Use of infection control measures in people with chronic lung disease: mixed methods study

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Among adults with chronic lung disease, physical distancing indoors, hand hygiene, and avoidance of busy places or unwell family and friends are infection control measures they intend to continue beyond the COVID-19 pandemic to help prevent exacerbations https://bit.ly/3G9gIaR

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Abstract

Background The introduction of community infection control measures during the COVID-19 pandemic was associated with a reduction in acute exacerbations of lung disease. We aimed to understand the acceptability of continued use of infection control measures among people with chronic lung disease and to understand the barriers and facilitators of use.

Methods Australian adults with chronic lung disease were invited to an online survey (last quarter of 2021) to specify infection control measures they would continue themselves post-pandemic and those they perceived should be adopted by the community. A subset of survey participants were interviewed (first quarter of 2022) with coded transcripts deductively mapped to the COM-B model and Theoretical Domains Framework.

Results 193 people (COPD 84, bronchiectasis 41, interstitial lung disease 35, asthma 33) completed the survey. Physical distancing indoors (83%), handwashing (77%), and avoidance of busy places (71%) or unwell family and friends (77%) were measures most likely to be continued. Policies for the wider community that received most support were those during the influenza season including hand sanitiser being widely available (84%), wearing of face coverings by healthcare professionals (67%) and wearing of face coverings by the general population on public transport (66%). Barriers to use of infection control measures were related to physical skills, knowledge, environmental context and resources, social influences, emotion, beliefs about capabilities and beliefs about consequences.

Conclusions Adults with chronic lung diseases in Australia are supportive of physical distancing indoors, hand hygiene, and avoidance of busy places or unwell family and friends as long-term infection control measures.

Introduction

Chronic lung diseases are a leading cause of morbidity and mortality worldwide [1]. A key contributor to the burden of chronic lung disease at a patient and health system level is acute exacerbations of respiratory symptoms. These exacerbations are commonly caused by respiratory viral infections [2]. Severe exacerbations that result in hospitalisation are costly and often make up a large majority of the treatment costs of chronic lung disease [3–6]. Hospitalisations have profound effects on physical function and quality of life and are associated with a poor prognosis in chronic lung disease [7–10].

During the COVID-19 pandemic, a range of infection control measures were encouraged or mandated at a population level to reduce the transmission of SARS-CoV-2 including hand hygiene, physical distancing and the wearing of face coverings. In some countries people with chronic lung disease were classified as

clinically vulnerable and were advised to take additional precautions to reduce face-to-face contact including "shielding" [11]. Multiple studies reported a substantial reduction in hospitalisations and exacerbations of chronic lung disease (*e.g.* asthma, bronchiectasis, COPD) during the pandemic [12–15]. This was proposed to be due to the adoption of infection control measures in response to COVID-19 and the associated lower prevalence of other respiratory viruses that are common causes of exacerbations [16–17]. Such a hypothesis was supported by subsequent evidence of a rebound in acute respiratory infections and asthma exacerbations requiring systemic corticosteroids or hospitalisation following lifting of COVID-19 restrictions, reduced face covering use and increased social mixing [18].

Current clinical guidelines in chronic lung diseases such as the Global Initiative for Asthma (GINA), Global Initiative for Chronic Obstructive Lung Disease (GOLD) and the European Respiratory Society (ERS) guidelines on bronchiectasis do not specifically recommend respiratory virus infection control measures as preventative measures for exacerbations [19–21]. Randomised controlled trials of infection control measures within the general population (conducted prior to COVID-19 pandemic) suggested uncertainty in their effectiveness to interrupt or reduce the spread of respiratory viruses [22].

