WHITE PAPER

The essential role of the dental team in reducing antibiotic resistance

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fdi
FDI World Dental Federation

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Executive summary

Antibiotics are lifesaving drugs—when you need them, you need them to work. Antibiotic resistance (ABR) poses a significant threat to human health and wealth. As patterns of resistance differ between places and over time, it is impossible to provide a single international solution to antibiotic resistance. It is a global problem and growing rapidly due to widespread misuse of antibiotics, putting patients at risk for 'superbugs' that are difficult (and sometimes impossible) to treat with antibiotics. The scope of this paper is to provide a framework for dental teams seeking to participate in tackling the problem of ABR.

Dental teams can help in help in raising awareness, preventing and controlling infections, and optimizing the use of antibiotics through antibiotic stewardship in dentistry. As ABR is a global issue, every country is developing a national action plan (NAP) based on World Health Organization (WHO) guidelines. National dental associations (NDAs) are encouraged to make a commitment to tackling antibiotic resistance, to advocate for the inclusion of dentistry within NAPs and to support members of their profession to use antibiotics responsibly. At a more local level, dental teams can implement antibiotic stewardship programmes (ASPs) to address issues that they identify as driving unnecessary use of antibiotics. Solutions will differ from team to team and from context to context: a team of endodontists may need a different solution than an oral surgery clinic, and dentists working in the outpatient setting may need different solutions than hospital-based clinics. As a result, rather than providing an 'off-the-shelf' solution for implementation, this white paper includes an online library of resources* from around the world that may be adopted/adapted to meet local needs.

The online library includes links to global resources, such as WHO and FDI World Dental Federation (FDI) policies and educational material, as well as national resources, such as guidelines and dental antimicrobial stewardship toolkits developed by NDAs. The online library is not intended to be exhaustive and readers are encouraged to use all sources of information available to them (such as published questionnaires and audits) when assessing the issues to be addressed in their local ASP. The aim of this white paper is to provide something for every reader, while recognizing the breadth of experience in dental antibiotic prescribing, resistance and stewardship, as well as differences in local contexts and the rapid pace of new developments.

*http://fdiforum.bsac.org.uk

1. Introduction

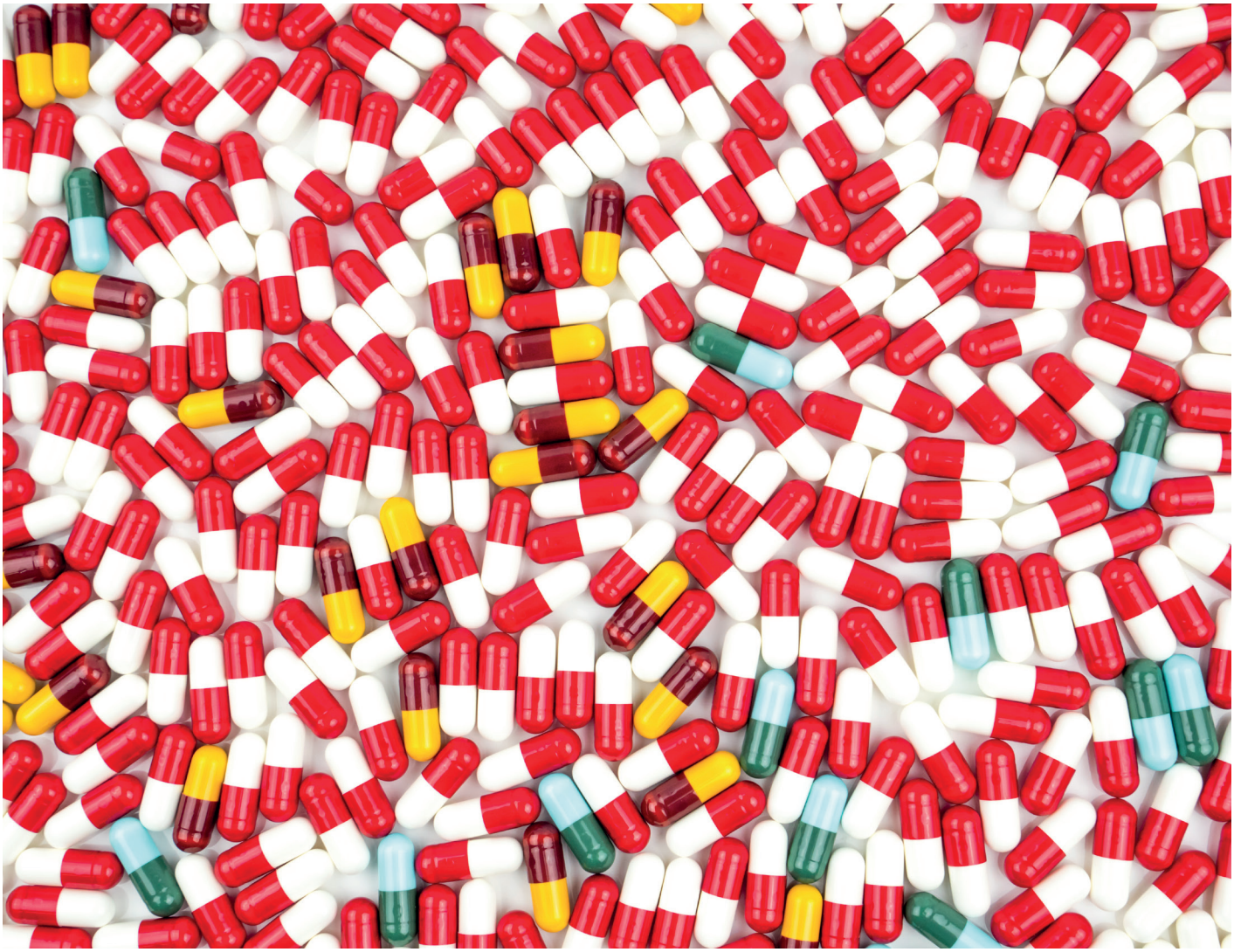
Antibiotics are life-saving drugs that are needed to treat life-threatening infections. Infections that do not respond to antibiotics are known as antibiotic-resistant infections. Antibiotic resistance (ABR) is a global problem that poses a significant threat to health and wealth, due to prolonged illnesses, longer hospital stays and increased mortality.[1] It is a problem that affects everyone (including you, your friends and family) and needs tackling immediately.[2] The WHO has highlighted the urgency of tackling ABR by including it in its list of five platforms to global health and well-being.[3]

Resistance is driven by the overuse of antibiotics in both people and animals (especially for food production) as well as in the environment.[4] Dentists are responsible for about 10% of antibiotic prescribing for humans (depending on the country).[5] Studies have shown that, despite efforts to reduce dental antibiotic use, too many antibiotics are still being prescribed by dentists.[6,7] The dental profession has a clear responsibility to engage, commit and contribute to global, national and local efforts to tackle ABR.

