REVIEW OF LITERATURE

TEAM UNDERTAKING REVIEW: Parts A and B - Health Protection Scotland, Part C - WHAIP				
CONTACT PERSON: Dawn Hill				
TOPIC: Use of personal protective equipment for the prevention and control of infection.				
PRINCIPAL RESEARCH QUESTION/ OBJECTIVE: To review the evidence base in relation to the use of personal protective equipment as a standard measure for the prevention and control of infection.				
METHODOLOGY				
i) Search strategy for identification of studies				
Period of publication	Part A: 1966 – 2004 Part B: 2004 – 2006 Part C: 2007- 2008			
Strategy key words for Part C	Personal protective equipment, PPE, protective clothing, personal protective barriers, barrier nursing; facial/face protection,[face] masks, visors, shields, respirators; eye protection, eye protective devices' goggles; theatre caps, footwear; gowns, [plastic]aprons, gloves [latex], head protective devices, [fluid] gowns; Infection and control, health and safety management, occupational exposure, occupational health and safety, equipment and supplies; Blood borne viruses [pathogens], cross infection, hospital acquired infection, micro organisms[transmission], contamination, mucus membrane/blood, exposure, body fluid, communicable disease infection, Infectious disease transmission infection control, transmissible infections; Healthcare practitioners, healthcare workers, occupational health personnel, healthcare environment, health personnel			
Electronic databases for Part C (tick as appropriate)	MEDLINE	√	HMIC	√
	Science Direct	√	British Nursing Index	√
	CINAHL	√	Health Technology Assessment	√
	Cochrane Library	√	Bandolier	√
Specialist web sites / portals searched for Part C	JBI-connect, National Electronic Library-Infection, National Library for Health Guidelines finder, CDC, Welsh Assembly Government (WAG), Scottish Executive Health Dept. (SEHD), Health Protection Agency (HPA), Health Protection Scotland (HPS), Department of Health (DH), Department of Health & Social Services & Public Safety (DHSSPS-NI) Northern Ireland, Health Information and Quality Authority (Republic of Ireland-Health), Hospital Infection Society, Infection Prevention Society			
Hand searching journals for Part C	American Journal of Infection Control, British Journal of Infection Control, Infection Control and Hospital Epidemiology, Journal of Hospital Infection			
ii) Selection criteria for inclusion of studies				
Sample	All health and social care workers.			

Outcome measure(s)	Interventions to minimise the spread of infection in the healthcare environment through the use of personal protective equipment.
Other inclusion criteria	N/A
Language Limitations	English language only.

iii) Quality assessment

Study quality assessment	
Part A (1966-2004)	Identified articles were reviewed according to Roe's model. Guidance documents, however, were unable to be subjected to all such criteria.
Part B (2004-2006) and Part C (2007-2008)	Identified articles were reviewed according to Roe's model for critical appraisal of scientific papers, Sign 50 methodology for systematic reviews and meta-analyses and the AGREE instrument for the evaluation of guidance documents as appropriate.
Data collation and analysis	Qualitative analysis of data performed on studies uncovered. Guidance documents reviewed for any relevant commentary. Anecdotal evidence also considered.

RESULTS ***Part A (1966 – 2004)***	When caring for patients, healthcare workers are often required to wear personal protective equipment (PPE) which includes a variety of items such as gloves, gowns, aprons, eye protection, face protection, masks, theatre footwear and caps. The rationale for using protective equipment is to protect both patient and healthcare worker from any potential cross contamination following exposure to microorganisms contained in blood and body fluids, as underlined by guidance from the Infection Control Nurses Association (ICNA). Guidance published in 1999 in relation to PPE takes account of the array of health and safety legislation which exists. In particular, the Health & Safety at Work Act (1974) places a duty of care on employers to provide a safe working environment for staff. Further legislation issued by the Health & Safety Executive in 1992 specified the use of personal protective equipment at work and highlighted the need for employers to take all reasonable steps to ensure appropriate PPE is made available to staff and that it is appropriately used in accordance with training (EC Directive 656). Although the focus of much of the guidance is on staff within acute services, the precautions described apply to all social care settings. Prior to any procedure being undertaken, a risk assessment should be conducted to determine which PPE should be used for a procedure or task. The nature of the task, the duration of the task, the potential for exposure to blood and body fluids, the potential for contamination of non-intact skin or mucous membranes should all be taken into account. A health or social care workers' hands are the most common route of transmission of infection within the health and social care settings. (See hand hygiene literature reviews for further details). Wearing gloves aims to: i) protect hands from contamination with organic matter or microorganisms; ii) protect hands from specific chemicals that may have a negative effect on the condition of the skin; iii) reduce the risk of cross infection by preventing the transmission of microorganisms from staff to patients and patients to staff.

	Gloves were first used by obstetricians as a form of barrier protection in 1758 (Fay and Dooher, 1992). The use of gloves has increased considerably since that time. With the introduction of universal precautions during the 1980s, which are now referred to as standard infection control precautions, gloves are used to protect against any microorganisms from both the patient and the health care worker. Wearing gloves, however, does not replace the need for handwashing following a procedure or period of care (Pratt et al., 2002). In June 1993, a European law was introduced dictating that all medical devices, including gloves, must comply with set standards. The Medical Devices Directive (1993) (MDD 93/42/EEC) facilitates the standardisation of the safety and marketing of such devices. Every medical device must, therefore, carry an appropriate CE marking (MDA, 1999a). For those procedures termed as exposure prone procedures (i.e. procedures which may result in exposure of patients' tissues to the blood of healthcare workers e.g. obstetric, cardiothoracic and gynaecological procedures), the UK Health Departments' (1998) guidelines recommend healthcare workers employ the double gloving strategy. Despite an initial loss in dexterity, staff are encouraged to comply with this recommendation to reduce the potential for cross infection. Parker (2000) indicated that using a coloured underglove increases the users' awareness of glove perforation during surgery. Furthermore, a Cochrane review of trials comparing the effectiveness of single and double gloving carried out by Tanner & Parkinson (2003) revealed that double latex gloves significantly reduces the number of perforations to the innermost gloves (when carrying out low risk surgical procedures). Wearing two pairs of latex gloves does not cause the user to sustain more perforations to the outer glove. Wearing double latex indicator gloves enables easier detection of perforations to the outer glove. In high risk surgical procedures, wearing a gloveliner between two pairs of latex gloves significantly reduced the number of perforations to the inner glove compared with double latex gloves only. The Health & Safety Executive Guidance on PPE (1998) underlines the importance of proper fitting PPE. Wearing poorly fitting gloves can lead to a number of problems such as: - interference with dexterity (ICNA, 2002); - friction; - excessive sweating (Truscott, 1995); - finger and hand muscle fatigue (Fleming et al. 1997).

