything about virus RNA. In other studies, no correlation was found between ATP-bioluminescence and microbial load (or cleanliness) as determined by qPCR of high touch objects [49]. Unfortunately, ATP readings can be corrupted by disinfectant residues, despite other studies supporting their value in assessing surface cleanliness in high-risk premises [50]. For these reasons, other more direct assessment methods are needed. The polymerase chain reaction is therefore a big step forward compared against ATP, fluorescent powders, or more time-consuming surrogate methods like press plates or tape lifts. Related molecular tools include the use of reverse-transcriptase loop mediated isothermal amplification (RT-LAMP) that can be performed without a cold chain or the need for extraction [51]. This was recently used to perform environmental sampling of the New York subway for SARS-CoV-2 [52]. The authors concluded that environmental sampling using molecular methods "*may quickly indicate if an area is infectious and a negative result (with appropriate confirmation) will possibly represent a lower risk. Indeed these tools and methods can help create a viral "weather report" if broadly used and partnered with continual validation*".

The risk of second wave infections after early exit strategies is very real. We only need look at Japan to see this in action where in Hokkaido, after what was thought to have been a successful and swift early containment - upon reopening, a second wave of infections without any overseas travel was worse than the first [53]. This experience echoed the words of the current WHO Director-General, Tedros Adhanom Ghebreyesus who stated that "*Lifting restrictions too quickly could lead to a deadly resurgence*" [54]. Indeed, a recent paper has modelled the post pandemic spread of the virus and warned that prolonged social distancing and additional interventions are likely to be required at least into 2022 and perhaps for longer [55]. In Australia, the aim is to interrupt transmission, protect vulnerable groups, apply broad public health measures and maintain and strengthen the existing health care system [56]. Evaluating surface stability, recovery and virus survival under indoor conditions is also a key component of the US Department of Homeland Security research effort [57]. And it's not just Australia that's focusing on "COVID Safe", since the United Kingdom has just released their own version called "COVID-19 Secure" for managing how best to lift restrictions [58]. The UK is planning to monitor for disease as a biosecurity threat and intends to work with businesses to "*collect a wide range of data to build a picture of COVID-19 infection rates across the country – from testing, environmental and workplace data to local infrastructure testing (e.g. swab tests)*".

The path to long term infection control will require a broad range of expertise. Due to mounting pressure to ease restrictions, once social distancing measures are relaxed, ongoing vigilance must occur to minimize the impact of further waves of infection. For these reasons, in Australia and elsewhere, environmental surveillance in addition to clinical testing should be a priority focus of validating for a COVID safe workplace.

REFERENCES

[1] S. Rawaf, H.Q. Yamamoto. and D. Rawaf, "Unlocking towns and cities: COVID-19 exit strategy". *East Mediterr Health J*. 2020; https://doi.org/10.26719/emhj.20.028

[2] E. Petersen, S. Wasserman, S. Lee, U. GO, A. Holmes, S. Abri, S. McLellan, L. Blumberg and P. Tambyah, "COVID-19–We urgently need to start developing an exit strategy", *International Journal of Infectious Diseases*, 2020.

[3] F. Romano, "An Estimate of the Economic Impact of COVID-19 on Australia" (April 14, 2020). Available at SSRN: https://ssrn.com/abstract=3581382 or http://dx.doi.org/10.2139/ssrn.3581382

[4] B. Coates, M. Cowgill, T. Chen and W. Mackey, "Shutdown: estimating the COVID-19 employment shock", 2020. [Online]. Available: https://grattan.edu.au/report/shutdown-estimating-the-covid-19-employment-shock/.

[5] L.A. Hierro, D. Cantarero, D. Patino, and D.R-P de Arenaza., Who can go back to work when the COVID-19 pandemic remits? *medRxiv* 2020.05.06.20093344; doi: https://doi.org/10.1101/2020.05.06.20093344