2. Scope

This white paper provides a framework for dental teams to participate in efforts to reduce ABR. It builds on FDI's policy statement on antibiotic stewardship in dentistry by setting out the context for the global problem of ABR and guiding the dental profession to play a part in tackling it. For those seeking solutions to implement with their teams, the white paper includes an online library of resources from around the world that may be adopted/adapted to meet their local needs.

No boundary is drawn on the international audience for this white paper. It is intended to be relevant for NDAs as well as individuals wishing to make a difference in their organization, service, university, government, charity and beyond. Recognizing the breadth of experience in dental antibiotic stewardship (ABS), differences in local contexts and the rapid pace of new developments, the aim is to provide something for every reader. From those just starting out in dental ABS to those with significantly more experience in this field, this white paper offers something for everyone.



3. The problem of resistance

Since Alexander Fleming's discovery of penicillin in 1928, antibiotics have become the cornerstone of modern medicine (see ***Figure 1***). Effective antimicrobial drugs are prerequisites for both preventive and curative measures, protecting patients from potentially fatal diseases and ensuring that complex procedures (such as surgery and chemotherapy) can be provided at low risk.[8] Systematic misuse and overuse of these drugs in human medicine and food production have driven the development and spread of resistance and put every nation at risk.[9] Patterns of resistance differ between places and over time, so it is impossible to provide a single international solution to ABR.

Overuse of antibiotics by dentists has been widely reported: a UK study[6] found an 80% rate of unnecessary use of antibiotics for treating acute dental conditions, while a US study[7] found an 80% rate of inappropriate use for prophylaxis. As the dental profession is responsible for around 10% of antibiotic prescriptions globally,[5,10] the dental community has an opportunity to contribute significantly to slowing the development and spread of ABR by optimizing prescribing. Different challenges to delivering this agenda exist in different contexts, such as interpretation of the evidence-base, underpinning guidelines related to antibiotics for prophylactic indications, periodontal disease, and delayed prescribing for acute conditions.[11,12] As a result, there is no 'one-size-fits-all' solution globally. A variety of approaches is required to craft tailor-made solutions to respond to the locally relevant factors that drive unnecessary use of dental antibiotics. Examples of resources from around the world are included within the white paper's online library for the reader to employ as appropriate for their own context.

In 2019, FDI adopted a policy statement on antibiotic stewardship in dentistry (see ***Appendix 1***).[5] The policy statement highlights the overwhelming case for improved antibiotic stewardship, with the aim of restricting the use of antibiotics to only when strictly necessary. It goes on to identify the crucial role that national organizations, local teams and individual prescribers have in proactive engagement with tackling the global problem of ABR.