	Medical gloves are for single use, according to MDA (2000) guidance and should never be reused. Such action could result in legal prosecution. Evidence would suggest that glove reuse is associated with transmission of MRSA and gram- negative bacilli (Olsen et al, 1993; Patterson et al, 1991; Maki et al, 1990). Washing gloves is not acceptable either and only helps to reduce the barrier properties of the glove (Adams et al., 1992). Instead, gloves should be disposed of following each task or episode of care (Pratt et al., 2001). Gloves contaminated with blood or body fluids should be disposed of as clinical waste. In recent years, the selection of glove type has grown as a result of reactions which can be evoked in some users to the natural proteins or the accelerators often added to latex gloves. Natural rubber latex (NRL) is a naturally occurring material (Hevea brasiliensis) from the rubber tree. It has been used in the healthcare setting for more than 60 years. Glove manufacturing requires chemicals to be added to give the strength, elasticity, flexibility and comfort needed (MDA, 1996). Although some of these chemicals may be removed during the washing stage of the manufacturing process, not all will be eliminated. As a result, there are three main types of reaction which can result: *Allergy:* an immunological reaction to a foreign substance with negative effects on body; *Hypersensitivity:* inappropriate or excessive response with the immune system; *Sensitisation:* production of specific antibodies by body in response to exposure to antigen. Latex sensitisation is the type of reaction most commonly seen amongst the healthcare worker population, however allergic responses are possible and are defined according to the allergen. Immediate hypersensitivity (between 5 and 30 minutes post-exposure) is indicative of an allergic response to the natural proteins in NRL. This reaction can be as a result of exposure of the skin, respiratory tract or the gastrointestinal tract to an allergen. Although removal of the allergen will result in the reaction lessening, fatal anaphylactic shock is possible (RCN, 1999). Delayed hypersensitivity (6 to 48 hours) reflects a response to the chemical accelerators used in the manufacturing process which results from repeated contact with an allergen. Once sensitised, any contact can evoke a recurrence (RCN, 1999). As a consequence of this, a risk assessment should be conducted to determine which gloves should be used, taking into account the patient's natural rubber latex (NRL) allergy status (ICNA, 1999, 2002). Guidance was produced by the MDA in 1996 highlighting the problem.

	Furthermore, although it has not yet been possible to determine an extractable protein level that can be defined as non- sensitising (HSC 1999/186), gloves should be low in extractable proteins (<50ug/g) and low in residual chemicals, according to ICNA guidance (2002). Additional guidance was issued by the Department of Health in 1998 recommending powdered gloves not be used within the healthcare environment. Evidence was uncovered indicating problems associated with the cornstarch powder used to ease donning of gloves. Studies suggest it acts as a vector of allergens and particles. In order to raise awareness of these issues and to provide important information to healthcare workers in terms of reporting allergies, support organisations etc., the Health & Safety Executive produced a latex safe guidelines toolkit in conjunction with the Department of Health in late 2003. Despite the concerns in relation to latex allergy, latex gloves still remain the glove of choice when dealing with blood or body fluids given the level of protection they offer the user (Pratt et al., 2001; Russell-Fell, 2000; Rego & Roley, 1999). To avoid unnecessary and prolonged contact, it is recommended that gloves should be worn only when necessary and should be removed immediately on completion of the procedure. Hands should then be decontaminated (Perry & Barnett, 1998). Non-natural rubber latex alternatives now exist in the form of i) neoprene and nitrile, ii) vinyl, iii) plastic/co-polymer gloves. The advantages and disadvantages of each have been the subject of much debate (Korniewicz et al, 1989). Neoprene and nitrile are acceptable alternatives to NRL, however, the protection offered by varying brands of glove needs to be considered in relation to the manfacturer's data. Such materials are resistant to tearing and puncturing and the user can handle various substances, including gluteraldehyde. It should be noted, however, that nitrile contains similar chemicals to NRL gloves and, therefore, may result in similar allergies. Vinyl gloves are produced to a similar standard as NRL gloves, however, their disadvantage is a decrease in durability and potential compromise in barrier protection when assessed during care (Rego & Roley, 1999). The MDA (1996), therefore, does not recommend vinyl gloves be used where exposure to blood and body fluids is likely. Rather vinyl gloves should only be used for brief periods and where fine dexterity is not required. Plastic/co-polymer gloves are not recommended for use in the healthcare setting (ICNA, 1999). Despite their low cost, their poor fitting and their likelihood of tearing, these gloves do not meet the needs of healthcare workers. Accordingly, plastic gloves tend to be used by those in the catering industry.

	Regardless of glove type, gloves generally have an average life span of 3 to 5 years. It should be noted that they may become compromised by heat, humidity, exposure to direct sunlight or sources of ozone (e.g. x-ray machines) and, therefore, appropriate storage should be considered while ensuring ease of access for users. Another means of protecting healthcare workers and patients alike from contamination is the wearing of gowns and/or aprons. Gowns, in particular, offer protection for healthcare workers' arms and exposed body areas and prevent contamination of clothing, according to CDC (2004). Gowns used within the UK are made in a variety of materials (e.g. traditional polyester cotton, modern woven and unwoven fabrics). However, Line (2003) raised the point that poly-cotton material allows penetration of bacteria and potential exposure of the healthcare worker to pathogens. Sterile gowns offer protection for the patient from healthcare associated infections (HAIs) when undergoing aseptic invasive procedures (e.g. surgery, insertion of central venous catheter) while single use fluid repellent aprons primarily protect the healthcare workers clothing from becoming contaminated with blood, body fluids or microorganisms. A working group established by the Hospital Infection Society concluded that theatre gowns and drapes should be made of waterproof disposable material, according to their review of the evidence (Woodhead et al, 2002). Saunders (2004) highlighted the move by healthcare institutions towards single use gowns designed to resist tearing, wetting and bacteria penetration and dispersal. However, according to a pilot study conducted by researchers at Bristol University, aprons can attract high levels of bacteria due to their large electrostatic charge. This in turn creates a large opposite charge when a HCW is in close contact with a patient causing them to attract high levels of bacteria. Further research is needed to investigate this issue in more detail, but to decrease the likelihood of cross contamination, PPE should, according to guidance, be changed following completion of each task. Whether theatre greens or normal uniform is worn underneath, care should always be taken when removing the gown/apron to avoid as far as possible contamination of undergarments. Wigglesworth (2003) and Lipp (2003) both highlighted that European standards exist (EN 13795) in relation to theatre drapes and gowns which support the requirements of the Medical Devices Directive (93/42/EEC).