[6] A. Desvars-Larrive, E. Dervic, N. Haug, T. Niederkrotenthaler, J. Chen, A. Di Natale, J. Lasser, D. S. Gliga, A. Roux, A. Chakraborty, A. Ten, A. Dervic, A. Pacheco, D. Cserjan, D. Lederhilger, D. Berishaj, E. F. Tames, H. Takriti, J. Korbel, J. Reddish, J. Stangl, L. Hadziavdic, L. Stoeger, L. Gooriah, L. Geyrhofer, M. R. Ferreira, R. Vierlinger, S. Holder, S. Alvarez, S. Haberfellner, V. Ahne, V. Reisch, V. D.P. Servedio, X. Chen, X. Maria Pocasangre-Orellana, D. Garcia, S. Thurner, "A structured open dataset of government interventions in response to COVID-19", *medRxiv* 2020.05.04.20090498; doi: https://doi.org/10.1101/2020.05.04.20090498

[7] G. F. Killeen, "A simple arithmetic rationale for crushing the epidemic curve of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) instead of flattening it", *medRxiv* 2020.05.06.20093112; doi: https://doi.org/10.1101/2020.05.06.20093112

[8] S. Chang, N. Harding, C. Zachreson, O. M. Cliff and M. Prokopenko. Modelling transmission and control of the COVID-19 pandemic in Australia. *arXiv*:2003.10218v3

[9] W. McKibbin and R. Fernando. "The global macroeconomic impacts of COVID-19: Seven scenarios", Centre for Applied Macroeconomic Analysis, 2020. [Online]. Available: https://cama.crawford.anu.edu.au/publication/cama-working-paper-series/16221/global-macroeconomic-impacts-covid-19-seven-scenarios.

[10] R. Moss, J. Wood, D. Brown, F. Shearer, A. J. Black, A. Cheng, J. M. McCaw, J. McVernon, "Modelling the impact of COVID-19 in Australia to inform transmission reducing measures and health system preparedness", *medRxiv* 2020.04.07.20056184; doi: https://doi.org/10.1101/2020.04.07.20056184

[11] F. Shearer, J. Walker, N. Tellioglu, J.M. McCaw, J. McVernon, A. Black and N. Geard. Assessing the risk of spread of COVID-19 to the Asia Pacific region. COVID-19 modelling papers and press conference. [Online]. Available: https://www.doherty.edu.au/news-events/news/covid-19-modelling-papers

[12] D. Dowdy and G. D'Souza, "Early herd immunity against COVID-19: a dangerous misconception. Johns Hopkins Coronavirus Resource Center, 2020. [Online]. Available: https://coronavirus.jhu.edu/from-our-experts/early-herd-immunity-against-covid-19-a-dangerous-misconception.

[13] J. Landis-Hanley, "Scott Morrison wants Australia to get back on the job. But what does a Covid-safe workplace look like?", the Guardian, 2020. [Online]. Available: https://www.theguardian.com/australia-news/2020/may/07/scott-morrison-wants-australia-to-get-back-on-the-job-but-what-does-a-covid-safe-workplace-look-like.

[14] "COVID-19 Roadmap to Recovery – A Report for the Nation – Group of Eight", Go8.edu.au, 2020. [Online]. Available: https://go8.edu.au/research/roadmap-to-recovery.

[15] Thompson, Jason and McClure, Roderick and Blakely, Tony and Wilson, Nick and Baker, Michael and de Sa, Thaigo Herick and Nice, Kerry and Wijnands, Jasper S. and Aschwanden, Gideon and Cruz-Gambardella, Camilo and Stevenson, Mark, The Estimated Likelihood of Eliminating the SARS-CoV-2 Pandemic in Australia and New Zealand Under Current Public Health Policy Settings: An Agent-Based-SEIR Modelling Approach (April 29, 2020). Available at SSRN: https://ssrn.com/abstract=3588074 or http://dx.doi.org/10.2139/ssrn.3588074

[16] S. Park, Y. Kim, S. Yi, S. Lee, B. Na, C. Kim, J. Kim, H. Kim, Y. Kim, Y. Park, I. Huh, H. Kim, H. Yoon, H. Jang, K. Kim, Y. Chang, I. Kim, H. Lee, J. Gwack, S. Kim, M. Kim, S. Kweon, Y. Choe, O. Park, Y. Park and E. Jeong, "Coronavirus Disease Outbreak in Call Center, South Korea", *Emerging Infectious Diseases*, vol. 26, no. 8, 2020.

[17] M. Boseley, "Cedar Meats cluster: why abattoir workers are on the coronavirus frontline", the Guardian, 2020. [Online]. Available: https://www.theguardian.com/australia-news/2020/may/09/cedar-meats-cluster-why-abattoir-workers-are-on-the-coronavirus-frontline.