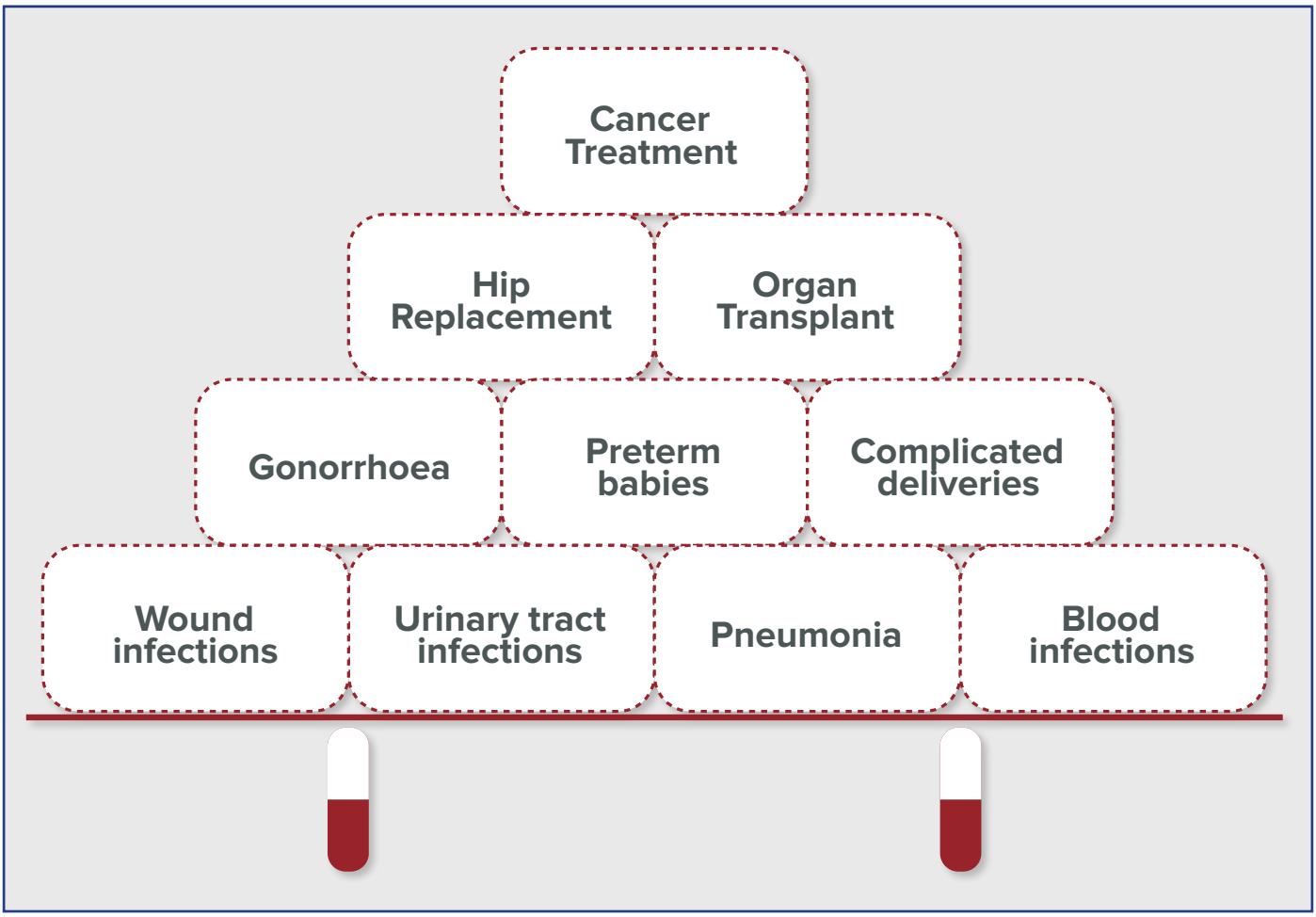


Figure 1. Antibiotics are the cornerstone of modern medicine. Reproduced with permission of ***ReAct – Action on Antibiotic Resistance****.*

3.1 What is resistance?

Antimicrobial resistance (AMR) occurs when micro-organisms such as bacteria, viruses, fungi and parasites change quickly so that the drugs used to treat the infections caused by them become ineffective.[13] The changes at molecular level result in the formation of 'superbugs', which cause infections that do not respond to treatment with drugs. This paper focuses specifically on ABR, as antibiotics are the most prescribed drugs by dentists.[10,14]

One of the principal ways in which ABR happens is when people are unnecessarily and overly exposed to antibiotics. Whilst antibiotics kill (or impede the growth of) bacteria that are susceptible to them, those bacteria that remain unaffected by them are left to flourish. This process is known as natural selection (see ***Figure 2***).[15] Not just bacteria that cause infections are affected by this selection process. Antibiotics affect the body's entire microbiome (sometimes known as 'good bacteria'), thus resulting in an imbalance that can seriously affect an individual's overall health and well-being.

ABR is not confined to healthcare. Given the interdependence between environmental, animal and human dimensions of ABR, a One Health approach has been developed to preserve their future effectiveness.[16] Pollution resulting from inadequate treatment of industrial, residential, and farm waste is expanding the resistome (a term used to describe a collection of antibiotic resistance genes) in the environment.[17] Intensive animal husbandry in agricultural industries has seen a movement towards mass 'precautionary and growth-promoting' in-feed use of medically important antimicrobials in animals. This has critically important implications for humans.

As antibiotic drugs become increasingly ineffective due to the development and spread of resistant infections, even minor surgeries and routine operations could become high-risk procedures, leading to prolonged illnesses and increased mortality. Without effective antibiotics, the success of modern medicine, such as cancer chemotherapy or major surgery, will be compromised; standard treatments for infections will become ineffective, and infections will persist and spread to others (see ***Figure 3***).[9]

Antimicrobials, particularly antibiotics, are the only drugs that have an impact both at individual and society levels. Why? Because the resistant bacteria that were selected (focus of infection and/or microbiota) due to the antibiotic treatment can be transmitted from the individual who has taken the antibiotic treatment to other human beings, animals or the environment.[2] Although resistance occurs naturally, the unnecessary use of antimicrobials is rapidly accelerating the pace at which it develops and spreads.[19] Misuse and overuse of antibiotics puts us all at risk (see ***Figure 4***). ABR is such a risk to public health that it has been compared to the risk posed by climate change and global terrorism.[20] With little prospect of new classes of antibiotics being developed (at least in the short term), a 'post-antibiotic' era is anticipated, in which effective antibiotics are no longer available.

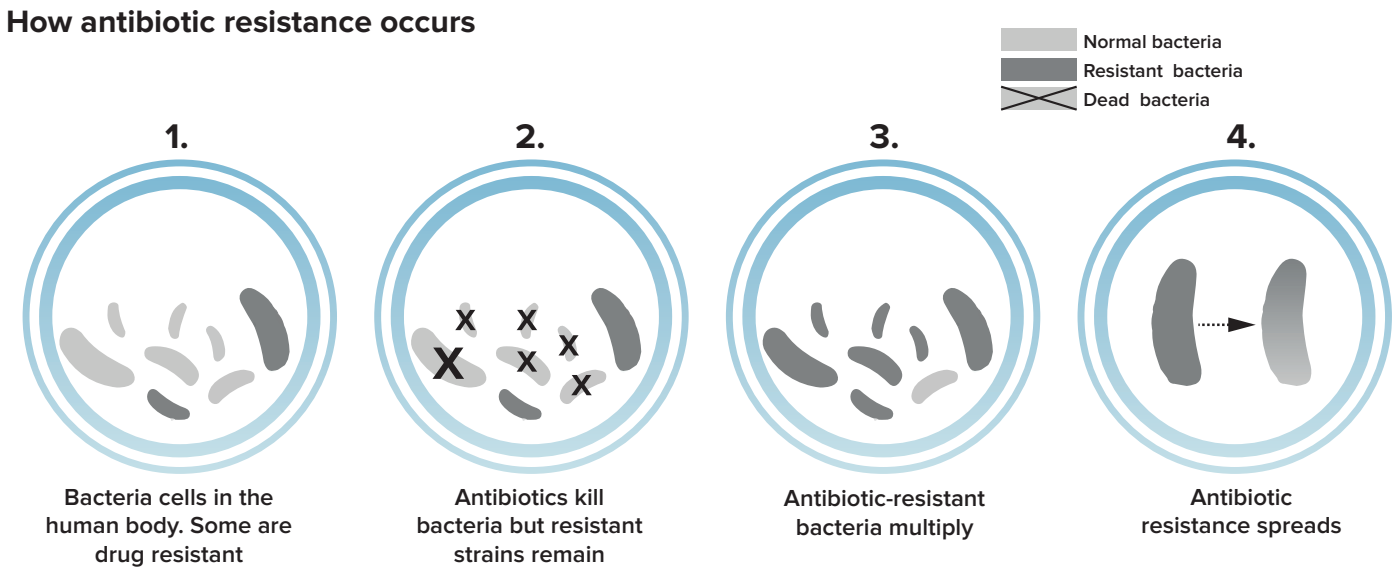


Figure 2. How Antibiotic Resistance Occurs.[1] Reproduced with permission of Public Health England (PHE).