A survey of people with chronic lung disease in the UK in 2021 suggested that many intended to continue with increased handwashing and physically distancing indoors to reduce their future risk of exacerbations and supported the adoption of such measures in the general population during the influenza season [23]. We sought to determine whether the same phenomenon could be observed in Australia. People's individual willingness to adopt preventative public health behaviours are often associated with societal level public risk perception [24]. The public's perceptions of the level of threat posed by COVID-19, as well as their receptiveness to adoption of infection control measures have been reported to vary across countries [25, 26]. Countries such as the UK and Australia also differed markedly in their overall strategy of managing the COVID-19 pandemic [25]. Cultural differences in beliefs and policies regarding specific public health measures (*e.g.* face coverings) to avoid respiratory infections may also exist between countries [27].

Understanding the acceptability of people with chronic lung disease in adopting respiratory virus infection control measures as strategies to avoid exacerbations across different countries will help inform international clinical guidelines and research. It is also important to understand the experience and perceptions of people with chronic lung disease in using infection control measures. The aim of this study was two-fold: 1) to conduct a national survey of Australian adults with chronic lung disease to measure acceptability of continuing with using infection control measures to prevent exacerbations of lung disease; and 2) to understand the barriers and facilitators of use of infection control measures to prevent exacerbations of lung disease.

Material and methods

Study design

A convergent parallel mixed methods study comprising an online survey and semi-structured interviews was conducted. The study was performed in accordance with the Declaration of Helsinki. This study was approved by Monash University Human Research Ethics Committee – approval: 29925. All participants provided informed consent to participate in this study. The survey landing page provided a summary of the study and link to an explanatory statement. Participants were made aware of the fact that by proceeding with the survey they were agreeing to the information provided by the explanatory statement. Those survey respondents who were invited to take part in an interview were sent an explanatory statement *via* e-mail. The e-mail contained a link to access an online consent form. They were asked to complete this form online before the interview or they provided their consent at the start of the interview recording.

Study participants

Adults (18 years or over) living in Australia with a self-reported diagnosis of COPD, asthma, bronchiectasis and/or interstitial lung disease were eligible. The study was advertised using mailing lists, newsletters, webpages and social media channels of national respiratory charities (Asthma Australia; Lung Foundation Australia). Each advertisement contained a link to access a survey on an online platform (Qualtrics). The survey landing page provided detailed information about the study before proceeding with the survey. Survey respondents were asked for their willingness to be contacted for an additional interview.

Study methods

Online survey

The survey was based on a previous study by Hurst *et al.* [23], which was an online survey of people with chronic lung disease in 2021 created by a UK charity (Asthma UK–British Lung Foundation (AUK–BLF) partnership). Similar to that of Hurst *et al.* [23], the current survey:

- Collected data on demographics (age, sex), self-reported respiratory diagnosis, breathlessness (MRC score) and influenza and COVID-19 vaccination status.
- Framed questions on infection control measures to respiratory virus transmission to cover a period after the COVID-19 pandemic.

The current survey was modified to the Australian context (see supplementary table S1). This included collecting data on the state of residence as the extent of COVID-19 containment measures varied across state jurisdictions. Additionally, the questions on infection control measures to reduce respiratory virus transmission were also asked with consideration of short-term ("few months") and long-term (12 months) intentions given that the survey was undertaken at a time when lockdowns and health measure mandates were still in place and the Australian population had not yet achieved vaccination milestones set by the government.

Semi-structured interviews

Interview participants were purposefully sampled from survey respondents to ensure maximum variation in sociodemographic variables and clinical characteristics including age, sex, type of self-reported lung disease, breathlessness, vaccination status and location (Australian state). Interviews took place between the lead author and each participant *via* telephone. The interview followed a topic guide (see supplementary material table S2) and was audio recorded.

Sample size

The online survey was designed to explore the acceptability of continued infection control measures; hence a formal sample size calculation was not performed. For qualitative studies, recent recommendations for sample size estimation indicate that this should be a stepwise decision during the research process and not definitively decided in advance. The use of data saturation as a concept in qualitative studies has been recently contested [28], and other approaches such as that suggested by Malterud *et al*. [29] where sample size is informed by "information power" may be more suitable, particularly those involving thematic analysis. Information power is influenced by the aim of the study; the specificity of the sample; the theoretical background; and the quality of dialogue. Given that this study necessitated an iterative and ongoing interpretation during the analytical process, the research team did not specify a definitive sample size *a priori* but anticipated recruiting at least 20 participants for this component of the study.