	Healthcare workers are also required to protect their eyes and face, in particular the mucous membranes of the eye (conjunctivae), nose and mouth, from contamination during procedures where splashing or aerosol spray of blood, body fluids or chemicals is possible (e.g. dentistry, surgery, midwifery, decontamination of instruments) (DoH Guidance, 1998). To do so, goggles, visors, face shields or masks are available. The choice of PPE for the face should be in line with an appropriate risk assessment and will depend on the patient interaction involved and the likelihood of blood splashing. A study conducted by Ward et al. (1997) suggests goggles are best worn where splashing is likely while visors or face shields are best worn where there is a risk of blood splattering or aerosolisation of potentially infectious material. Eye protection of any sort should be comfortable to wear and fit properly to ensure maximum protection. In the event of contamination of the eyes with blood or other body fluid or chemical, the eye should be rinsed with copious amounts of eye wash. If contact lenses are worn, these should be removed before doing so (DOH Guidance, 1998). Multi-use items should be cleaned with detergent following use and then rinsed and dried before being stored (RCN, 1997). If contaminated with blood or other material, eye protection should be cleaned and then disinfected according to hospital policy. Any such items which become scratched following multi-use should be replaced as an impairment of vision could result, thereby compromising patient care (HSE, 1992). Face-masks offer protection from cross infection to both healthcare workers and patients alike. According to CDC guidance (2004), there are two types of mask available for use in the healthcare setting. Firstly, surgical masks prevent potential shedding of microorganisms from healthcare workers and potential exposure of the mucous membranes of the mouth, nose and eyes of healthcare workers to microorganisms via splashes of blood and body fluids given their fluid resistant properties (UK Health Departments, 1998). Although worn as standard in theatre, Lipp and Edwards (2002) suggest from their systematic review of the literature that there is no clear benefit or harm to the patient undergoing clean surgery if a surgical face mask is worn or not. In addition to the standard surgical mask, respirator masks (also known as procedure or isolation masks) are also available which protect the user from small particles (<5um) containing infectious agents transmitted via the airborne route, as outlined by CDC guidance (2004).

	These respirators differ in their efficiency to filter particles (e.g. FFP1, FFP2, FFP3) and their maximum inward leakage. Each type of mask can vary in its size, shape, filtration efficiency and method of attachment (e.g. ties, elastic, ear loops) (CDC guidance, 2004). The mask selected for use must be appropriate for its purpose. In operating theatres, it is recommended that staff wear surgical masks where the splashing of blood or body fluids is anticipated or when the procedure undertaken carries a higher risk of an SSI (e.g. prosthetic orthopaedics). Outwith the theatre, surgical masks are recommended for any procedure which involves a risk of splashing of blood/body fluids (Pratt et al, 2001). When dealing with patients carrying infections spread via the airborne or droplet routes (e.g. tuberculosis, SARS), varying types of mask/respirator may be required. Details of related guidance/literature will appear in the series of reviews on transmission based precautions. Often, procedures may require other types of face and eye protection be worn in conjunction with a mask (e.g. goggles, visor) as mentioned previously. Regardless of the type of mask used, however, all masks should be worn correctly (according to manufacturer's instructions) and should be close fitting, covering the nose and mouth, according to guidance from the UK's National Association of Theatre Nurses (NATN) (1998). Masks should be handled as little as possible to minimise the potential for cross infection. If masks become wet or soiled, they should be changed and should be renewed after each operation (HIS, 2002; Romney, 2002, European Standard, 2001). NATN (1998) recommends changing masks every two hours where possible. When changing or on final removal of a mask, the straps should be used and minimal contact made with the mask itself. After removing, the mask should be disposed of immediately as clinical waste. It should never be reused. In areas such as theatre, sterile services units, aseptic suites in pharmacy where asepsis is of primary importance, caps are worn to reduce the dispersal of bacteria from the hair. However, evidence to support the need for all theatre staff to do so is lacking. Humphreys et al. (1991) suggested in their study that the wearing of caps by the scrub team in theatre aided a reduction in air bacterial counts. However, Horton and Parker (1997) produced evidence to suggest that non-scrubbed theatre staff need not wear caps given the effectiveness of air ventilation systems to counteract any possible increase in bacterial counts.

	This recommendation was corroborated by a Hospital Infection Society Working Party Report which advised that non-scrubbed theatre staff need not wear disposable caps. Rather the report advised that hair should be clean and tied back. However, the NATN recommend that all theatre staff cover their hair at all times (NATN, 1998). Similarly, the British Orthopaedic Association (BOA) recommend that all staff within the operating theatre suite, including the anaesthetic room and corridor, should cover hair at all times. According to guidance and available evidence, however, caps are not required in theatre recovery. Furthermore, there is no requirement for caps as part of standard isolation, according to Ayliffe et al. (2000). Even in protective isolation, they suggest that evidence to support the use of caps remains unsubstantiated. When caps are worn they should be close fitting, covering the hair completely, and be made of impervious plastic, paper or wool (Ayliffe et al, 1992). For male theatre staff with beards, helmet-style caps should be worn, according to ICNA guidance, to ensure complete coverage of facial hair. As applies for the donning and removal of all PPE, hands should be decontaminated prior to donning caps and when disposed of after use to avoid cross infection. Therefore, it would appear that such recommendations are based on general principles of best practice, which may not be necessary. In operating theatres, full time or regular theatre staff usually have personal theatre footwear. Occasional staff are often asked to wear overshoes. The use of overshoes, however, has been questioned given evidence to suggest that bacteria are aerosolised into the environment from the bellows when walking (Carter, 1990). Furthermore, a study by Jones & Jakeways (1988) uncovered small holes in overshoes while Ayliffe et al. (1990) and Carter (1990) highlighted the transfer of bacteria from floor to hand which can occur when donning and removing overshoes. As a consequence, dedicated shoes are preferable to overshoes in areas such as theatre or sterile services suites (e.g. CSSD, TSSU). Care should be taken to keep dedicated shoes clean. Following use they should be decontaminated using clean hot water and a general purpose detergent (UK Health Departments, 1998). If contaminated with blood or body fluids, footwear should be washed and then disinfected according to hospital policy. Footwear which is processable through a washer-disinfector or autoclave would be preferable. Dedicated footwear should not be worn outside. Wearing of dedicated footwear may help to reduce the risk of percutaneous injury and exposure to BBVs.

	Wellington boots or overboots may offer greater protection than clogs or shoes and may be preferable for surgery involving high risk patients, although their impracticalities and discomfort are also recognised in the literature. The appropriate selection, use and maintenance of any of the above PPE are crucial for its effectiveness. Reference should be made to the Health and Safety Executive's (1998) guidance when performing a related risk assessment and putting the PPE into use. Furthermore, supplies of PPE must be available as near to the point of use as possible. Following the use of any item of PPE, hand decontamination should be the final step in the process to avoid cross infection (CDC Guidance, 2004). As is apparent from the review of the literature, the evidence to support particular infection control measures in relation to PPE is often lacking. Rather than relying on common sense and principles of best practice, research needs to be undertaken to address the gaps identified.
RESULTS ***Part B (2004 – 2006)***	The annual literature review aims to identify, review and critique any scientific studies or guidance, which have been published in the intervening period since the original literature review, to determine if changes to guidance are required. The literature search using the described strategies identified very few additional studies specifically on PPE during the period of review. Most of the recently published studies relating to PPE, were opinion based articles and commentary and although interesting did not contain enough scientific evidence to effect a change to guidance, e.g. comment on the relative efficacy of different shapes of face visor (Loveridge *et al.*, 2006). Two recently published articles looked at the use of gowns as PPE but were more specifically concerned with their use as part of infection control measures to prevent onward transmission during outbreak situations. One study, (Puzniak *et al.*, 2004), estimated the cost-benefit of gown use as part of the measures used to control Vancomycin-Resistant *Enterococci* (VRE) transmission in a hospital in the USA. The results of the study demonstrated a decrease in the expected transmission rate of VRE and the cost-benefit was estimated based on gown cost versus cost of the healthcare associated with the expected transmission of VRE. This study demonstrates the importance of the use of gowns as PPE as part of effective infection control strategy in outbreak situations. Conversely, another study (Grant *et al.*, 2006), demonstrated only a small detectable decrease in MRSA transmission, attributable to gown use; however this study was very small and had a number of limitations which made the results difficult to decipher. Only one paper was identified by the search strategy, within the period of review specifically on surgical masks (Beck *et al.*, 2004).