3.2 Resistance is a global problem

The spread of resistant infections respects no borders, making this a complex global health problem that requires a global solution. International action is required across governments and societies to arrest the progress of resistant infections and develop new drugs. Some countries have reported that more than 42% of infections are resistant to common therapies.[13] Life-threatening infections caused by Klebsiella pneumoniae that are resistant to the last-resort treatment, carbapenems, have already spread worldwide. Failure to treat gonorrhoea using a 'last-resort' medicine has been confirmed in at least 10 countries (Australia, Austria, Canada, France, Japan, Norway, Slovenia, South Africa, Sweden, and the United Kingdom).[13]

If ABR continues to increase, it has been estimated that by 2050, infections resistant to drugs will be the number-one cause of death globally, with 10 million people dying every year (see ***Figure 5***).[1] Both the United Nation's sustainable development agenda[21] and the World Bank[22] have highlighted the potential annual economic impact of antimicrobial resistance (up to US$ 3.4 trillion per year). Low-income countries are anticipated to experience larger drops in economic growth than wealthy countries.

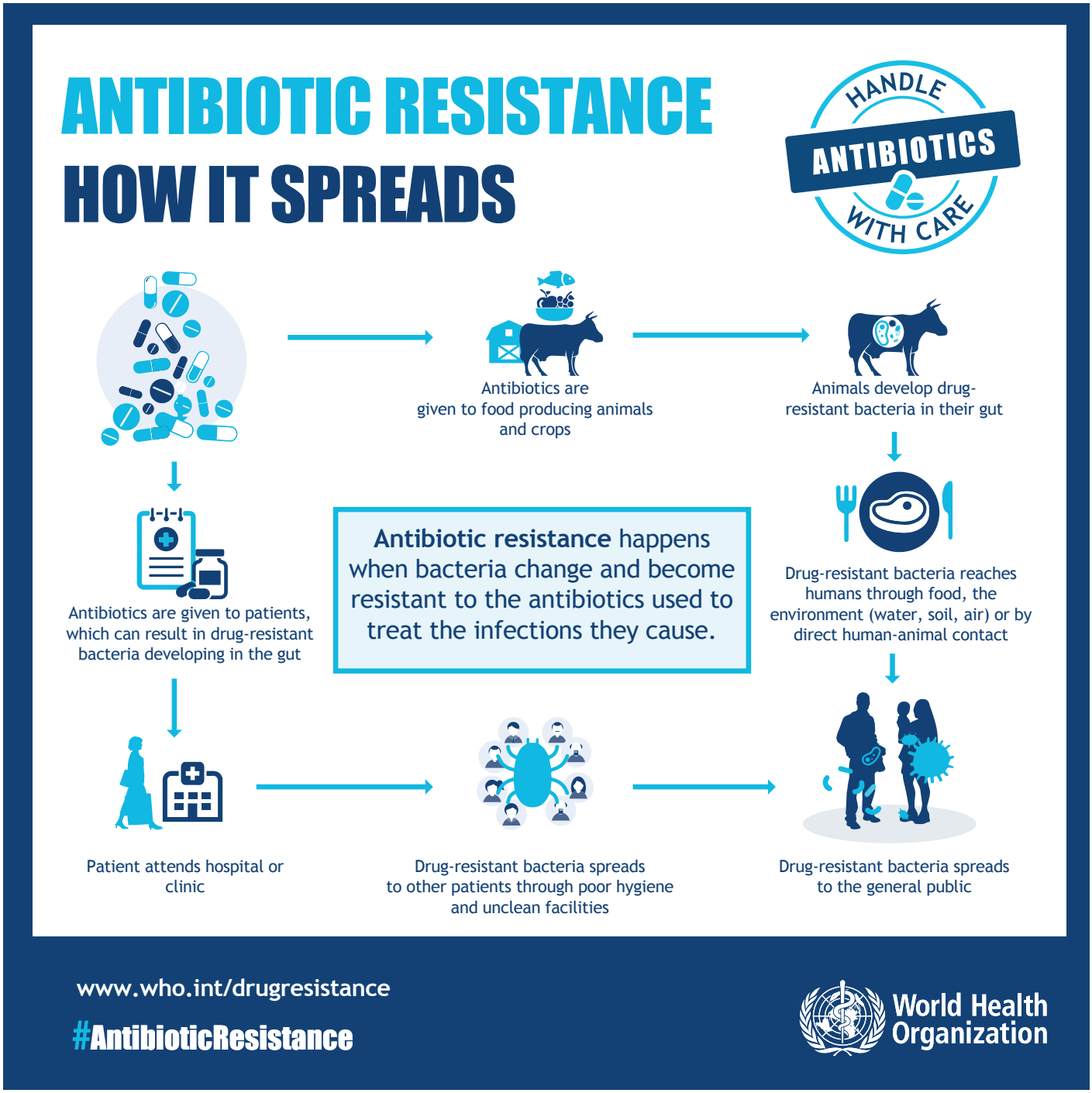


Figure 3. How antibiotic resistance spreads. Reproduced with permission of the World Health Organization: https://www.who.int/mediacentre/events/2015/world-antibiotic-awareness-week/infographics/en/.