Study analysis

Quantitative

Data were exported from Qualtrics and collated in Excel. Demographic data and acceptability of infection control measures were reported descriptively. To aid interpretation of all survey responses, the following thresholds were pre-specified in line with Hurst *et al*. [23]: 1) 66% or more of the respondents represented general support for a measure; 2) 33% or a lower proportion represented the absence of significant support; and 3) a difference of >10% between respiratory diagnosis groups indicated a potentially meaningful difference.

Qualitative

Audio recordings of all interviews were transcribed verbatim. Anonymised transcripts were analysed *via* NVivo software (QSR International, Daresbury). A thematic analysis known as the framework method was adopted [30], which consisted of seven analytical phases: transcription, familiarisation with the interview, coding, developing a working analytical framework, applying the analytical framework, charting data into the framework matrix and interpreting the data. The approach taken was also informed by McGowan *et al.* [31], which recommends the flexible application of behaviour change theory analysis of qualitative data, to ensure that codes are not limited by the applied framework. Two members of the team independently coded (line-by-line) the transcripts. The codes were generated inductively before being mapped on to the six components of the COM-B model [32] and the 14 constructs of the Theoretical Domains Framework [33].

Mixed methods integration

Integration of the quantitative and qualitative data was performed using triangulation [34]. Joint display was used for data interpretation and reporting [35].

Results

Characteristics of study participants

A total of 193 people participated in the online survey between August 2021 and December 2021. Full characteristics of the survey participants are detailed in table 1. The majority of the participants were older adults, female, up to date with COVID-19 vaccine doses (at time of survey) and had received the most recent influenza vaccine. Characteristics of the 20 participants purposefully sampled for the semi-structured

TABLE 1 Characteristics of survey participants

Characteristics	
Australian state of residence	
Australian Capital Territory	6 (3)
New South Wales	52 (27)
Northern Territory	2 (1)
Queensland	32 (17)
South Australia	18 (9)
Tasmania	8 (4)
Victoria	62 (32)
Western Australia	13 (7)
Sex, female	149 (77)
Age years	
18–29	2 (1)
30–39	14 (7)
40–49	26 (14)
50–59	26 (14)
60–69	74 (38)
70–79	42 (22)
80+	9 (5)
Lung disease	
Asthma	33 (17)
Bronchiectasis	41 (21)
COPD	84 (44)
Interstitial lung disease	35 (18)
MRC dyspnoea score	2.4±1.0
COVID-19 vaccinations	
Yes, two doses	173 (90)
Yes, one dose	12 (6)
No but still plan to	4 (2)
No, and don't plan to	4 (2)
Influenza vaccination	
Yes	169 (88)
No, but still plan to	14 (7)
No, and don't plan to	10 (5)

Data are presented as n (%) or mean±SD. COVID-19: coronavirus disease 2019; MRC: Medical Research Council.

interview between January and April 2022 are reported in supplementary table S3. The mean±SD duration of the interviews was 39±17 min.

Acceptability of infection control measures

Responses on the long-term acceptability of infection control measures in people with chronic lung disease are reported in table 2. A breakdown of responses according to type of lung disease is reported in supplementary table S4.

Measures by self

At the time of survey, people with chronic lung disease were supportive in the short-term ("next few months") of continuing with wearing face coverings, but in the longer term ("year from now"), only keeping distance in public and hand hygiene were generally supported as measures to continue (supplementary table S5).

Measures by others

There was general support from people with chronic lung disease for physically distancing indoors, increased handwashing and hand sanitiser being widely available to be policies for everyone during the influenza season and at all times. Although there was general support for a policy of face coverings on public transport during the influenza season, there was no such level of support for other policies regarding face coverings. People with chronic lung disease generally supported policies of healthcare professionals wearing face coverings during the influenza season. However, people with chronic lung disease did not provide general support for policies encouraging working from home more often or working from home if unwell with colds or flu.