	This paper dealt with the possibility of a negative psychosocial impact by the wearing of masks in paediatric settings. This was based on the experiences of staff dealing with the SARS outbreak in Canada and the authors suggested a number of practical measures to lessen this potential impact on children, which may be of interest to HCWs working in this type of setting in Scotland. The use of gloves as PPE is considered a standard infection control precaution when there is a risk that the wearer might be exposed to blood or other body fluids. However several studies and academic comment have centred on the lack of compliance with this aspect of infection control. Poor compliance with use of gloves as PPE was shown in a scientific article recently published in the USA (Shimokura *et al.*, 2006), which showed that compliance with hand hygiene and glove use was low by haemodialysis staff despite frequent exposure to blood during the procedure. This study recommended that more staff specific training was required to increase awareness and understanding of the risks. Another recently published article (Girou *et al.*, 2004) discussed the results of a study which showed that inappropriate glove use, (e.g. failure to remove or change contaminated gloves) is a contributing factor in poor hand hygiene compliance. This thereby demonstrates the importance of staff conformity with guidance on use of PPE.

RESULTS ***Part C (2007-2008)***	This review aims to identify, review and critique any studies or guidance, which have been published in the intervening period since the last update, to determine if changes to guidance are required. There were limited additional relevant scientific papers published in the period of the literature review on personal protective equipment (PPE). The epic2 guidelines (*Pratt et al.2007*), highlighted the health and safety implications of PPE provision and the associated educational needs were emphasized. They identified studies showing that both a lack of knowledge of guidelines and non-adherence to guideline recommendations are widespread and that on going in-service education and training is required. The guidelines laid down a series of standards for personal protective equipment: General * Selection of PPE must be based on an assessment of the risk of transmission of microorganisms to the patient or to the carer, the risk of contamination of the healthcare workers (HCW's) clothing and skin by patients' blood, body fluids, secretions and excretions. * Everybody involved in providing care should be educated about standard principles and trained in the use of PPE. * Adequate supplies of disposable plastic aprons, single use gloves and face protection should be available wherever care is delivered. Gowns should be available when advised by the infection control team. Gloves: Risk assessment for the use of gloves should include: - Considering who is at risk (patient and/or HCW), and whether sterile or non-sterile gloves are required - The potential for exposure to blood, body fluids, secretions and excretions - Contact with non-intact skin or mucous membranes during general care and invasive procedures. The guidelines emphasis that gloves used for clinical practice may leak even when apparently undamaged, and that the use of gloves as a method of barrier protection reduces the risk of contamination but does not eliminate it and hands are not necessarily clean because gloves have been worn. Standards for the use of gloves include: *Gloves must be worn for invasive procedure, contact with sterile sites and non-intact skin or mucous membranes, and all activities that have been assessed as carrying a risk of exposure to blood, body fluids, secretions and excretions; and when handling sharp or contaminated instruments.

	*Gloves must be worn as single use items. They are put on immediately before an episode of patient contact or treatment and removed as soon as the activity is completed. Gloves are changed between caring for different patients, or between different care/treatment activities for the same patient. *Gloves must be disposed of as clinical waste and hands decontaminated, ideally by washing with soap and water after gloves have been removed. *Gloves that are acceptable to healthcare personnel and CE marked must be available in all clinical areas. *Sensitivities to natural rubber latex in patients, carers and healthcare personnel must be documented and alternatives must be available. *Neither powdered nor polythene gloves should be used in health care activities. <u>Aprons/gowns</u>: *Disposable plastic aprons must be worn when close contact with the patient, materials or equipment are anticipated and when there is a risk that clothing may be become contaminated with pathogenic microorganisms or blood, body fluids, secretions or excretions, with the exception of perspiration. *Plastic aprons/gowns should be worn as single-use items, for one procedure or episode of care, and then discarded and disposed of as clinical waste. Non-disposable protective clothing should be sent for laundering. *Full-body fluid- repellent gowns must be worn where there is a risk of extensive splashing of blood, body fluids, secretions or excretions, with the exception of perspiration, onto the skin or clothing of healthcare personnel (e.g. when assisting with childbirth). <u>Eye/face protection:</u> *Face masks and eye protection must be worn where there is a risk of blood, body fluids, secretions or excretions splashing into the face and eyes. *Respiratory protective equipment i.e. a particulate filter mask, must be correctly fitted and used when recommended for the care of patients with respiratory infections transmitted by airborne particles. A review article by *Hinkin et al. (2008)*, examined the importance and use of PPE by community nurses. It highlighted shortfalls in compliance and the need for education and improvement in this area given the drive to provide more complex patient care in their own homes.

	Several papers highlighted the need for eye/facial protection during procedures/surgery. *Davies et al. (2007)*, published a prospective study which was carried out by a single surgeon on all cases performed over a 1 year period. Protective masks and glasses were examined for blood and body fluid splashes before and after all operations. A total of 384 operations were performed with 174 (45%) showing blood or body fluid splashes on the lens of the glasses. 79% of vascular procedure resulted in splashes, 100% of amputations and 50% of laparoscopic cases. The author recommended the routine wearing of eye and facial protection during surgical operations. A study by *Endo et al. (2007)*, analysed the results of face-shield blood splatter contamination at six medical facilities to determine exposure risk when facial protection is not used. Blood splatter exposure was evaluated on the basis of overall incidence, location of splatter on face shields, surgical speciality, risk for operating room staff, length of surgery and volume of blood loss. 600 face shields were evaluated visually and by staining with leucomalachite green. Visual examination detected blood splatter contamination in 50.5 % and staining in 66.0%. Blood contamination was 36.6% in the orbital region, 37.8% in the para-orbital region and 57% in the mask region. The incidence of blood contamination was highest in the lead surgeon (83.5%), followed by the main assistant (68.5%), and the scrub nurse (46%). Cardiovascular surgery was highest risk with an incidence of 75.3% (113/150), followed by neurosurgery at 69.3% (104/150) with gastrointestinal at 60.0% (90/150) and orthopaedic surgery at 60.0% (90/150). This study again emphasizes the need for compliance with wearing facial protection during surgical operations. A paper by *Birnie et al. (2007)*, quantified the number of facial splashes that occurred during skin surgery, assessed the provision of eye protection and assessed the attitudes to its use in skin surgery. This was a prospective observational study on 100 consecutive dermatological surgical procedures, plus 100 procedures where an assistant was present. Face-mask visors examined visually for blood spots and a postal survey of all UK-based members of the British Society of Dermatological Surgery was carried out. In 15% of procedures there was at least 1 splash to the operator, and in 15% of procedures the assistant received at least one splash. The use of bipolar , electrocautery was more likely to result in a splash. In the postal survey. 20.8% (33/159) said face masks were not available, 68.8% did not have access to face masks with visors and 34% (54/159) wore no facial protection at all when operating.