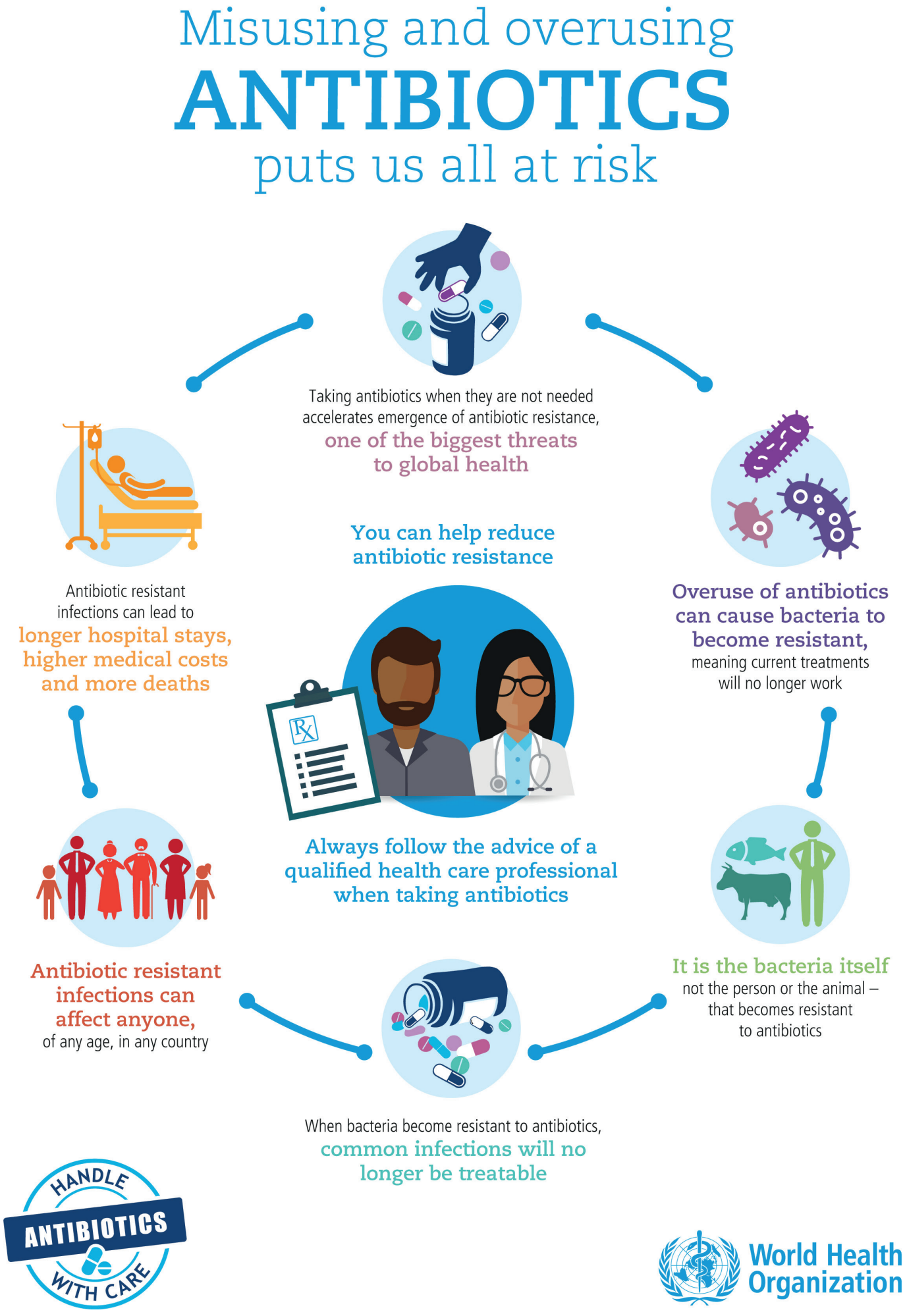


Figure 4. Misusing and overusing antibiotics puts us all at risk. Reproduced with permission of the World Health Organization: www.who.int/campaigns/world-antibiotic-awareness-week/2017/infographics/en/.

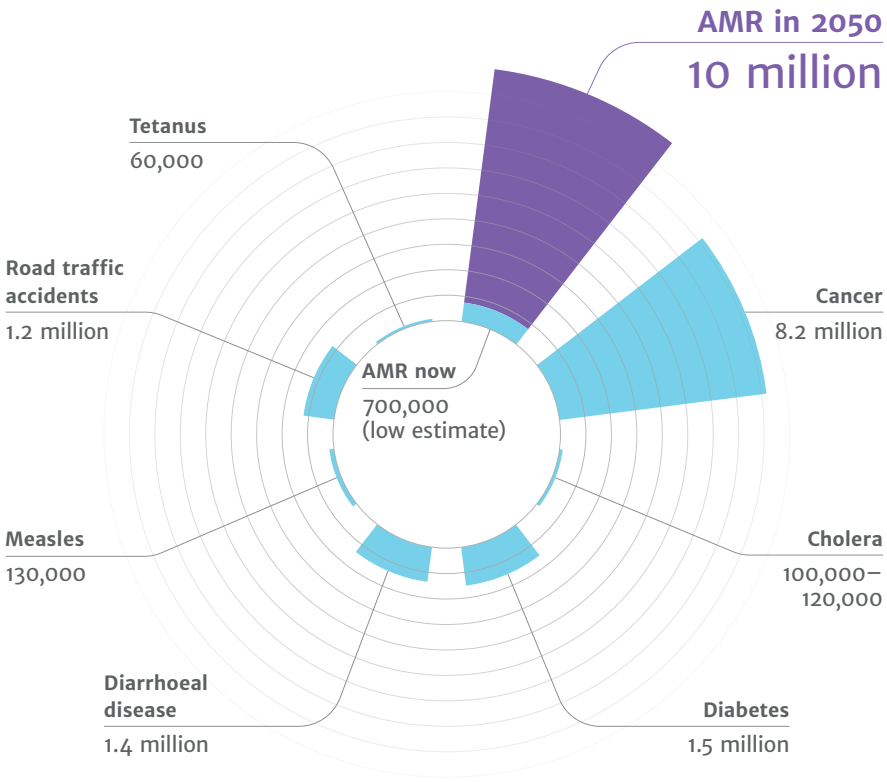


Figure 5. Growing global burden of deaths attributed to antimicrobial resistance (AMR) in 2016 and 2050, compared to other major causes of death in 2016. Courtesy of the O'Neill Review on Antimicrobial Resistance.[1]

3.3 Resistance is a personal problem for everyone

ABR is a universal issue that could affect anyone, including you, your friends and family: everyone is vulnerable.[2] At this time, most people do not personally know anyone affected by antibiotic resistance, or do not immediately connect specific issues (like failure of an antibiotic to treat a patient's infection) with the broader issue of resistance. However, many cases do exist. An example of where an infection failed to respond to antibiotics is presented in ***Box 1***.