[18] C.L. Jones "Environmental surface contamination with SARS-CoV-2 - a short review", *J Hum Virol Retrovirolog*., 8(1), PP. 15-19, 2020.

[19] National Academies of Sciences, Engineering, and Medicine 2020. Rapid Expert Consultation Update on SARS-CoV-2 Surface Stability and Incubation for the COVID-19 Pandemic (March 27, 2020). Washington, DC: The National Academies Press. [Online]. Available: https://doi.org/10.17226/25763.

[20] Brurberg KG. Contact based transmission of SARS-CoV-2. Rapid review 2020. Oslo: Norwegian Institute of Public Health, 2020. [Online]. Available: https://www.fhi.no/globalassets/dokumenterfiler/rapporter/2020/contact-based-transmission-of-sars-cov-2-report-2020.pdf

[21] R. Suman, M. Javaid, A. Haleem, R. Vaishya, S. Bahl, and D. Nandan. "Sustainability of Coronavirus on different surfaces", J Clin Exp Hepatol. 2020 May 6. doi: 10.1016/j.jceh.2020.04.020. Epub ahead of print. PMID: 32377058; PMCID: PMC7201236.

[22] L. Fiorillo, G. Cervino, M. Matarese, C. D'Amico, G. Surace, V. Paduano, M. T. Fiorillo, A. Moschella, A. La Bruna, G. L. Romano, R. Laudicella, S. Baldari, and M. Cicciù, "COVID-19 Surface Persistence: A Recent Data Summary and Its Importance for Medical and Dental Settings," *International Journal of Environmental Research and Public Health*, vol. 17, no. 9, p. 3132, Apr. 2020 [Online]. Available: http://dx.doi.org/10.3390/ijerph17093132

[23] R. Sinclair, S.A. Boone, D. Greenberg, P. Kleim and C. P. Gerba. Persistence of category A select agents in the environment. *Applied and Environmental Microbiology*. vol 74 (3), pp. 555-563, 2008.

[24] "Coronavirus (COVID-19) Environmental cleaning and disinfection principles for health and residential care facilities", Australian Government Department of Health, 2020. [Online]. Available: https://www.health.gov.au/resources/publications/coronavirus-covid-19-environmental-cleaning-and-disinfection-principles-for-health-and-residential-care-facilities. [Accessed: 11- May- 2020]

[25] "List N: Disinfectants for Use Against SARS-CoV-2 | US EPA", US EPA, 2020. [Online]. Available: https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2. [Accessed: 11- May- 2020]

[26] A. Green, C. Shen and Y. Bar-Yam, Coronavirus guidelines for cleaning and disinfecting to prevent COVID-19 transmission, New England Complex Systems Institute (April 9, 2020). [Online]. Available: https://necsi.edu/coronavirus-guidelines-for-cleaning-and-disinfecting-to-prevent-covid-19-transmission

[27] A. Guh and P. Carling. "Options for evaluating environmental cleaning". CDC. 2010. [Online]. Available: https://www.cdc.gov/hai/toolkits/evaluating-environmental-cleaning.html

[28] C.A. Davidson, C.J. Griffith, A.C. Peters and L.M. Fielding., "Evaluation of two methods for monitoring surface cleanliness – ATP bioluminescence and traditional hygiene swabbing", *Luminescence*, vol. 14, pp. 33-38, 1999.

[29] K. Huslage, W.A. Rutala, M.F. Gergen, E.E. Sickbert-Bennett, and D.J. Weber. "Microbial assessment of high-, medium-, and low-touch hospital room services". *Infection Control and Hospital Epidemiology*. Vol. 34(2), pp. 211-212, 2013.

[30] C.L. Jones "Comment on fungal tape lift reporting frameworks". *J Bacteriol Mycol Open Access*. vol. 7(6), pp. 155-157, 2019.

[31] W.K. Ng, "How clean is clean: a new approach to assess and enhance environmental cleaning and disinfection in an acute tertiary care facility". *BMJ Quality Improvement Reports*. Vol. 3(1), 2014.

[32] P.C. Carling, J.L. Briggs, J. Perkins, and D. Highlander, "Improved cleaning of patient rooms using a new targeting method", *Clinical Infectious Diseases*. Vol. 42, 2006.