	53.3% thought they received a facial splash in less than1% of procedures. The paper concluded that there was a substantial risk of a blood splash to the face of the operator and assistant during dermatological surgery. They conclude that the use of facial protection is advisable at all times but especially when using bipolar electrocautery or when operating on known high risk patients. Also, that the perceived risk of receiving a blood splash to the face was substantially underestimated by UK dermatologists. The risk of virus transfer from PPE to healthcare workers skin and clothing was examined in a paper by *Casanova et al. (2008).* CDC has addressed the concern of contamination of hands and clothing during removal of PPE by designing a protocol for the suggested removal of PPE (*Siegel et al. 2007*). This study evaluated this protocol by contaminating PPE (gowns, gloves, respirators, goggles) with a non-pathogenic bacteriophage. After removal of the PPE staff were sampled for the presence of this bacteriophage on hands, PPE and scrubs worn under PPE. It concluded that even when the protocol for PPE removal was followed there was still a substantial risk of transfer of virus to hands and clothing. They suggest that the use of double gloving and following surgical protocols for the removal of PPE may improve on these finding and reduce the risk of transfer. The need for good hand hygiene was emphasized in this study. The issue of double gloving was examined in an experiment by *Lefebvre et al. (2008)*. A needle contaminant with viscosity comparable to water was used in an enzyme-colorimetry assay to accurately quantify the miniscule inoculation volumes delivered by suture needles passed through various types and layers of commonly used surgical gloves. They found that one glove layer removed 97% of contaminant from tapered needles, and 65% from cutting needles, compared with no-glove control data. Additional glove layers did not significantly improve contamination removal from tapered needles. For the cutting needle, 2 glove layers removed 91% of contaminant, which was significantly better than a single glove. There were no statistically significant differences between glove types although it was a very underpowered study. They found that there was no advantage to triple gloving but that double gloving provided superior protection for a surgeon.

	Diaz et al. (2008) examined the issue of contamination of examination gloves in patient rooms. An assessment of bacterial contamination on examination gloves indicated that contaminated gloves may be a mechanism of indirect transmission from the hands of HCWs to patients. This mechanism was indicated by the recovery of identical *Acinetobacter baumanni* isolates from gloves and from clinical cultures of a patient with invasive infection. The authors simulated contamination of gloves to ensure their method worked. Then an assessment was carried out of gloves in patient rooms. Latex examination gloves were sampled from rooms with patients known to be colonised and/or infected with MRSA, VRE, carbapenem-resistant *A. baumanni*, or ESBL *K. pneumonia*. Gloves were also sampled from rooms not known to contain patients with these organisms. The gloves were taken from wall mounted boxes in the rooms, or isolation carts outside the rooms. No pre-existing contamination was observed on gloves from newly opened boxes. 75% of gloves sampled from patient rooms were contaminated with at least one bacterial species. Skin organisms were most commonly isolated and the average bioburden was low. Potentially pathogenic organisms were isolated from 1/27 boxes sampled (*P.aeruginosa* and *A baumanni*). The *A. baumanni* was determined as identical to the patient strains by PFGE. They were isolated from a box mounted by a sink, but not from the box on the trolley outside the door. The authors postulate that poor hand hygiene before putting on gloves may have contaminated the box/gloves. *Stenotrophomonas paucimobilis* was isolated from gloves obtained from 5 rooms on 4 units. No clinical cultures were identified amongst patients, although the organism may be a pathogen in units with immunocompromised patients. The hospital policy mandates hand hygiene before putting on gloves and after removing gloves and these findings provide evidence of the need for compliance with hand hygiene practices. The authors also suggest that when a patient who is infected/colonised with a carbapenem-resistant *A. baumanni* is discharged, consideration should be given to discarding the remaining examination gloves as part of the terminal room cleaning protocol. They conclude that gloves in patients room may serve as a reservoir for organisms, and a viable mechanism by which organisms may be transmitted to susceptible patients.

CONCLUSIONS ***Part A (1966 – 2004)***	*The rationale for using protective clothing is to protect both patient and healthcare worker from any potential cross contamination following exposure to microorganisms contained in blood and body fluids. *The type(s) of protective equipment used should be based on a risk assessment which considers the nature of the task, the duration of the task, the potential for exposure to blood and body fluids, the potential for contamination of non-intact skin or mucous membranes. *Wearing gloves aims to reduce the risk of cross infection by preventing the transmission of microorganisms from staff to patients and patients to staff. *For those procedures termed as exposure prone procedures (i.e. procedures which may result in exposure of the patient's tissues to the blood of the healthcare workers e.g. obstetric, cardiothoracic and gynaecological procedures), the UK Health Departments' (1998) guidelines recommend healthcare workers employ the double gloving strategy. *Wearing gloves, however, does not replace the need for handwashing following a procedure or period of care (Pratt et al., 2002). *In recent years, the choice of glove type has grown as a result of reactions which can be evoked in some users to the natural proteins or the accelerators often added to natural rubber latex gloves. *Latex sensitisation is the type of reaction most commonly seen amongst the healthcare worker population, however allergic responses are possible and are defined according to the allergen. *As a consequence of this, guidance was produced by the MDA in 1996 highlighting the problem. *Additional guidance was issued by the Department of Health in 1998 recommending powdered gloves not be used within the healthcare environment. Evidence was uncovered indicating problems associated with the cornstarch powder used to ease donning of gloves