BOX 1 – DID YOU KNOW?

Surviving an infection that was resistant to antibiotics can be traumatic

Vanessa Carter, drug-resistant infection survivor. Courtesy Vanessa Carter.

Drug-resistant infection survivor Vanessa Carter was involved in a car accident in 2004. She suffered multiple facial fractures and required several prosthetic facial implants. An infection associated with one of the implants was treated with multiple courses of antibiotics and required a decade of surgeries to manage. Emergency surgery was required to remove the prosthetic that tested positive for methicillin-resistant Staphylococcus aureus (MRSA) bacteria. Two years after the MRSA was clear, a maxillofacial and plastic microsurgeon performed a zygomatic osteotomy and flap surgery to repair the damage. Vanessa is now a patient advocate for ABR.

Reflecting on her experience, Vanessa says:

"Being ignorant about antibiotic resistance made me feel powerless... I believe I could have played a much bigger role in not only making more informed decisions about surgeries, but also about the role I had towards managing the infection, including with infection prevention/control and medication adherence. I found very few decipherable, patient-friendly resources online. Further to this, my doctors could have informed me and explained antibiotic resistance as a possibility for why the antibiotics might not have been effective. The specialists were all working in silos and prescribed my antibiotics without the other practitioners' knowledge."

Since becoming a patient advocate, Vanessa has helped to implement the Antibiotic Guardian campaign in South Africa. By encouraging multi-stakeholder participation across human, animal and environmental health (One Health) at all levels, the campaign aims to improve the responsible use of antibiotics.

As a drug-resistant infection survivor, Vanessa believes clinicians have an important responsibility to share information with the public, peers and other healthcare workforces. Further, as an e-patient, she believes that the web and social media are powerful tools to share information effectively, even in the developing world where over 50% of the population now have internet access.

Resistance that occurs when a patient takes antibiotics has been shown, in clinical studies, to persist in that patient's microbiome for up to 12 months.[23] Furthermore, the bacteria develop resistance not only to the causative drug, but to several others as well.[24] Exposing a patient to antibiotics when *not* necessary (for example 'just in case' or to meet patient demands) increases that patient's risk that the antibiotics will fail when they *are* necessary.[25]

Failure of antibiotics to effectively treat an infection in the mouth or elsewhere in the body, e.g. respiratory tract or sepsis, or to provide prophylaxis before major surgery, e.g. joint replacement or organ transplant, can pose a life-threatening risk. A 20% higher in-hospital death rate associated with antibiotic-resistant bacteria has been found[26], yet hospitals are often reluctant to advise individuals (or their surviving families) that a resistant infection is/was responsible, due to the hospital's fear of being blamed for failing.[27,28] Optimizing use of antibiotics through prescribing in accordance with guidelines will result in improved outcomes for all of us and especially for the most vulnerable in our society. Ensuring access to the right care for the right patient at the right time is an essential element of this optimization.[29] Patients needing to wait for access to the right care often receive more antibiotics than they normally would if the care were immediately available. For example, a UK-based clinical audit found 40% of children awaiting extraction of infected teeth under general anaesthetic received antibiotics.[30]

3.4 Resistance is important for dental teams

For patients with a spreading dental infection, effective antibiotics are vital: sepsis and the spread of infection toward vital structures may occur rapidly for patients with dental infections, and these conditions can be life-threatening (see ***Figure 6***).[31]

Ensuring quick, appropriate and effective treatment is extremely important for these patients.

Infections that are resistant to antibiotics, therefore, pose a serious risk to dental patient safety. Most dental infections are amenable to treatment by a dental procedure (such as extraction of the tooth) to remove the source of the infection without the need for antibiotics. Dentists are surgeons, skilled and equipped to diagnose and treat acute dental conditions during urgent appointments. This highlights the importance of access to dental, rather than medical, care for patients with acute dental conditions.[29]

Optimizing dental prescribing will, at the same time, increase patient safety by reducing the risk of adverse reactions. Reports have indicated that dental prescribing has contributed to the incidence of Clostridium difficile/Clostridoides difficile (C. difficile) in the general population.[32] Antibiotic-related colitis caused by C. difficile is associated with significant morbidity and can be life threatening, especially for elderly and medically compromised patients.[33] Clindamycin is recognized as being associated with significant rates of fatal and non-fatal adverse drug reactions associated with C. difficile infections.[34] Increasing rates of allergy/anaphylaxis due to antibiotics have also been reported.[35] Furthermore, incorrect labelling of patients as penicillin-allergic has been shown to result in increased morbidity, mortality and healthcare costs due to the use of broad-spectrum alternatives.[36,37]

Case studies about patients experiencing adverse reactions to antibiotics prescribed by dentists are presented in ***Box 2***.[38-40] For clinicians, basing clinical decisions on relevant guidelines may be a valuable way to defend against accusations of clinical negligence.[41]

Figure 6. Infections such as this Ludwig's Angina can rapidly become life threatening if they spread toward vital structures, such as the airway. Reproduced with permission of Prof (Dr) M Verma and Dr S Mohanty.

BOX 2 – DID YOU KNOW?

