

Prudent Care of Instruments from an Infection Prevention Perspective

Compliance with basic infection control procedures.

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The global burden of infectious diseases has a major impact on all healthcare systems as well as international prosperity and welfare. Throughout the history of mankind, infectious diseases have been one of the largest killers. Today, infectious diseases appear at several levels in relation to treatment of patients as well as in our relations with other people in our everyday lives.

Infectious diseases – the world’s number one killer

In 1995, according to The World Health Organization (WHO), infectious diseases are the world’s leading cause of death, killing at least 17 million people every year, most of them young children. Today the number of deaths has not decreased—on the contrary it has increased. The six biggest killers are: acute respiratory infections (4.4 million deaths), tuberculosis (3.1 million), diarrheal diseases (3.1 million), malaria (2.1 million), hepatitis B (1.1 million), HIV/aids (> 1 million) and measles (> 1million).

According to WHO’s 2002 figures, another way to understand the burden of infectious diseases is an index called “Years of Life Lost due to premature mortality” (YLL). It is a calculation of life years lost in comparison with the expected average length of life. YLL will make it possible to compare the burden of disease with life expectancy in different countries or regions. The Years of Life Lost statistics for infectious diseases are 26 years per death compared with 10 years for malignancies and 7 years for cardiovascular diseases. Total average for all types of diseases is 16 years per death.

What can we do without antimicrobial drugs?

The level of antibiotic resistant bacteria is increasing globally, which will influence all currently available advanced treatments. For some 80 years, it has been possible to treat bacterial infections effectively by using antibiotics. Very soon after the introduction of this new life-saving drug, antibiotic resistance was identified and warnings against overuse were raised. Micro-organisms are counterattacking rapidly and resistance against antiviral and antifungal pharmaceuticals is also a fact. With the ever increasing development of antimicrobial resistance, the world population is facing a serious threat against major achievements in healthcare as well as the development of modern society and global economy. Without antimicrobials we can close modern society! Why cure a patient from cancer, when the treatment itself will cause immunodeficiency making the patients susceptible to infectious diseases, some of which are without treatment possibilities because of the development of antimicrobial resistance. How about transplant patients? Premature children? Patients going through major surgery? Patients, such as HIV/aids under life-long antiviral treatments? Et cetera.

Healthcare-associated infections equal an airplane crash a day in casualties!

Healthcare-associated infections (HCAI) are a major problem worldwide. These are infections that patients (or personnel) are at risk to contract just because they visited a healthcare provider. HCAI cause tremendous additional costs, further contribute to increase antibiotic resistance, jeopardize treatment outcomes, prolong patient suffering, decrease treatment capacity and create badwill. A very conservative estimate of healthcare-associated infections shows approximately 37,000 directly attributable deaths each year in the EU and 70,000 in the USA. A substantial number of these deaths can be avoided if healthcare personnel strictly adhere to basic infection control and prevention procedures, such as proper hand disinfection.

Cross-infection control must be considered today's most important tasks in all healthcare systems.

Most infectious agents will be transmitted from previously unknown cases

Diseases are most infectious during their incubation period, i.e. before the first symptoms appear. Symptom-free carriers of infectious diseases cannot always be identified. Pathogenic micro-organisms in blood, saliva and in secretions from mucous membranes or wounds can be transmitted from patient to patient, from patient to dental healthcare personnel or from dental healthcare personnel to patient.

Many infections and infectious agents can be transmitted without a diagnosis or an awareness of the presence of an infectious agent. Infected people can often be carriers of pathogenic micro-organisms *without* this resulting in any disease process in the person in question. However, micro-organisms can be transmitted from a "healthy" carrier to other people who then develop the disease.

Contaminated, colonized, infected or diseased?

It is important to distinguish between contaminated, colonized, infected and diseased. Micro-organisms occur everywhere; in soil, dust, air, water and on our clothes, mucous membranes and skin. The micro-organisms which are always present on the skin and on all mucous membranes are referred to as the normal flora. The normal flora protects the body from invasion of disease-causing (pathogenic) micro-organisms. If an intruding micro-organism settles for example on a hand, the hand is just soiled with something that does not belong there. The next time the hand is washed or disinfected, the intruding micro-organism will be eliminated. In the alternative scenario, the intruder is not only able to contaminate, but also to procreate and multiply: the area is occupied by an invader, in other words colonized. Once the intruding micro-organism enters the body system, the stage of infection is reached. Infection is a condition in which an infectious agent has invaded the body and multiplied. However, most incidents of infection do not lead to a disease, but the infectious agent is dealt with and destroyed by the immune system. Only when the invasive micro-organism overcomes the immune system, a disease condition is at hand.

From infection control and prevention perspective—being contaminated, colonized, infected or diseased—the individual is a carrier of a potential disease-causing agent and therefore also has the capability of spreading the infectious agents to other individuals, directly or indirectly. In the dental office, there are lots of possibilities to transfer infectious agents to patients, who then in turn function as reservoirs and transfer infectious agents to others, who may be more susceptible to infectious diseases.