	*Despite these concerns, latex gloves still remain the glove of choice when dealing with blood or body fluids. *Non-natural rubber latex alternatives now exist in the form of i) neoprene and nitrile, ii) vinyl, iii) plastic/copolymer gloves. The advantages and disadvantages of each have been the subject of much debate (Korniewicz et al, 1989). *Another means of protecting healthcare workers and patients alike from contamination is the wearing of gowns and/or aprons. Gowns, in particular, offer protection for the healthcare workers' arms and exposed body areas and prevent contamination of clothing, according to CDC guidance (2004). *Gowns used within the UK are made in a variety of materials (e.g. traditional polyester cotton, modern woven and unwoven fabrics). However, Line (2003) raised the point that poly-cotton material allows penetration of bacteria and potential exposure of the healthcare worker to pathogens. *Sterile gowns offer protection for the patient from healthcare associated infections (HAIs) when undergoing aseptic invasive procedures (e.g. surgery, insertion of central venous catheter) while single use fluid repellent aprons primarily protect the healthcare workers clothing from becoming contaminated with blood, body fluids or microorganisms. *Evidence, including the report of a working group established by the Hospital Infection Society, suggests that theatre gowns and drapes should be made of waterproof disposable material, according to their review of the evidence (Woodhead et al, 2002). *Whether theatre greens or normal uniform is worn underneath, care should always be taken when removing the gown/apron to avoid as far as possible contamination of undergarments. *Healthcare workers are also required to protect their eyes and face, in particular the mucous membranes of the eye (conjunctivae), nose and mouth, from contamination during procedures where splashing or aerosol spray of blood, body fluids or chemicals is possible. *Goggles, visors or face shields and masks are available. *The choice of PPE for the face should be in line with an appropriate risk assessment and will depend on the patient interaction involved and the likelihood of blood splashing.

	*A study conducted by Ward et al. (1997) suggests goggles are best worn where splashing is likely while visors or face shields are best worn where there is a risk of blood splattering or aerosolisation of potentially infectious material. *In the event of contamination of the eyes with blood or other body fluid or chemical, the eye should be rinsed with copious amounts of eye wash. If contact lenses are worn, these should be removed before doing so (DOH Guidance, 1998). *Face-masks offer protection from cross infection to both healthcare workers and patients alike. *According to CDC guidance (2004), there are two types of mask available for use in the healthcare setting. *Surgical masks prevent potential shedding of microorganisms from healthcare workers and potential exposure of the mucous membranes of the mouth, nose and eyes of healthcare workers to microorganisms via splashes of blood and body fluids given their fluid resistant properties (UK Health Departments, 1998). *In addition to the standard surgical mask, respirator masks (also known as procedure or isolation masks) are also available which protect the user from small particles (<5um) containing infectious agents transmitted via the airborne route, as outlined by CDC guidance (2004). These respirators differ in their efficiency to filter particles (e.g. FFP1, FFP2, FFP3) and their maximum inward leakage. *The mask selected for use must be appropriate for its purpose. In operating theatres, it is recommended that staff wear surgical masks where the splashing of blood or body fluids is anticipated or when the procedure undertaken carries a higher risk of an SSI (e.g. prosthetic orthopaedics). *Outwith the theatre, surgical masks are recommended for any procedure which involves a risk of splashing of blood/body fluids (Pratt et al, 2001). *When dealing with patients carrying infections spread via the airborne or droplet routes (e.g. tuberculosis, SARS), varying types of mask/respirator may be required. Details of related guidance/literature will appear in the series of reviews on transmission based precautions. *Often, procedures may require other types of face and eye protection to be worn in conjunction with a mask (e.g. goggles, visor).

	*Regardless of the type of mask used, all masks should be worn correctly (according to manufacturer's instructions) and should be close fitting, covering the nose and mouth. *If masks become wet or soiled, they should be changed and should be renewed after each operation (HIS, 2002, Romney, 2002, European Standard, 2001). NATN recommends changing masks every two hours where possible. *Masks should be handled as little as possible to minimise the potential for cross infection. After removing, the mask should be disposed of immediately as clinical waste. It should never be reused. *In areas such as theatre, sterile services units, aseptic suites in pharmacy where asepsis is of primary importance, caps are worn to reduce the dispersal of bacteria from the hair. However, evidence to support the need for all theatre staff to do so is lacking. *When caps are worn they should be close fitting, covering the hair completely, and be made of impervious plastic, paper or wool (Ayliffe et al, 1992). *As applies for the donning and removal of all PPE, hands should be decontaminated prior to donning caps and when disposed of after use to avoid cross infection. *In operating theatres, full time or regular theatre staff usually have personal theatre footwear. *Occasional staff are often asked to wear overshoes. However, the use of overshoes has been questioned given evidence to suggest that bacteria are aerosolised into the environment from the bellows when walking (Carter, 1990). *As a consequence, dedicated shoes are preferable to overshoes in areas such as theatre or sterile services suites (e.g. CSSD, TSSU). Care should be taken to keep dedicated shoes clean. *The appropriate selection, use and maintenance of any of the above PPE are crucial for its effectiveness. *Supplies of PPE must be stored appropriately and as near to the point of use as possible. *Following the use and disposal of any item of PPE, hand decontamination should be the final step in the process to avoid cross infection.

CONCLUSIONS ***Part B (2004 – 2006)***	*There were limited publications specifically on PPE produced within the period of this annual review of the model policies. *An interesting study has been published looking at the possible psychosocial impact on the wearing of masks in paediatric settings. There are recommended possible tactics to lessen this effect, which may be useful for HCWs working within this type of setting in Scotland (Beck et al., 2004) *Some studies and commentary to consider at this time, suggest that there is poor compliance with correct use of gloves as PPE and this highlights the requirement for ongoing training and support to ensure that the standards set down in present guidance on PPE are achieved
CONCLUSIONS ***Part C (2007-2008)***	*A lack of knowledge of guidelines and non-adherence to guideline recommendations are widespread and on going in-service education and training is required. *Selection of PPE must be based on an assessment of the risk of transmission of microorganisms to the patient or to the carer, the risk of contamination of the HCW's clothing and skin by patients' blood, body fluids, secretions and excretions. *Gloves used for clinical practice may leak even when apparently undamaged, and that the use of gloves as a method of barrier protection reduces the risk of contamination but does not eliminate it. *Good hand hygiene practices are an essential component of glove use. *Several studies emphasis the risk of blood or body fluid splashes to the face during surgical procedures, and the need for more general use of facial protection. *Healthcare workers underestimate the risk of blood or body fluid splashes during surgical procedures. *Adequate PPE (e.g. facial protection) may not be available to HCWs. *Removing PPE carries a risk of contamination of hands and clothing and adequate hand hygiene after removal is essential. *Double gloving provides superior protection to single gloving for a surgeon. *Gloves in patients' rooms may serve as a reservoir for organisms, and a viable mechanism by which organisms may be transmitted to susceptible patients. Compliance with hand hygiene measures is essential. *Consideration should be given to discarding the remaining examination gloves as part of the terminal room cleaning protocol in patients who are colonised with multiply-antibiotic resistant organisms.