Adverse reactions to antibiotics can pose a serious risk to patient safety

The potential benefits of using antibiotics must be balanced against the risk of adverse outcomes such as severe allergy/anaphylaxis or antibiotic-related colitis/C. difficile infection. An increasing range of case studies presenting such adverse outcomes are detailed below:

A dentist prescribed co-amoxiclav to a patient with pulpitis from a heavily restored molar. There was no history of allergy to the antibiotic and the patient did not want endodontic treatment. A drug-induced vasculitis developed and required six months of medical treatment with an immune-modulating drug. The dentist was held liable for all the patient's medical costs because there were no justifiable clinical grounds for the use of the antibiotic.[38]

A healthy 19-year-old patient was given peri-operative prophylactic antibiotics for elective maxillofacial surgery to correct excessive maxillary gingival show when smiling and masticatory dysfunction. She acquired a C. difficile infection, and after a prolonged stay in hospital, she was left with life-changing abdominal surgery (subtotal colectomy and ileostomy).[39]

A 35-year-old stockbroker and father of two underwent endodontic therapy in the United States. He was prescribed prophylactic clindamycin and, as a result, developed toxic megacolon as a result of a C. difficile infection. A few days later he died. The suit for malpractice filed by the patient's widow was settled in court.[40]

Antibiotic use is not benign therapy.[39] Prescribing medication when there is no clinical basis for it cannot be in the patient's best interest and could amount to negligence.

4. Tackling resistance

The WHO global action plan (GAP) on AMR aims 'to ensure, for as long as possible, continuity of the ability to treat and prevent infectious diseases with effective and safe medicines that are quality-assured, used in a responsible way, and accessible to all who need them.'[3] To achieve these aims, WHO has identified five objectives for its implementation (see ***Table 1***).

The FDI policy on antibiotic stewardship in dentistry highlights the crucial role that dentists, their teams and NDAs have in ensuring the appropriate use of antibiotics.[5] To achieve this, FDI has identified nine policy statements, which align closely with WHO objectives, as demonstrated in ***Table 1***. The close alignment between WHO and FDI objectives is demonstrated in ***Table 1***. Three key areas for the dental team's contribution to global efforts to tackle ABR are highlighted: awareness raising, infection prevention and control, and optimizing the use of antibiotics (stewardship) (see ***Figure 7***). Each of these is considered in more detail below.

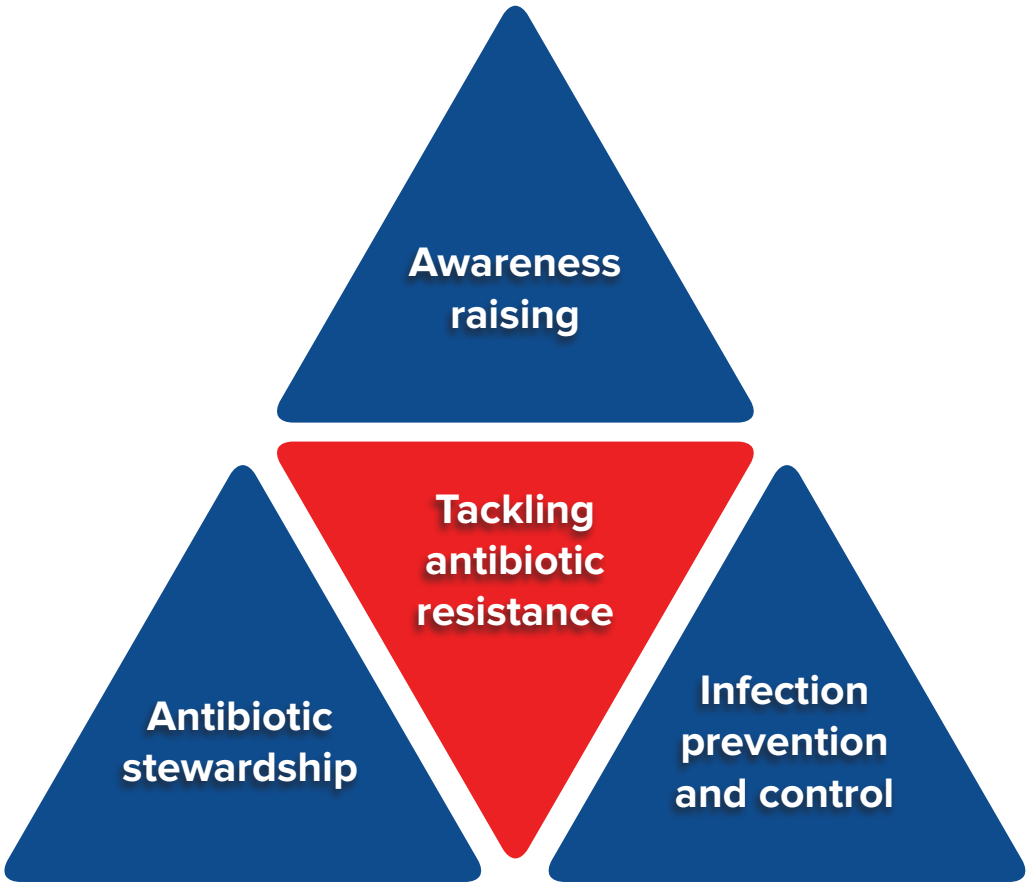


Figure 7. Opportunities for dental teams to contribute to global efforts to tackling antibiotic resistance. Courtesy of the FDI World Dental Federation Antimicrobial Resistance Working Group.