A common misconception is that an individual who is contaminated, colonized or infected with a pathogenic micro-organism rapidly develops symptoms and becomes acutely ill. Actually, only a very small proportion of individuals getting into contact with an infectious agent will actually develop a disease!

The preconditions for causing an infection and a disease condition include a susceptible host, a pathogen with sufficient infectivity and numbers and a portal through which the micro-organism may enter the host.

Humans as breeding vessels

A contaminated, colonized or infected person can function as a breeding vessel, giving options for micro-organisms to adapt to new conditions. The type A flu virus is actually the same virus that turns the globe yearly. By using humans and animals as breeding vessels, the flu virus has the possibility to change its appearance and thereby not be recognized by our immune system. Every year we will meet a slightly different type A flu virus. Bird flu is a mixture of human type A flu virus and bird type A flu virus, as well as swine flu human plus swine type A virus. These changes are so obvious that they cannot be overlooked, but actually the virus has the possibilities to change with every single infected individual.

The spread of infectious agents on micro-level, meso-level or macro-level

The spread of infection can be described on different levels: micro-level, meso-level, macro-level or a combination of several levels.

The micro-level is between micro-organisms. They will spread information, such as virulence, pathogens and/or resistance genes to each other. In biofilms, 15-20% of bacterial genetic material exists outside the bacterial cell. The meso-level is between individuals, which is the most commonly perceived level of cross-contamination. Finally, the macro-level is cross-contamination between geographical entities. Preventing cross-contamination on macro-level and meso-level is an obvious choice and could be prevented in the dental clinic by introducing quite simple precautions. The major and probably most important task must be to have a proper infection control and prevention at micro-level: in the treatment of every single patient, there is a risk of contributing to cross-infection at micro-level. For a care provider, it is important to have routines that do not contribute to spreading infections on any of these levels. Most care providers focus on the meso-level, which is quite obvious, but they tend to forget about the micro-level. Allowing bacteria to form well-established biofilms also contributes to give them extended possibilities for exchanging and sharing information such as virulence, pathogens and/or resistance genes, which will make the bacteria stronger, more resistant and more disease-causing. This will of course influence and decrease the possibilities to treat future infections.

It is important to practice overkill when micro-organisms should be eliminated, if not it will give the survivors a chance to adopt and become more resistant, a capacity that they can share through the spread of information at micro-level later on. In this context, it must be remembered that we do not want to kill all micro-organisms since "the good ones" will actually protect us. If an area is overpopulated with friendly micro-organisms there is no room for the bad ones to settle in that area. However, the friendly bacteria can transfer different genetic information to the bad ones if we somehow help the friendly ones to develop different capacities.

Antibiotic resistance, for instance, is often spread from our normal intestinal bacterial flora to disease-causing bacteria—simply because an overuse of antibiotics has made our normal friendly bacteria resistant to antibiotics. It is of no danger if our own bacteria are resistant, but if they share this information with foes we are in a bad situation.

Similarities with airport security

Identifying and preventing infectious micro-organisms from causing harm can be compared to the security control at airports: Most micro-organisms are friendly and play a very important role in life on earth; however, a few of them are “terrorists”. Of thousands of known bacterial species, only relatively few cause disease in humans. In all healthcare systems, it is of great importance to take measures to stop the “terrorists” and at the same time cause as little harm as possible to the friendly micro-organisms.

Always carry out a risk analysis

Infection control and prevention must include a cross-infection risk analysis. Symptom-free carriers of infectious diseases cannot always be identified through medical history-taking, physical examination or laboratory tests, and it is practically impossible to identify who is contaminated, colonized or infected and with what. It is therefore important to work on the principle that all patients and all staff can be carriers of micro-organisms which can cause diseases. All clinical procedures must be carried out as if everyone is infected with everything. This is actually done quite easily just by strict adherence to basic infection control and prevention principles. Most important are proper hand hygiene and disinfection, basic barrier protection by wearing gloves, face protection and clinical clothing, prudent reprocessing of instruments and aseptic techniques while carrying out clinical procedures.

The risk analysis must include where, when, how and why certain procedures should be carried out. It is easy, with the best intentions, either to overdo procedures or to underestimate risks. Solid instruments are much simpler to reprocess than hollow instruments. Results from risk analyses show that a solid instrument only has outer surfaces to clean, decontaminate and disinfect, which is quite easily done. Hollow instruments, such as dental handpieces, are much more difficult due to the internal lumen and crevices, and thereby they also pose a greater risk for cross-contamination.

All exposure-prone procedures require prudent adherence to aseptic techniques, and the dental team’s knowledge, training, skills and experience of procedures to be carried out will greatly influence the results, as well as the patients’ general health status and susceptibility to infections. All these measures require a constant and never-ending quality assurance, because there are always possibilities of improvement, no matter how small.

Beware of fragile barriers

The human body has protective barriers such as the skin, the mucous membranes, and the enamel/dentin of the teeth. In all healthcare situations, it is important to consider the consequences of opening, penetrating or altering fragile barriers. A key issue is to maintain or strengthen important protective functions. Hygiene and infection control in clinical dentistry must encompass not only the risk of transmitting infection, but also susceptibility to infection as well as evaluation of exposure-prone procedures and instruments.

