Airborne Particles from Latex Gloves in the Hospital Environment

S. W. B. Newsom[1] and Peggy Shaw[2]

[1]Formerly Consultant Microbiologist at Papworth and Addenbrookes Hospitals and Honorary Consultant to the PHLS,
[2]Microbiology Research Department, Papworth Hospital, Cambridge, UK

Eur J Surg 1997; Suppl 579: 31–33.

ABSTRACT
Air sampling studies are described which show high levels of airborne starch powder contamination in areas where powdered latex gloves are used. Furthermore, culture of collected samples show a clear association between starch particles and bacterial colonies in an experimental system suggesting that airborne particles could act as a vector for pathogens in the hospital environment.

Key words: starch particles, latex proteins, hypersensitivity, hospital air.

INTRODUCTION

The incidence of latex hypersensitivity in health care workers has increased steadily over the past few years. It is now thought to be somewhere between 6 and 17%-indeed some papers appearing in the literature are now speaking of an 'epidemic' of occupational allergy to latex involving health care workers (1).

Research into the problems posed by medical gloves and latex allergies has mirrored this growth. In 1987, only 85 research papers on gloves were published. Last year this number had increased to 120. There has been a similar growth in interest in gloves and allergy, with publications increasing from 7 in 1987 to 24 in 1995.

Baur and Jäger (2) noted that latex proteins can act as antigens via inhalation, as proteins can be transferred to the starch glove powder, which may then be inhaled. In order to establish the level of airborne contamination with glove powder in an average hospital, and thus the extent of related problems, a number of pilot studies using fixed and portable air samplers were performed.

EXPERIMENTAL STUDIES

In a series of hospital surveys, the level of air contamination by starch particles was assessed. The key variables considered were the type of hospital room, the activity undertaken, the gloves used, and the availability of mechanical ventilation. Because of the possibility that hospital bed sheets may contain starch contaminants, control samples were taken in a psychiatric ward, where there was no glove use.

A 'personal air sampler' (Cassella, Bedford, UK) was set to sample 2 L air/min at hourly intervals. The sampler was fitted with 0.5 μm cellulose acetate filters and run for 15 min (30 L air). Each test room was sampled on five consecutive days (45 samples). Starch particles were visualised by staining the filters with Lugol's iodine, and counted using a $\times 10$ hand lens. Repeat tests were run in the Accident (A/E) Department after a change to powder-free gloves.

RESULTS

The fall in mean counts when powder-free gloves were used in the A/E department was statistically significant. The mean count did not fall further because some powdered gloves still 'crept' into the department in dressings packs, on hands or clothing of staff from other departments (Tables I and II).

The other results are shown in Table III (note: statistical analysis showed the distribution was not normal, but since the units were three dimensional, a cubed root transformation was performed and the resultant data became linear).

Analysis showed that the non-ventilated intensive care ward was significantly worse than other clinical units. Interestingly enough, there was little difference between the two theatres, but it transpired that although the surgical teams were wearing powder-free gloves, the ancillary nurses (circulating staff) wore powdered gloves.

There were few starch particles in the psychiatric ward, suggesting that our techniques and assumptions

 ISSN 1102–416X

Table I. *Accident and Emergency with powdered gloves*

No of tests	Mean Count	SD	SE
45	2.61	1.07	0.16

Table II. *Accident and Emergency with powder-free gloves*

No of tests	Mean Count	SD	SE
45	1.68	0.44	0.07

Table III. *Summary of counts from various sites sampled in two hospitals*

Site	No. tests	Mean count	SD	SE
Intensive care 1**	45	1.97	0.7	0.1
Intensive care 2**	45	2.77	0.7	0.1
Intensive care 3	40	3.48	0.7	0.1
Theatre 1**	41	2.16	0.86	0.13
Theatre 2 (orthopedic)**	45	2.37	1.04	0.16
Scrub room 1**	45	2.16	1.04	0.16
Scrub room 2**	45	2.55	1.07	0.16
Powder free ward-control	9	0.95	0.55	0.18

Mean count = mean of stated number of test results expressed a cubed root of count per 30L of air. Actual overall mean count was 13.8 particles /30L Air.
* * = ventilated room.