[33] D. Hurst, "Employers warned over health and safety amid Covid-19 workers' compensation claims", the Guardian, 2020. [Online]. Available: https://www.theguardian.com/world/2020/apr/16/employers-warned-over-health-and-safety-amid-covid-19-workers-compensation-claims.

[34] B. Woodhouse and C. Pagent, "COVID-19: facing the risk of class actions", Corrs Chambers Westgarth, 2020. [Online]. Available: https://corrs.com.au/insights/covid-19-facing-the-risk-of-class-actions.

[35] T. Julian, F. Tamayo, J. Leckie and A. Boehm, "Comparison of Surface Sampling Methods for Virus Recovery from Fomites", *Applied and Environmental Microbiology*, vol. 77, no. 19, pp. 6918-6925, 2011.

[36] World Health Organization, "Surface sampling of coronavirus disease (COVID-19): a practical "how to" protocol for health care and public health professionals", Apps.who.int, 2020. [Online]. Available: https://apps.who.int/iris/handle/10665/331058.

[37] W. Ahmed, N. Angel, J. Edson, K. Bibby, A. Bivins, J. O'Brien, P. Choi, M. Kitajima, S. Simpson, J. Li, B. Tscharke, R. Verhagen, W. Smith, J. Zaugg, L. Dierens, P. Hugenholtz, K. Thomas and J. Mueller, "First confirmed detection of SARS-CoV-2 in untreated wastewater in Australia: A proof of concept for the wastewater surveillance of COVID-19 in the community", *Science of The Total Environment*, vol. 728, p. 138764, 2020.

[38] R. Van Meter, T. Mayer and B. Beausoleil, "INSIGHT: Business Immunity Will Prevent Covid-19 Litigation Crisis", News.bloomberglaw.com, 2020. [Online]. Available: https://news.bloomberglaw.com/corporate-governance/insight-business-immunity-will-prevent-covid-19-litigation-crisis-7.

[39] E. Livni, "US businesses want immunity from coronavirus lawsuits", Quartz, 2020. [Online]. Available: https://qz.com/1843873/us-businesses-wants-immunity-from-coronavirus-lawsuits/.

[40] M. Molteni, "Microbe Mappers Are Tracking Covid-19's Invisible Traces", Wired, 2020. [Online]. Available: https://www.wired.com/story/microbe-mappers-are-tracking-covid-19s-invisible-traces/.

[41] N. van Doremalen, T. Bushmaker, D.H. Morris, M. G. Holbrook, A. Gamble, B.N. Williamson, A.Tamin, J.L. Harcourt, N.J. Thornburg, S.I. Gerber, J. O. Lloyd-Smith, E. de Wit, and V. J. Munster, "Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1", *The New England Journal of Medicine*, vol. 382, pp. 1564-1567, 2020.

[42] S-Y. Ren, W-B. Wang, Y-G. Hao, H-R. Zhang, Z-C. Wang, Y-L. Chen, and R-D. Gao. "Stability and infectivity of coronaviruses in inanimate environments", *World J Clin Cases*., vol. 8(8), pp. 1391-1399, 2020.

[43] B. Pastorino, F. Touret, M. Gilles, X. de Lamballerieand R. N. Charrel, "Prolonged viability of SARS-CoV-2 in fomites", 19-Apr-2020. [Online]. Available: osf.io/7etga.

[44] D. Zhang, "SARS-CoV-2: air/aerosols and surfaces in laboratory and clinical settings", *Journal of Hospital Infection*, no. 06, 2020. doi: 10.1016/j.jhin.2020.05.001. Epub ahead of print. PMID: 32387746; PMCID: PMC7204655.

[45] A. C Fears, W. B Klimstra, P. Duprex, A. Hartman, S. C. Weaver, K. S. Plante, D. M., J. Plante, P. V. Aguilar, D. Fernandez, A. Nalca, A. Totura, D. Dyer, B. Kearney, M. Lackemeyer, J. K. Bohannon, R. Johnson, R. F Garry, D. S Reed, and C. J Roy. "Comparative dynamic aerosol efficiencies of three emergent coronaviruses and the unusual persistence of SARS-CoV-2 in aerosol suspensions", *medRxiv* 2020.04.13.20063784; doi: https://doi.org/10.1101/2020.04.13.20063784.

