Infections virales et autres en qualité de l'air à l'intérieur des locaux

Virus and other infections in the context of indoor air quality

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RÉSUMÉ

Selon le Dr David TYRRELL qui fut jusqu'à une date récente directeur de la section du Medical Research Council britannique chargée d'étudier le rhume banal, ce dernier est probablement la maladie infectieuse la plus courante qui affecte la race humaine. Une grande diversité de virus intervient et produit des spectres variables de symptômes.

La transmission des maladies des voies respiratoires supérieures et d'autres infections causées par des virus et des bactéries a plus de chance de se produire à l'intérieur des locaux qu'à l'extérieur, en particulier lorsque la densité d'occupation est forte. La diffusion de telles maladies par les conduits de ventilation a été signalée pour des maladies bactériennes comme la tuberculose, mais il n'est pas sûr que les maladies virales puissent se propager de cette façon. Les virus se transmettent le plus couramment par un aérosol, contenant des particules virales, provoqué par un éternuement, mais l'on pense aussi que la transmission peut parfois s'effectuer par la toux et des gouttelettes infectées déposées sur des journaux ou sur les mains et mises en contact avec le nez par les doigts... Le spectre des symptômes associés aux infections recouvre celui associé aux allergènes et celui des irritants chimiques. C'est pourquoi dans toute étude sur la diffusion des infections virales, il est indispensable que le ou les virus soient formellement identifiés.

Les affections des voies respiratoires supérieures qui nuisent à la productivité et sont une cause d'absentéisme ont des effets économiques importants. Des épidémies de grippe peuvent causer des centaines, voire des milliers de morts. Dans le cas de la grippe, la vaccination contre le type de virus responsable peut empêcher une épidémie, mais les mesures prises pour empêcher l'extension d'autres types d'infections sont moins efficaces. Les masques légers en coton sont des barrières très inefficaces pour empêcher l'inhalation de gouttelettes infectées, mais il a été prouvé que l'irradiation par les UV réduit la transmission de la rougeole. En théorie, une certaine prévention est possible en se désinfectant les doigts et en évitant de transférer au nez et aux yeux les gouttelettes déposées sur la peau, les journaux, etc...

Ceux qui ont la responsabilité de la conception et de la ventilation des bureaux et autres lieux de travail doivent porter davantage d'attention aux moyens de réduire la transmission de personne à personne des infections virales et bactériennes.

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ABSTRACT

According to Dr David TYRRELL, until recently the Director of the UK Medical Research Council's Common Cold Unit, the common cold is probably the commonest infectious disease to affect the human race. A wide variety of viruses is involved, and these give rise to varying spectra of symptoms.

The transmission of upper respiratory and other diseases caused by viruses or bacteria is much more likely to occur indoors than outdoors, particularly where people are crowded together. The spread of such diseases via ducted ventilation systems has been reported for bacterial diseases such as tuberculosis, but it is uncertain whether viral diseases can be spread in this way. An aerosol containing virus particles generated by sneezing is the commonest means by which viruses are transmitted, although spread via coughing and spread by infected droplets that have landed on papers or hands being transferred by fingers to the nose is thought sometimes to occur. The spectrum of symptoms associated with infections overlaps that associated with allergens and that associated with chemical irritants. For this reason in any scientific study of the spread of virus infections, it is essential for the virus/viruses to be positively identified.

Upper respiratory infections detract from performance and are responsible for absenteeism and these effects are of major economic importance. Epidemics of influenza may be associated with hundreds or thousands of deaths. In the case of influenza, vaccination against the responsible type of virus may prevent an epidemic. Measures to prevent the spread of other types of infection are less effective. Light cotton masks are very inefficient as barriers to the inhalation of infected droplets and UV irradiation has been shown to reduce the transmission of measles.

Theoretically disinfection of fingers, and care not to transfer droplets that have landed on the skin or on papers et coetera to the nose and eyes might be of value.

Those responsible for the design and ventilation of offices and other work places need to give more thought than at present to ways of reducing the transmission of virus and bacterial infections from person to person.

Introduction

According to David TYRRELL (1992), until recently the Director of the UK Medical Research

Council's Common Cold Unit, the common cold is probably the commonest infectious disease to affect the human race. A wide variety of viruses is involved (see Table 1) and these give rise to varying spectra of symptoms (see Table 2). The fact that so many different viruses are involved helps to explain why infections are so frequent, with adults suffering on average one or two attacks per year and young children as many as five or six attacks. The immune response to one virus offers little or no protection against the two hundred or so other viruses which can cause common colds.

Table 1
Common cold viruses

	No. of types
Rhinoviruses	> 100
Enteroviruses	> 70
Influenza	A & B and subtypes
Parainfluenza	4
Respiratory syncytial	2
Coronaviruses	> 2
Adenoviruses	> 30

Table 2
Symptoms and complications of acute respiratory virus infections

Nose	Discharge/obstruction
Nasal sinuses	Pain/inflammation
Nasopharynx	Sore throat
Eustachian tubes	Blockage/ear ache
Larynx	Loss of voice/cough
Trachea	Cough/phlegm
Bronchi/bronchioles	Cough/dyspnoea/phlegm
Lung parenchyma	Cough/dyspnoea/chest pain
General	Fever/malaise/ toxaemia/death

Transmission of respiratory infections

The transmission of upper respiratory and other diseases caused by viruses or bacteria is much more likely to occur indoors than outdoors, particularly where people are crowded together. There are anecdotal reports of the spread of bacterial diseases such as tuberculosis via ducted air ventilation systems but it is uncertain whether viral diseases can be spread in this way. An aerosol containing virus particles generated by sneezing is the commonest means by which viruses are transmitted, although spread via coughing and spread by infected droplets that have landed on papers or hands being transferred by fingers to the nose has been demonstrated to occur (TYRRELL, 1992). The spectrum of symptoms associated with infections overlaps that associated with allergens and that associated with chemical irritants. For this reason, and because several different common cold viruses may be circulating within a community simultaneously, it is essential in any scientific study of the spread of virus infections, for the virus/viruses responsible to be positively identified.