TABLE 2 Acceptability of continuing with infection control measures in people with chronic lung disease

Infection control measure	Continue to do yourself %	Everyone during "flu season" %	Everyone at all times %
Face covering – indoor public places	52	51	42
Face covering – outdoor public places	16	11	7
Face covering – public transport	53	66	52
Washing hands more often	77	74	72
Keeping distance indoors	83	79	70
Keeping distance outdoors	54	46	36
Avoiding busy places	71	Not asked	Not asked
Avoiding friends/family unwell with colds/flu	79	Not asked	Not asked
Hand sanitiser widely available	Not asked	84	81
Healthcare staff to wear face coverings	Not asked	67	65
Working from home if sick	Not asked	59	60
Encourage working from home	Not asked	47	40

Barriers and facilitators of use of infection control measures

An overview of the factors influencing use of infection control measures that were mapped to the constructs of the Theoretical Domains Framework and components of the COM-B are illustrated in figure 1. A comprehensive list of supporting quotations for the barriers and facilitators are reported in supplementary table S6.

Physical capability (physical skills)

A commonly reported barrier to adopting infection control measures, mainly face coverings, for many participants was respiratory symptoms. This was linked to the difficulty of breathing while wearing a face covering, which resulted in stopping more often while walking, wearing a face covering over mouth only or choosing to stay at home. Participants also expressed that when others, such as healthcare professionals, wear face coverings it presents challenges to communication due to their hearing difficulties.

Psychological capability (knowledge; memory, attention and decisions processes; behavioural regulation)

Participants expressed that their existing knowledge of the impact of cold or influenza-like illness on their lung disease, and their awareness of cultures adopting measures prior to the COVID-19 pandemic, facilitated their adoption of infection control measures. Some participants indicated a lack of access for specific information for people with lung disease during the pandemic, or information only being available if you were already connected with relevant organisations or knew where to seek information. Some participants wanted information on the risk of specific settings for them as the wider community continued with their lives following the peak of the pandemic.

Participants reflected on their focus of choosing between measures in specific situations. During and beyond the pandemic this includes decisions where their selection of measures depends on whether the pros of use outweigh the cons. Some participants suggested that they have incorporated infection control measures into their existing exacerbation action plans or if not already in place, find that being supported to manage this would facilitate use. It was expressed that this is particularly relevant in the context of COVID-19 and antivirals.

Physical opportunity (environmental context and resources)

During the peak of the COVID-19 pandemic having sufficient supply of resources (*e.g.* face coverings, hand sanitiser and rapid antigen testing) was a barrier to adopting use of infection control measures. Some participants admitted to now having supplies at various locations (home, work or when travelling) to continue behaviours. The financial cost of maintaining a supply of these resources was expressed.

Social opportunity (social influences)

Social influences appeared as key factors in determining use of infection control measures. Participants were encouraged by the togetherness of the community to follow recommendations during the pandemic but were unsure that the general population will continue to be vigilant beyond the pandemic. They viewed

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FIGURE 1 Mapping of barriers or facilitators to use of infection control measures to the six domains of COM-B and 14 constructs of the Theoretical Domains Framework. Boxes with solid lines: domain of COM-B model; boxes with dashed lines: construct of the Theoretical Domains Framework; red text: coded barrier; green text: coded facilitator.

support from family as facilitating existing and future infection control, which was founded upon on a pre-pandemic strong understanding of the risk of viral infections.

The shift in culture towards wearing face coverings as a strategy to avoid infection made some participants feel they would continue. However, participants expressed their concerns over what face masks represent in the wider community once public health mandates had finished. The impact that face coverings can have on the quality of conversation with friends or colleagues also led to some participants valuing mental health over the use of measures.

Reflective motivation (beliefs about capabilities; intentions; beliefs about consequences; goals)

The majority of the participants reported being confident in following the necessary advice, with some stating that adopting the measures was just common sense. Participants were committed to continuing with infection control measures beyond the COVID-19 pandemic but did express concern of the stability of such intentions where complacency is possible when the immediate risk is not there. Some held the belief that they were not capable of wearing face coverings because of their respiratory symptoms.