Basic infection control and prevention—three basic principles

Basic infection control is very simple to maintain. There is always a source for the infectious agent and a recipient, and between the two a route of transmission. Infection control and prevention come down to three basic principles: firstly to reduce the potentials of the source, secondly to strengthen the defence of the recipient and thirdly to make sure there are no possibilities of transmission.

The first point of reducing the source for the infectious agents includes a lot of strategies such as surveillance, identification of risk groups, elimination of possible vectors, isolation of known cases, eradication of sources, improved living conditions, social networking, reducing risk behaviour.

The second point of strengthening the defence of the potential receiver comprises maintenance or strengthening of important protective functions through good general health, vaccination programs and aseptic techniques while carrying out invasive procedures.

The third and most important point is the route of transmission in the daily clinical perspective! Interfering with the route of transmission locally comes down to three very simple basic principles: 1) Hand hygiene and the use of gloves, 2) Protective clothing including face protection and clinical gowns and 3) Prudent handling of instruments.

Disinfect your hands and forearms with an alcohol-based hand disinfectant between every patient. Use gloves: the main reason being an excellent protection against needle and puncture wounds. Change clinical clothing every day and use a protective apron when carrying out procedures that produce a lot of splatter and aerosols (high-speed preparation and ultrasonic scaling) or other procedures that will wet the clinical clothing.

The reprocessing of instruments

The important pathways of transmission of infectious diseases are direct or indirect. To avoid direct transmission via instruments, prudent handling of instruments must include not only the aseptic technique, but also the reprocessing of items and instruments: cleaning, decontamination, disinfection and sterilization. In the dental clinic, the indirect transfer takes place via the hands of the staff, from the clinical clothing or through improper care of instruments. It is also important to recognize that processes not only include what is done at the clinic, but also include very important precautions in a general infection control and prevention perspective. If the dental personnel neglect to clean, decontaminate, disinfect and sterilize the instruments properly it will give possibilities for cross-infection at micro-level, for example antibiotic resistance. One dental patient can become the carrier of antibiotic-resistant micro-organisms at the dental clinic without being affected. In the next step, this person can spread the antibiotic-resistant micro-organisms to someone else, who never visited the clinic in question.

Just imagine a loving son coming to visit his mother in a hospital who has just gone through major life-saving surgery. The son kisses her and transmits the (for the mother) deadly micro-organism he got in his mouth at the dental office from the dental handpiece—just because the dental personnel did not care to handle the handpiece properly.

When reprocessing instruments or carrying out other infection control and prevention procedures, it is of great importance for the personnel to recognize that this should not only be done at the clinic to maintain a good reputation and to fulfil quality standards due to regulations or from a marketing and competition perspective where the dentist's primary concern is to increase turnover. The most important reason must be to avoid illnesses and save people's lives. Hygiene and infection control and prevention must be considered today's most important tasks in all healthcare systems—if we do not share this goal we can close down development and prosperity.

Don't neglect the importance of "ordinary" infections

The risk of transmission of infection associated with dental practice is strongly associated with blood-borne infections, such as hepatitis B-virus (HBV), hepatitis C-virus HCV and human immunodeficiency virus (HIV). These infectious diseases are very scaring and give good headlines in mass media. However, one must remember that in a risk analysis, the possibilities for dentists to transmit these diseases to patients are low (even if they are very serious and real and should be treated with great concern). There are several infectious diseases that are much more common and actually contribute to a large number of deaths every year. The regular flu virus for example, viz. influenza virus type A, results in some 500,000 – 1 million deaths yearly. The possibilities of transmitting ordinary infectious agents such as the flu virus in the dental office are by far much larger than transmitting diseases that will make headlines.

Dentistry has a great responsibility

The outpatient nature of the dental practice, with a large turnover of patients and a wide range of treatment of varying difficulty, requires well-functioning and carefully integrated hygiene routines. Pathogenic micro-organisms in blood, saliva and in secretions from mucous membranes or wounds can be transmitted from patient to patient, from patient to dental healthcare personnel or from dental healthcare personnel to patient.

All health and medical care facilities have a lot of old equipment. The standard of equipment in use today is in general far below the required level, and most clinics and surgeries have insufficient understanding of up-to-date hygiene technologies and processes. This means that instruments that have been processed through a 'sterilizer' are *not* necessarily sterile, basically because prior decontamination and cleaning are neglected.

Conclusion

From a general evaluation of the three levels of risk: the micro-level, the meso-level and the macro-level, dentistry has a great responsibility. There are few or no other professionals meeting such a large proportion of the population on a yearly basis as the dental profession. Acting with respect for this responsibility, the marketing slogan "Think globally and act locally" may take on a completely new meaning, which may in turn heighten the respect for the dental profession. This is a mutual concern for dental health personnel, regulatory affairs, the dental industry, dealers and dental associations alike.

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