Available preventive measures

Table 3 summarizes what can be done to cut down the incidence of acute respiratory infections. Only in the case of influenza is immunization a practical option. Epidemics of influenza can been associated with hundreds or thousands of deaths and it has been established that mass vaccination can prevent an epidemic provided that the serotype of the virus in question is precisely known. Measures to prevent the spread of other types of respiratory virus for which vaccination is not an option are less effective and/or impracticable. Light cotton masks are very inefficient as barriers to the inhalation of infected droplets. UV irradiation on the other hand has been shown to reduce the transmission of

Table 3
Protection from acute respiratory virus infections

Immunization	Too many serotypes (rhinoviruses)
	Poor persistence of antibodies (coronaviruses)
	of value (influenza viruses)
UV light	Some value
Light cotton masks	Little value
Personal hygiene	Can prevent transfer of viruses from papers/ hands to nose
Avoidance of overcrowding	Very valuable
Adequate ventilation	Very valuable

measles. Theoretically, disinfection of fingers and care not to transfer droplets that have landed on the skin or on papers et cetera to the nose and eyes should be of some value.

Undoubtedly the three most important available preventive measures are, firstly, the avoidance of overcrowding within indoor spaces. Secondly, is the provision of adequate and effective ventilation that is designed in such a way that expired droplets from one person are not inhaled by another. Theoretically, a third measure could be the most effective of all. This is one that would require that people who know or suspect that they have an infection should isolate themselves at home and avoid mixing with other people. Unfortunately, this measure is not a practical one. It would cost employers too much money, especially if people cheated by claiming to have infections when they were in fact well. Also such a measure would interfere with an disrupt the social lives of people to an unacceptable degree.

Ambient humidity and temperature

There are several important questions (see Table 4). Firstly, does high or low ambient humidity influence the transmission of viruses from person to person ? A common feature of the viruses listed in Table 1 is that they are well adapted to proliferate at the temperature of about 33 °C which is typically that of the normally moist nasal mucosa. One might expect, therefore, the risk of transmission to be reduced if the nasal mucosa is dry because of low ambient temperature is low. However, the sensations of dryness and coldness of the nose relate mainly to the front part of the nose and even under conditions of extreme cold and/or low humidity the posterior part of the nasal mucosa remains warm, moist and suitable for viral proliferation.

Table 4

Factors influencing transmission and symptoms of common colds

Transmission	
All viruses	> Stable at low temp.
Viruses with lipid envelope	> Stable in dry air (e.g. influenza)
Viruses with no envelope	> Stable in moist air (rhino and adeno-viruses)
Symptoms	
Irritants make symptoms worse	
e.g. –	No_x
	So_2
	Aldehydes
	Particles

Of much more relevance is the fact that viruses in general are more stable at low ambient temperatures. Hence virus particles present in aerosols remain infective for longer during cold weather than during hot weather. As far as humidity is concerned, viruses which are protected by a lipid envelope (e.g. influenza, parainfluenza, respiratory syncytial and corona viruses) are more stable in dry air than in moist air whilst viruses without a protective envelope (e.g. rhino, entero, and adeno viruses) are more stable in moist air. This helps to explain why influenza epidemics in temperate regions usually occur during the cold winter season when low humidity is more prevalent.

It is a matter of common experience that the symptoms of respiratory infections are made worse by irritants such as oxides of nitrogen, sulphur dioxide, aldehydes and particles. This is true, for example, for exposure to cooking and heating fumes and for exposure to other people's tobacco smoke under conditions of poor ventilation. However, it is not clear that exposure to irritants increases the risk of transmission of viral infections. Some smokers choose to believe that tobacco smoke acts like a disinfectant and protects them from picking up infections. However, there seems to be no evidence either for enhancement or reduction of incidence of colds among smokers. In the case of young children there have been many reports of higher incidences of respiratory symptoms in households where one or both of the parents smoke than in non-smoking households. However, there have also been many reports of studies in which no such association was found. Unfortunately, research in this area is not straightforward because of the difficulty of obtaining reliable data, the lack of any objective measure of exposure, and the existence of numerous confounding variables, including many associated with socioeconomic status (HOOD *et al.*, 1982).

Atopy and the transmission of viral infections

Atopic individuals who suffer from allergic rhinitis or asthma tend to be more sensitive than normal subjects to irritants in the ambient air. Also they tend to suffer more severely when they do pick up respiratory infections. However, there is no hard evidence that atopy increases the risk of being infected by respiratory viruses.

Conclusions

Upper respiratory infections detract from performance and are responsible for absenteeism and these effects are of major economic importance. Hence those responsible for the design and ventilation of offices and other places of work need to give more thought than at present to ways of reducing the transmission of virus and bacterial infections from person to person. On the other hand, the extent to which the incidence of respiratory infections in the workplace could be reduced by improved ventilation is limited by the fact people whose working environment is satisfactorily protective against their picking up infections in the workplace are all too frequently thrust into close contact with other people, including some with colds, while travelling to an from work. According to TYRRELL (1992) isolation of communities of people from the outside world, as on islands such as SPITZBERGEN and Tristan DU CUNHA, is associated with the complete disappearance of colds within about 6 months. However, the arrival of a ship with sailors who mix with the local people is all too likely to spark off epidemics of colds. Consequently, it has to be accepted that there is at present no way of eliminating acute respiratory viral infections from the list of health problems that humans have to bear.

References

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