Some participants perceived that continued use of infection control measures can avoid exacerbations of their symptoms based on the lack of colds or influenza-like illnesses they have experienced during the pandemic. Others, however, remained uncertain on the specific value of face coverings and would want to see more evidence on the consequences of use before continuing. It appears that some participants were using “if then” rules to facilitate translation of their intentions to continue using measures.

Automatic motivation (emotion; reinforcement; optimism; social/professional role and identity)

Although being a strong negative emotion in response to the pandemic, the fear of contracting viral infections and the impact that has on lung health was a facilitator to use of infection control measures. Despite this fear, the adoption of infection control measures in the pandemic brought sadness and stress when having to isolate from friends and family. Recommendations of physical distancing, handwashing and communicating with close friends or family when unwell reinforced behaviours that were already part of routines, particularly during the winter period.

There was no enjoyment from wearing face coverings whereby participants commonly expressed the lack of comfort. However, the combination of measures including the use of face coverings has meant that some have optimism of maintaining control of frequency of exacerbations including for the first time being able to inform the likely trigger of the symptoms (*i.e.* separate infectious to non-infectious causes). For some participants, following such infection control practices aligns with qualities expected in previous roles as a carer or a healthcare professional. Similar views were shared in support of continued use of face coverings by healthcare professionals during consultations with people with chronic lung disease. Participants expressed that healthcare professionals can be exposed to unwell people on a regular basis and hence should consider protecting themselves as well as those they care for during the winter period.

Meta-inferences

Triangulation was used to integrate the inferences of the survey and semi-structured interviews in the form of meta-references. The data are presented as a joint display in table 3.

Discussion

The main findings of this study are that physically distancing indoors and hand hygiene are acceptable infection control measures that Australian adults with chronic lung disease intend to continue long-term for the prevention of exacerbations. Avoidance of busy places and friends or family unwell with colds or influenza-like illness were additional long-term strategies that will be continued. However, there was a lack of widespread support for continuation of face coverings across all settings. Wearing of face coverings by healthcare professionals or encouraging use in the general population on public transport during the influenza season were acceptable measures to people with chronic lung disease.

This mixed methods study provides additional insight into the experiences and perceptions of infection control measures in people with chronic lung disease and lends explanatory data to existing findings during the COVID-19 pandemic. The survey findings in this Australian context mirror those of a previous UK study [23]. Irrespective of the differences in the overall national public health responses to the pandemic in Australia and the UK it appears that people with chronic lung disease agree that physical distancing and hand hygiene are widely acceptable, but the population is split on the long-term use of face coverings. To our knowledge, the current study is the first to use semi-structured interviews to further explore the

TABLE 3 Joint display showing meta-inferences

Quantitative findings: acceptability of infection control measures	Qualitative finding: TDF constructs representing barriers or facilitators	Integration of quantitative and qualitative findings: meta-inferences
77% of people with chronic lung disease will continue to wash hands more often while ⩾72% view increased handwashing and use of hand sanitiser as policies to be always implemented	• Environmental context and resources • Reinforcement • Intentions	Hand hygiene is part of everyday routine and can become a habit in people with chronic lung disease but should be encouraged and supported in the wider community
79% of people with chronic lung disease will continue to avoid friends and family unwell with colds/flu	• Knowledge • Social influences • Reinforcement	Risk of infection in people with chronic lung disease is well understood by family and close friends with long established practices in avoiding face-to-face contact when unwell to continue beyond the COVID-19 pandemic
83% of people with chronic lung disease will continue distancing indoors and 71% will continue to avoid busy places	• Emotion • Intentions • Beliefs about capabilities • Beliefs about consequences	Distancing indoors and avoidance of busy, crowded places has become part of life for people with chronic lung disease These are now viewed as long-term adjustments to life driven by the pandemic
16% of people with chronic lung disease will continue to wear face coverings outdoors while even fewer people (7%) view them as policies to be always implemented	• Physical skills • Beliefs about capabilities • Emotion	Face coverings are not comfortable due to breathlessness, particularly when walking outdoors, which makes them difficult to adopt as a long-term strategy
52% of people with chronic lung disease will continue to wear face coverings indoors; 66% take the view that everyone should wear face coverings on public transport during flu season	• Social influences • Beliefs about consequences	Encouragement of face coverings is an acceptable policy during the winter, but it is likely that further evidence of their role in the prevention of exacerbations is required to inform widespread use by all with chronic lung disease in indoor settings
Decrease in proportions of intended use in infection control measures from “a few months” to “a year from now”	• Social influences • Intentions	Adoption of infection control measures are likely to wane over time, and interventions will be needed to maintain motivation and limit complacency
67% of people with chronic lung disease want healthcare professionals to wear face coverings during the influenza season	• Physical skills • Social influences • Beliefs about consequences	Healthcare professionals should wear face coverings during the winter but need to discuss method of communication, particularly with those who are hard of hearing