[46] H. Seale, A. Heywood, J. Leask, M. Steel, S. Thomas, D. Durrheim, K. Bolsewicz and R. Kaur, "COVID-19 is rapidly changing: Examining public perceptions and behaviors in response to this evolving pandemic", 2020.

[47] Y. Liu, T. Li, Y. Deng, S. Liu, D. Zhang, H. Li, X. Wang, L. Jia, J. Han, Z. Bei, Y. Zhou, L. Li and J. Li, "Stability of SARS-CoV-2 on environmental surfaces and in human excreta", 2020. *medRxiv* 2020.05.04.20091298; doi: https://doi.org/10.1101/2020.05.04.20091298

[48] K. Faasse and J. Newby, "Public perceptions of COVID-19 in Australia: perceived risk, knowledge, health-protective behaviours, and vaccine intentions", 2020. *medRxiv* 2020.04.25.20079996; doi: https://doi.org/10.1101/2020.04.25.20079996

[49] K. Johani, D. Abualsaud, D.M. Costa, H. Hu, G. Whitley, A. Deva and K. Vickery. "Characterization of microbial community composition, antimicrobial resistance and biofilm on intensive care surfaces". *Journal of Infection and Public Health*, vol. 11(3), pp. 418-424, 2018.

[50] G. Tebbutt, V. Bell, and J. Aislabie, "Verification of cleaning efficiency and its possible role in programmed hygiene inspections of food businesses undertaken by local authority officers". *Journal of Applied Microbiology*. vol. 102, pp. 1010-1017, 2007.

[51] A. N. Mohon, J. Hundt, G. van Marle, K. Pabbaraju, B. Berenger, T. Griener, L. Lisboa, D. Church, M. Czub, A. Greninger, K. Jerome, C. Doolan, and D. R Pillai, "Development and validation of direct RT-LAMP for SARS-CoV-2", *medRxiv* 2020.04.29.20075747; doi: https://doi.org/10.1101/2020.04.29.20075747

[52] D. Butler, C. Mozsary, C. Meydan, D. Danko, J. Foox, J. Rosiene, A. Shaiber, E. Afshinnekoo, M. MacKay, F. Sedlazeck, N. Ivanov, M. Sierra, D. Pohle, M. Zietz, U. Gisladottir, V. Ramlall, C. Westover, K. Ryon, B. Young, C. Bhattacharya, P. Ruggiero, B. Langhorst, N. Tanner, J. Gawrys, D. Meleshko, D. Xu, P. Steel, A. Shemesh, J. Xiang, J. Thierry-Mieg, D. Thierry-Mieg, R. Schwartz, A. Iftner, D. Bezdan, J. Sipley, L. Cong, A. Craney, P. Velu, A. Melnick, I. Hajirasouliha, S. Horner, T. Iftner, M. Salvatore, M. Loda, L. Westblade, M. Cushing, S. Levy, S. Wu, N. Tatonetti, M. Imielinski, H. Rennert and C. Mason, "Shotgun Transcriptome and Isothermal Profiling of SARS-CoV-2 Infection Reveals Unique Host Responses, Viral Diversification, and Drug Interactions", 2020. bioRxiv preprint doi: https://doi.org/10.1101/2020.04.20.048066

[53] A. Leonard, "This Japanese Island Lifted Its Coronavirus Lockdown Too Soon and Became a Warning to the World", Time, 2020. [Online]. Available: https://time.com/5826918/hokkaido-coronavirus-lockdown/.