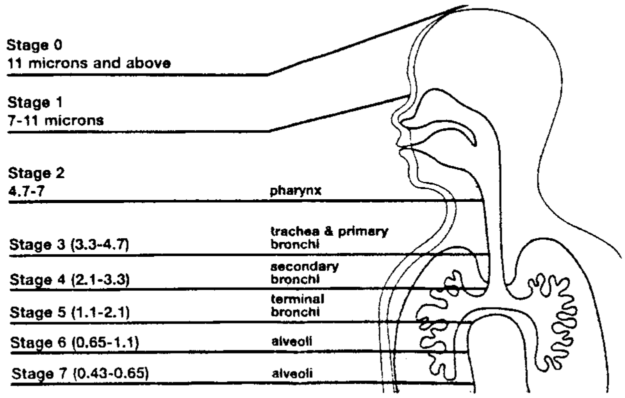

Fig. 1. The Andersen Sampler incorporates a number of filter stages. Each stage of particle capture corresponds to a stage of particle size capture in the human respiratory system, as shown in this diagram.

were valid. This assumption was supported by the fall in mean counts when the A&E department changed from powdered gloves to powder-free gloves.

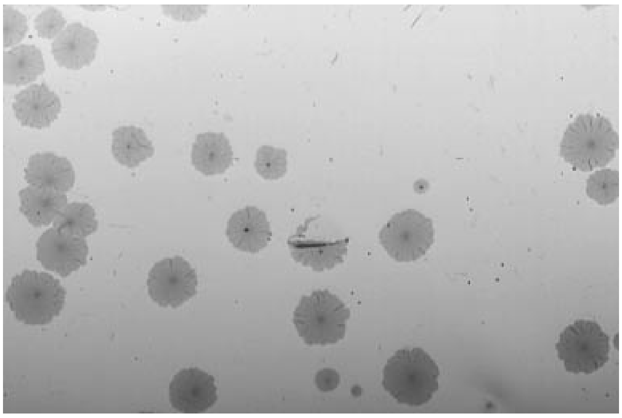

Fig. 2. Removed filter cultured and stained. The dark dot of a starch particle can clearly be seen at the centre of many colonies.

Table IV. *Pilot study with gloves and* B subtilis

Particle size	bacteria	bacteria + starch	Starch
>11u	252	180	330
7–11u	8	5	22
<7u	13	0	12

Table V. *Microbiology laboratory results*

>11u	31	0	3
7–11u	32	4	9
<7u	32	1	5

BACTERIAL CARRIAGE

A second set of tests were performed using an Anderson sampler (Fig. 1) set to sample 27 L/min in a laboratory while a technician removed a pair of gloves from hands which had already been covered with a pair of gloves then dipped into a culture of *Bacillus subtilis*. The filters were cultured and stained for starch. The results (Fig. 2) showed a clear association between starch particles and bacterial colonies (a black centre comprising a stained starch particle at the centre of a colony) indicating that starch particles can act as carriers for bacteria (see Table IV, V and VI)). The same sampler was used to take air samples in a microbiology laboratory, where starch powdered gloves were in use, and in the canteen. Starch particles were captured via the Anderson sampler, and the filter was then cultured and stained. Control studies were undertaken to ensure that the bacteria did indeed adhere to starch particles, rather than making starch themselves.

Table VI. *Canteen results*

>11u	31	0	0
7–11u	17	0	0
<7u	99	0	0

Formal statistical analysis of all the data from these studies has not yet been completed, but the preliminary results of the pilot study suggest an association between starch particles and bacteria. In the hospital canteen, where there was no glove use, we did not find any bacteria in association with starch. We hope to continue this work using a more sophisticated air sampler and membrane filter system.

DISCUSSION

During discussion the following points were noted:

- Multiple antibiotic resistant bacteria such as MRSA and VRE may be able to use glove powder as a vector and/or food source in a hospital environment. Infections caused by these organisms have a high associated morbidity and mortality. The potential for such carriage should be investigated.
- Further studies may involve the use of 'personal samplers' worn by patients as they move around the hospital.

REFERENCES

1. Hunt LW, Fransway AF, Reed CE, *et al*. An epidemic of occupational allergy to latex involving healthcare workers. J Occup Environ Med 1995; 37: 1204–1209.
2. Baur K, Jäger A. Airborne antigens from latex gloves. Lancet 1990; 335: 912.

Address for correspondence:
Dr S.W.B. Newsom
11 The Footpath
Coton
Cambridgeshire CB3 7PX
UK