TDF: Theoretical Domains Framework; COVID-19: coronavirus disease 2019.

continuation of pandemic infection control measures, and in doing so, has identified barriers and facilitators that may influence such behaviours.

Several observational studies have reported reductions in exacerbations and hospitalisations of chronic lung disease during the pandemic or an increased risk of acute respiratory infections and exacerbations following relaxation of COVID-19 restrictions [12–18]. Many of the interview participants in the current study reported a reduced number of viral infections during the pandemic, which provides support to hypotheses that reductions in exacerbations are causally related to lowered exposure to viral triggers [17]. The reported reductions in hospitalisations for exacerbations during the pandemic were of a greater magnitude than existing optimisation of care of chronic lung disease [12]. Participants in the current study expressed views that it was the first 12-month period they had not fallen ill with influenza, and they did not recall having any common cold since the start of the pandemic.

The familiarity of infection control measures to family and close friends (*e.g.* taking precautions when unwell or exposed to symptoms of infection) supports the key role they play in promoting behaviour or monitoring and managing symptoms of exacerbations in people with chronic lung disease [36]. The fear of COVID-19 expressed by participants in this study is consistent with other reports [37, 38], and it is likely that this perceived vulnerability to severe outcomes partly explains why people with chronic lung diseases viewed the additional measures (*e.g.* strict isolation, wearing of face coverings) as acceptable in the short-term despite their discomfort or impact on mental health. It is these more challenging behaviours, however, that as public health mandates have ended appear to have mixed support for long-term use. While the COVID-19 pandemic has increased the acceptability of face coverings, additional implementation strategies will be needed to overcome barriers for wider long-term adoption and may require further evidence of their specific benefit on prevention of exacerbations.

The key strength of this mixed methods study is that it provides a patient perspective on the continuation of infection control measures in people with chronic lung disease beyond the COVID-19 pandemic. The study offers specific implications for research and practice. It is highly recommended that use of infection control measures should be discussed during medical reviews of people with chronic lung disease, particularly those who have frequent exacerbations or are newly diagnosed, as outside of a pandemic the clinical potential of these minimal strategies may be forgotten. Participants in the interviews only drew on their personal experience of lowered respiratory infections and exacerbations during the COVID-19 pandemic, but these clinical consultations offer an opportunity ("teachable moment") to inform people with chronic lung disease about the widespread reduction in such events following the introduction of infection control measures in the community and the potential magnitude of these effects in disease management. The winter period can offer a time on an annual basis where encouragement of infection control measures in the wider community is an acceptable policy. Specific educational resources and behavioural strategies need to be developed to help people with chronic lung disease overcome specific barriers for wearing of face coverings (*e.g.* discomfort and beliefs of increased breathlessness, self-consciousness and communication issues when wearing). Initiatives with the broader community are also required to avoid any stigma related to choosing to continue wearing face coverings. Studies evaluating the effectiveness of face coverings in the prevention of exacerbations are recommended to inform clinical practice guidelines, with any clinical trials likely needing to consider patient preferences in their design. People with chronic lung disease want their healthcare professionals to be wearing face coverings, particularly during the influenza season, but implementation requires consideration of strategies to overcome barriers in communication with those who are hard of hearing.