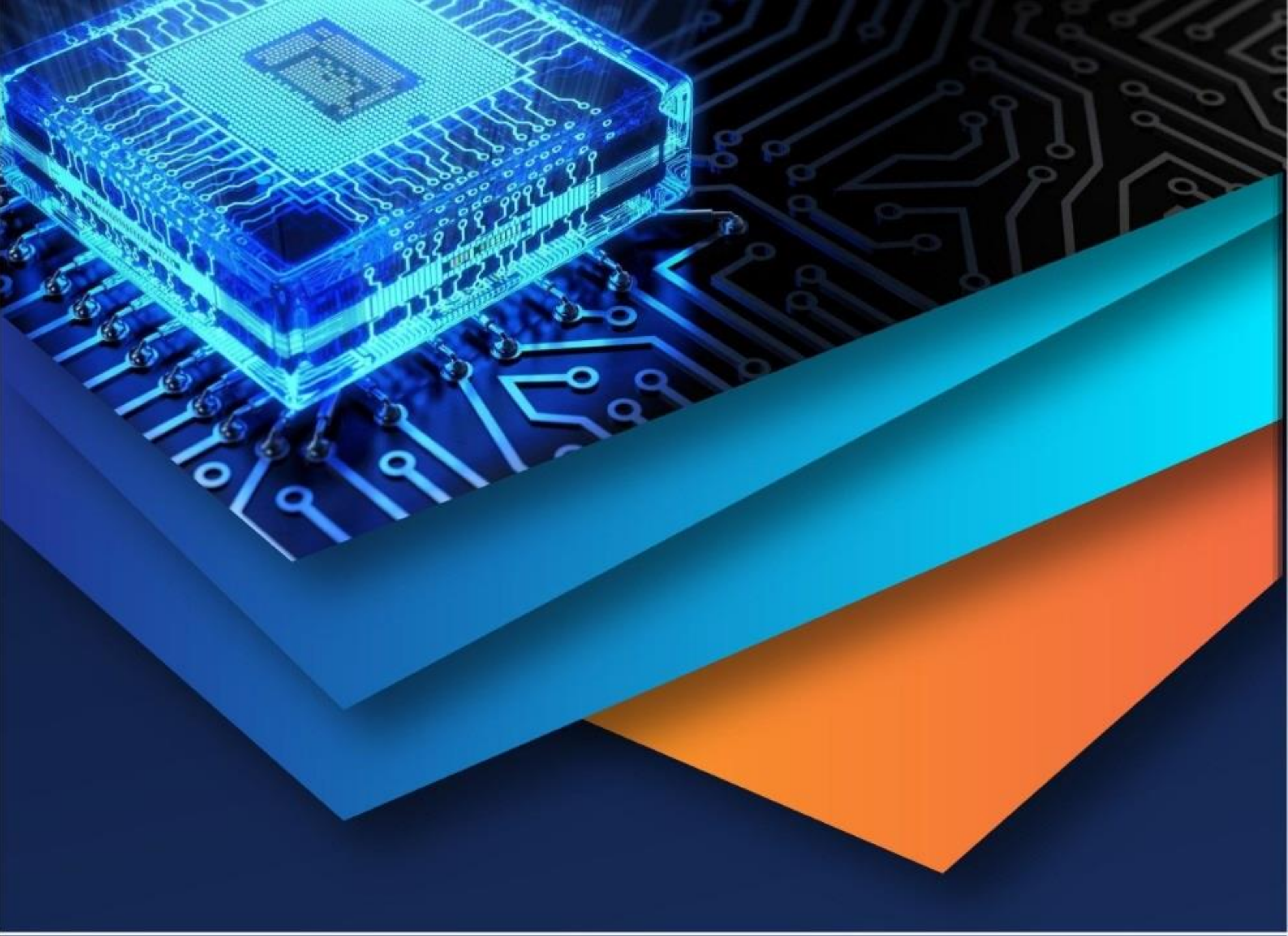
[54] "Beware the second wave of COVID-19", Australian Financial Review, 2020. [Online]. Available: https://www.afr.com/policy/health-and-education/beware-the-second-wave-of-covid-19-20200504-p54pkm.

[55] S. Kissler, C. Tedijanto, E. Goldstein, Y. Grad and M. Lipsitch, "Projecting the transmission dynamics of SARS-CoV-2 through the postpandemic period", Science, p. eabb5793, 2020.

[56] "Department of Health and Human Services Victoria | Theoretical modelling to inform Victoria's response to coronavirus (COVID-19)", Dhhs.vic.gov.au, 2020. [Online]. Available: https://www.dhhs.vic.gov.au/theoretical-modelling-inform-victorias-response-coronavirus-covid-19.

[57] "S&T's Research, Development, Testing and Evaluation (RDT&E) Efforts re COVID-19", Department of Homeland Security. Scribd, 2020. [Online]. Available: https://www.scribd.com/document/456897616/DHSST.

[58] "Our plan to rebuild: The UK Government's COVID-19 recovery strategy", GOV.UK, 2020. [Online]. Available: https://www.gov.uk/government/publications/our-plan-to-rebuild-the-uk-governments-covid-19-recovery-strategy.



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