RECOMMENDATIONS	
Part A (1966 -2004)	*A healthcare worker's hands are the most common route of transmission of infection within the health care setting. *Wearing gloves, however, does not replace the need for handwashing following a procedure or period of care (Pratt et al., 2002). *A risk assessment should be conducted to determine which gloves and other PPE should be used for a procedure or task. The nature of the task, the duration of the task, the potential for exposure to blood and body fluids, the potential for contamination of non-intact skin or mucous membranes. *For those procedures termed as exposure prone procedures (i.e. procedures which may result in exposure of the patient's tissues to the blood of the healthcare workers e.g. obstetric, cardiothoracic and gynaecological procedures), the UK Health Departments' (1998) guidelines recommend healthcare workers employ the double gloving strategy. *The Health & Safety Executive Guidance on PPE underlines the importance of proper fitting PPE. *Medical gloves are for single use and should never be reused. *Washing gloves is not acceptable either and only helps to reduce the barrier properties of the glove. *Gloves should be disposed of following each task or episode of care (Pratt et al., 2001). Gloves contaminated with blood or body fluids should be disposed of as clinical waste. *Natural rubber latex gloves remain the glove of choice when dealing with blood or body fluids given the level of protection they offer the user, however, individuals can develop reactions towards the natural proteins/chemical accelerators. * Latex gloves should, therefore, be low in extractable proteins (<50ug/g) and low in residual chemicals, according to ICNA guidance (2002). *Non-natural rubber latex alternatives also exist in the form of i) neoprene and nitrile, ii) vinyl, iii) plastic/co¬polymer gloves, but have their advantages and disadvantages. *Additional guidance was issued by the Department of Health in 1998 recommending powdered gloves not be used within the healthcare environment.

	*It is recommended that gloves are worn only when necessary and should be removed immediately on completion of the procedure to avoid unnecessary and prolonged contact. Hands should then be decontaminated. *Another means of protecting healthcare workers and patients alike from contamination is the wearing of gowns and/or aprons. Gowns, in particular, offer protection for the healthcare workers' arms and exposed body areas and prevent contamination of clothing. *Evidence indicates that single use gowns designed to resist tearing, wetting and bacteria penetration and dispersal should ideally be used. *Care should always be taken when removing the gown/apron to avoid as far as possible contamination of undergarments. *Healthcare workers are also required to protect their eyes and face, in particular the mucous membranes of the eye (conjunctivae), nose and mouth, from contamination during procedures where splashing or aerosol spray of blood, body fluids or chemicals is possible. * To do so, goggles, visors or face shields and masks are available. *The choice of PPE for the face should be in line with an appropriate risk assessment and will depend on the patient interaction involved and the likelihood of blood splashing. *Evidence suggests goggles are best worn where splashing is likely while visors or face shields are best worn where there is a risk of blood splattering or aerosolisation of potentially infectious material. *Eye protection of any sort should be comfortable to wear and fit properly to ensure maximum protection. *In the event of contamination of the eyes with blood or other body fluid or chemical, the eye should be rinsed with copious amounts of eye wash. If contact lenses are worn, these should be removed before doing so. *Multi use items should be cleaned with detergent following use and then rinsed and dried before being stored. If contaminated with blood or other material, eye protection should be cleaned and then disinfected according to hospital policy. *Any such items which become scratched following multi¬use should be replaced as an impairment of vision could result, thereby compromising patient care.

	*Face-masks offer protection from cross infection to both healthcare workers and patients alike. *According to CDC guidance (2004), there are two types of mask available for use in the healthcare setting: surgical masks which prevent potential shedding of microorganisms from healthcare workers and potential exposure of the mucous membranes of the mouth, nose and eyes of healthcare workers to microorganisms via splashes of blood and body fluids given their fluid resistant properties and respirator masks (also known as procedure or isolation masks) which protect the user from small particles (<5um) containing infectious agents transmitted via the airborne route. These respirators differ in their efficiency to filter particles (e.g. FFP1, FFP2, FFP3) and their maximum inward leakage. *Each type of mask can vary in its size, shape, filtration efficiency and method of attachment (e.g. ties, elastic, ear loops). *The mask selected for use must be appropriate for its purpose. *In operating theatres, it is recommended that staff wear surgical masks where the splashing of blood or body fluids is anticipated or when the procedure undertaken carries a higher risk of an SSI (e.g. prosthetic orthopaedics). *Outwith theatre, surgical masks are recommended for any procedure which involves a risk of splashing of blood/body fluids (Pratt et al, 2001). *When dealing with patients carrying infections spread via the airborne or droplet routes (e.g. tuberculosis, SARS), varying types of mask/respirator may be required. Details of related guidance/literature will appear in the series of reviews on transmission based precautions. *Often, procedures may require other types of face and eye protection be worn in conjunction. *Regardless of the type of mask used, however, all masks should be worn correctly (according to manufacturer's instructions) and should be close fitting, covering the nose and mouth. *Masks should be handled as little as possible to minimise the potential for cross infection. If masks become wet or soiled, they should be changed and should be renewed after each operation. *When changing or on final removal of a mask, the straps should be used and minimal contact made with the mask itself. After removing, the mask should be disposed of immediately as clinical waste. It should never be reused.

	*In areas such as theatre, sterile services units, aseptic suites in pharmacy where asepsis is of primary importance, caps should be worn to reduce the dispersal of bacteria from the hair. *When caps are worn they should be close fitting, covering the hair completely, and be made of impervious plastic, paper or wool (Ayliffe et al, 1992). *For male theatre staff with beards, helmet-style caps should be worn to ensure complete coverage of facial hair. *As applies for the donning and removal of all PPE, hands should be decontaminated prior to donning caps and when disposed of after use to avoid cross infection. *In operating theatres, full time or regular theatre staff should have dedicated personal theatre footwear. *The use of overshoes is not recommended the transfer of bacteria from floor to hand which can occur when donning and removing overshoes. *Care should be taken to keep dedicated shoes clean. Following use they should be decontaminated using clean hot water and a general purpose detergent. If contaminated with blood or body fluids, footwear should be washed and then disinfected according to hospital policy. Footwear which is processable through a washer-disinfector or autoclave would be preferable. *The appropriate selection, use and maintenance of any of the above PPE are crucial for its effectiveness. *Supplies of PPE must be stored appropriately and as near to the point of use as possible. *Following the use and disposal of any item of PPE, hand decontamination should be the final step in the process to avoid cross infection
Part B (2004 – 2006)	No change to present guidance recommendations in literature review available 16/08/05
Part C (2007-2008)	Nothing additional needs to be added to Infection Prevention Model Policy/Procedure 3 (version 1) as a result of the literature review for part C.
PRACTICAL APPLICATION	As the use of personal protective equipment (PPE) has been recommended for some time, no significant change to practice should be required, however, the standards set down must be achieved.
RESOURCE IMPLICATIONS	As per current policies. All resources required for the provision of PPE should already be in place.