We note some limitations. While the survey had representation from people with chronic lung disease in all states in Australia, most participants were older adults and women, and the survey was only open to online completion. The participants were recruited through invitations from national respiratory charities, who may not fully reflect the chronic lung disease population. It would be prudent to consider these aspects of our study sample when interpreting the findings including that almost all those interviewed had been vaccinated for COVID-19. The lack of widespread support for measures such as encouraging working from home may have been due our sample not being representative of a working age population whereby such measures were not applicable as opposed to not being acceptable. Similarly, the views of people with asthma may be under-represented in the interviews, a population that is likely to be younger than that for other chronic lung diseases represented in the interviews. We did not collect data on ethnicity to determine whether this had any influence on survey responses. The sample size in the survey was substantially smaller than a previous UK study by Hurst *et al.* [23], but the overall findings are similar. Unlike Hurst *et al.* [23] the sample size of the current study lacked sufficient participant numbers to fully explore differences in subgroups of lung diseases or age groups but did broaden the study population to those living with interstitial lung disease and further explored experience and perceptions of participants using semi-structured interviews. The survey was cross-sectional in nature; hence it is important to recognise the timing of this study and that views may change over time. For example, reported acceptability and intentions of measures may have been influenced by the survey being undertaken at a time when lockdowns and health measure mandates were still in place and hence the perceived risk of COVID-19 is different to now. However, given that participant views on the acceptability of continuing with infection control measures matched responses to intended use in the hypothetical long-term but not short-term scenario suggests that our findings are congruent with what people with chronic lung disease find acceptable to continue with beyond COVID-19. The deductive approach to qualitative data would have placed some constraints on the theme generation, but the behavioural analysis taken allowed us to inform what factors are important in adoption and maintenance of infection control measures. The mapping of these sources of behaviour to the COM-B model and Theoretical Domains Framework means that intervention frameworks such as the behaviour change wheel [32] could be applied to systematically develop targeted interventions to support use of infection control measures.

In conclusion, physically distancing indoors, hand hygiene, avoidance of crowded places and avoidance of unwell family or friends are acceptable long-term infection control measures for Australian adults living with asthma, bronchiectasis, COPD and interstitial lung disease. Although additional measures like wearing face coverings were followed during the COVID-19 pandemic, this mixed methods study indicates that there is no widespread support for continued use, due to perceived barriers that influence their long-term adoption.

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Ethics statement: The study was performed in accordance with the Declaration of Helsinki. This study was approved by Monash University Human Research Ethics Committee – approval: 29925. All participants provided informed consent to participate in this study.

Author contributions: A.W. Jones and A.E. Holland conceived the idea for this study. A.W. Jones, A.E. Holland, J.R. Hurst, A. Cumella and N.S. Hopkinson informed and designed the study protocol. A.W. Jones coordinated the delivery of the survey and conducted the interviews. A.W. Jones and B.E. King undertook data analysis. All authors were involved in data interpretation, drafting and review of the manuscript.

Conflict of interest: Authors disclose the following: leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid (A.E. Holland: Thoracic Society of Australia and NZ; N.S. Hopkinson: ASH, Asthma+Lung UK); consulting fees (J.R. Hurst: AstraZeneca, GSK); payment or honoraria for lectures, presentations, speakers' bureaus, manuscript writing or educational events (J.R. Hurst: Boehringer Ingelheim, Chiesi, Sanofi and Takeda); support for attending meetings and/or travel (J.R. Hurst: AstraZeneca); participation on a data safety monitoring or advisory board (J.R. Hurst: AstraZeneca); receipt of equipment, materials, drugs, medical writing, and gifts or other services (J.R. Hurst: Nonin). The other co-authors have nothing to declare.

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