KEY REFERENCES ***Part A (1966 – 2004)***	Allen J & Henshaw D (unpublished), Static charge as a mediator of nosocomial infections in an isolation ward, University of Bristol. Ayliffe GAJ, Fraise AP, Geddes AM, Mitchell K (2000), Control of Hospital Infection, A Practical Handbook, Fourth Edition, Arnold, London. Ayliffe GAJ, Lowbury EJL, Geddes AM, Williams JD (1992), Control of Hospital Infection, A Practical Handbook, Third edition, Chapman Hall Medical, London. Department of Health (1999), Health Service Circular (HSC 1999/186) *Late Medical Gloves and Powdered Latex Medical Gloves*, DOH, London. European Standard (EN 13795) surgical drapes, gowns and clean air suits, used as medical devices, for patients, clinical staff and equipment. Part one: general requirements for manufacturers, processors and products. European Committee for Standardisation. Health & Safety Executive (1992), *Personal Protective Equipment at Work, Guidance on Regulations L25*, Health and Safety Executive, London. Health and Safety at Work Act (1974), Health Service Advisory Committee, the Stationery Office, London. Health and Safety Executive (1998), The selection, use and maintenance of respiratory protective equipment: a practical guide, HSG53 (Second edition), HSE Books, 1998, ISBN 0 7176 15375. Humphreys H, Russell AJ, Marshall RJ, Ricketts VE, Reeves DS (1991), The effect of surgical head-gear on air bacterial counts, Journal of Hospital Infection, 19, 3, 175-180. Infection Control Nurses Association (1999) *Glove usage guidelines*, ICNA, c/o Fitwise, Bathgate. Infection Control Nurses Association (2002) *A comprehensive glove choice*, ICNA, c/o Fitwise, Bathgate. Lipp A & Edwards P (2002), Disposable surgical face masks: a systematic review. *Journal of Advanced Perioperative Care*, 1, 4 1-46. Medical Devices Agency (1996), *Latex Sensitisation in the Healthcare Setting. Use of Latex Gloves*, DB(96)0 1, Stationery Office, London.

Medical Devices Agency (1998), Medical Devices Directive (MDD) *Latex Medical Gloves (Surgeons and Examination) Powdered Latex Medical Gloves (Surgeons and Examination)*, MDA SN9 825 (June), London.

Medical Devices Agency (MDA) (1999a), The CE Mark, Bulletin No. 2, MDA, London.

National Association of Theatre Nurses (1998), Principles of Safe Practice in the Perioperative Environment, 66, Harrogate, UK.

NHS Greater Glasgow, Infection Control Committee (2005), Prevention and Control of Infection Manual.

NHS Scotland (2004), Partnership Information Network (PIN) Board, Occupational Health and Safety Strategy Implementation Group, *Glove Selection Guidance (Draft)*, St. Andrew's House, Edinburgh.

PPE at Work Regulations (1992) EC Directive 656.

Rego A & Roley L (1999) In use barrier integrity of gloves: latex and nitrile superior to vinyl. *American Journal of Infection Control*, 27 (5): 405-4 10.

Royal College of Nursing (1997), *Hepatitis*, RCN, London.

Royal College of Nursing (RCN) (1999), Latex allergy in healthcare settings. Working well initiative. Employment Brief 25/99, RCN, London.

Royal College of Nursing, *Getting a Grip on Latex Allergy*
Tanner J & Parkinson H (2004) Double gloving to reduce surgical cross infection (Cochrane review), Cochrane Library, 2 (2004).

Truscott W (1995), They are not just gloves: a guideline on proper use. *Chicago Dental Society Review*, 88 (2): 22-29.

UK Health Departments (1998), *Guidance for clinical health care workers: protection against infection with blood borne viruses*, Recommendations of the Expert Advisory Group on AIDS and the Advisory Group on hepatitis, DoH, London.

Ward v, Wilson J, Taylor L, Cookson B, Glynn A (1997), *Preventing hospital acquired infection. Clinical guidelines.* PHLS, London.

Part B (2004 – 2006)	Beck, M. Antle, B. J. Berlin, D. Granger, M. Meighan, K. Neilson, B. J. Shama, W. Westland, J. & Kaufman, M. (2004) Wearing masks in a pediatric hospital: developing practical guidelines *Canadian Journal of Public Health. Revue Canadienne de Sante Publique.* 95 256-7, 2004 Jul-Aug. Girou, E. Chai, S. H. Oppein, F. Legrand, P. Ducellier, D. Cizeau, F. & Brun-Buisson, C. (2004) Misuse of gloves: the foundation for poor compliance with hand hygiene and potential for microbial transmission? *Journal of Hospital Infection.* 57 162-9, 2004 Jun. Grant, J. Ramman-Haddad, L. Dendukuri, N. & Libman, M. D. (2006) The role of gowns in preventing nosocomial transmission of methicillin-resistant *Staphylococcus aureus* (MRSA): gown use in MRSA control *Infection Control & Hospital Epidemiology* 27 191-4. Loveridge, J. M. Gozzard, C. & Bannister, G. C. (2006) The effectiveness of a visor as a surgical barrier: an inverted position is better Journal of Hospital Infection 62 251-3. Puzniak, L. A. Gillespie, K. N. Leet, T. Kollef, M. & Mundy, L. M. (2004) A cost-benefit analysis of gown use in controlling vancomycin-resistant Enterococcus transmission: is it worth the price? Infection Control & Hospital Epidemiology. 25 418-24, 2004 May. Shimokura, G. Weber, D. J. Miller, W. C. Wurtzel, H. & Alter, M.J.(2006) Factors associated with personal protection equipment use and hand hygiene among hemodialysis staff American Journal of Infection Control. 34 100-7, 2006 Apr.

Part C (2007-2008)	Birnie A.J., Thomas K.S., and Varma S. (2007) Should eye protection be worn during dermatological surgery: prospective observational study. *British Journal of Dermatology* 156(6):1258-1262. Casanova L., et al. (2008) Virus transfer from personal protective equipment the healthcare employees' skin and clothing. *Emerging Infectious Diseases* . 14(8):1291-1293. Davies C.G., et al. (2007) Blood and body fluid splashes during surgery--the need for eye protection and masks. *Annals of the Royal College of Surgeons of England* . 89(8):770-772. Diaz M.H., et al. (2008) Contamination of examination gloves in patient rooms and implications for transmission of antimicrobial-resistant microorganisms. *Infection Control & Hospital Epidemiology* . 29(1):63-65. Endo S., et al., (2007) Risk of facial splashes in four major surgical specialties in a multicentre study. *Journal of Hospital Infection.* 67(1):56-61. Hinkin J., Gammon J. and Cutter J. (2008) Review of personal protection equipment used in practice. *British Journal of Community Nursing* , 13(1):14-19. Lefebvre D.R., Strande L.F. and Hewitt C.W. (2008) An enzyme-mediated assay to quantify inoculation volume delivered by suture needlestick injury: two gloves are better than one. *Journal of the American College of Surgeons.* 206(1):113-122. Pratt, R.J. et al. (2007) epic2:national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. *Journal of Hospital Infection,* 65 (Suppl). Siegel J.D., Rhinehart E., Jackson M., Chiarello L. and Health Care Infection Control Practices Advisory Committee. 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Health Care Settings. *American Journal of Infection Control* . 35(10:Suppl 2):
REVIEW STATUS	Complete
DATE ISSUED	
REVIEW DATE	September 2012