WHO Objectives[3]	FDI Policy Statements[4]	Concept
Improve awareness and understanding of resistance through effective communication, education and training	• FDI supports the improvement of knowledge and understanding of ABR and stewardship through further research, better information, intelligence and data, and the promotion of epidemiological work at regional and national levels. • FDI acknowledges that dentists should ensure their knowledge is up to date on ABR and stewardship and that their antibiotic prescribing is in line with best practice. • FDI encourages the development of educational programmes on ABR, prescribing and stewardship that are suitable for the continuum of the professional lives of dentists and dental teams. • FDI strongly encourages dentists to provide the necessary information for their patients regarding ABR and appropriate use of antibiotics. • FDI encourages major stakeholders (pharmaceutical companies, scientific journals, policy makers, NDAs and experts through experience/patients) to provide information and communicate about ABR and stewardship, in particular in scientific and professional journals but also at the practice and patient levels. • FDI also recommends that each NDA make a clear and public commitment to tackling ABR.	Awareness raising
Reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures	• FDI acknowledges that, along with antibiotic stewardship programmes, infection prevention and control programmes should be implemented as fundamental components of good clinical practice.	Infection prevention and control
Optimize the use of antimicrobial medicines in human and animal health	• FDI encourages and supports NDAs to actively engage in their AMR national action plan framework and to plan and implement antibiotic stewardship programmes in dentistry at local and national levels. NDAs can help improve dentists' antibiotic prescribing practices by making scientific evidence available to them. • FDI encourages NDAs to advocate to their policy makers to ensure that a robust national action plan to tackle ABR is in place.	Antibiotic stewardship
Strengthen the knowledge and evidence base through surveillance and research	• FDI encourages research and development of additional solutions for prevention and treatment of dysbiosis of oral microbiota. • No FDI policy statement has been made relating to surveillance. This presents an opportunity for the dental community to work with the wider ABR community.	
Develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions	• No FDI policy statement has been made relating to investment. This presents an opportunity for the dental community to work with the wider ABR community.	

Table 1. Mapping the WHO global action plan objectives and FDI antibiotic stewardship in dentistry policy.

4.1 National action plans

The WHO global action plan (GAP) advocates multi-sectoral national action plans (NAPs) to ensure delivery of its objectives on antimicrobial resistance.[9] These NAPs are needed to provide the basis for an assessment of the resource needs whilst taking account of national and regional priorities and addressing relevant national and local governance arrangements. A library of NAPs is provided by WHO and can be accessed via this white paper's online library of resources. Empowering organizations and individuals to play a part in tackling ABR is an important part of NAPs. An example is presented in ***Box 3***, showing how the Royal Dutch Dental Association is playing its part in delivering the Netherlands' NAP.

With around 10% of worldwide antibiotic use originating with dentists and with different factors influencing dental prescribers compared to medics, it is important to ensure that dentistry is explicitly included within these NAPs.[42] NDAs have a key role to play in advocating for the dental profession, including by ensuring incorporation of the FDI policies within the NAPs. It is recommended that each NDA make a clear and public commitment to tackling ABR through awareness raising, infection prevention and control, and antibiotic stewardship.[43]

Tailoring national approaches relevant to the specific context first requires a thorough analysis of the problem in that context: a plethora of national studies exist in the published literature.[44-48] For example, differences between countries exist in relation to whether therapeutic or prophylactic use contributes most to unnecessary use of antibiotics. Furthermore, different issues may be relevant to low- and middle-income countries, such as the availability of antibiotics for purchase (over the counter in pharmacies, from grocery stores and from street vendors).[29,49] 'Infestation of the market' with substandard and counterfeit drugs (a problem in up to 60% of countries in Africa and Asia) is another issue not addressed by programmes in high-income countries. In more remote parts of the world, access to dental professionals and/or to online resources may be limited. For those working in these areas, consideration needs to be given on how relevant information and guidance is provided to those who need it.

FDI has committed to support the development of NAPs. In some cases, significant investment and resources may be required in order to implement a NAP, for example to develop appropriate, evidence-based guidance. Rather than relying on existing research (which has generally been undertaken in high income countries),[42,50] new research in the local context may be required to produce a more relevant evidence base for guidelines. Furthermore, multi-disciplinary collaboration with microbiology/infectious disease specialists and pharmacists is important for the development of guidelines that fit into the wider context, for example relating to ABR patterns for common pathogens in the local area.

BOX 3 – GOOD PRACTICE STORY

Dutch dentists and the One Health approach

Recognizing that the health of humans is related to the health of animals and the environment, the government of the Netherlands has taken a One Health approach within its national action plan on ABR. In relation to the human healthcare sector, the government agreed to cut back antibiotic use by halving unnecessary prescriptions within five years.

Responding to this challenge, the Royal Dutch Dental Association (KNMT) began developing its own antibiotic stewardship programme through the theme of 'patient safety' using a multidisciplinary approach. First, it included antibiotics within its programme of continuous professional education (IQual). Dentists were invited to attend lectures by doctors and pharmacists about the responsible use of medication and how dentists may contribute to the prevention of ABR. Next, developing guidelines specifically for dentists was undertaken through the Dutch Knowledge Institute for Oral Healthcare (KIMO - Kennis Instituut voor de Mondzorg). Following an initial phase of assessing and evaluating the challenges for antibiotic use in the Netherlands, priorities were set that form the basis of the new guideline.

Working in partnership has been an important element of the Dutch approach to dental antimicrobial stewardship. KIMO is an association made up of KNMT (the professional association for dentists, oral surgeons and orthodontists in the Netherlands); the Association for Dutch Dentists (ANT); and an umbrella of scientific associations in dentistry. Funding for the guidelines was raised through their memberships, supplemented by the Ministry of Health. The new guideline is expected to come into force in spring 2021.

4.2 Awareness raising

Communicating the concept of resistance to professional and non-professional audiences can be tricky. Personalizing the agenda for individuals by framing the problem as undermining modern medicine and focusing on the immediacy of the problem is advised, based on international research.[2] These are the recommended key messages:

- ABR is a problem that affects everyone (including you, your friends and family) and needs tackling immediately.
- As a trusted healthcare professional, you hold a high degree of respect within your local community and have an important role in raising awareness about ABR among the general population, as well as with patients.

The WHO GAP highlights the urgent need to raise awareness of resistance and promote behavioural change through public communication programmes that target different audiences in human health, animal health and agricultural practice, as well as consumers. Making resistance a core component of professional education, training, certification, continuing education and development will help to ensure proper understanding and awareness among health professionals. To underpin delivery of this aim, in 2019 WHO published its Health Worker's Education and Training on AMR.[51] This is available, together with a range of examples of awareness raising material from around the world, in the online library of resources to this white paper.

Resources in the online library material include those produced for World Antimicrobial Awareness Week (WAAW), which is held annually in November. WAAW provides a helpful focus and opportunity to refresh messaging and action plans each year. In 2019, a poster was included that reminded dental teams and their patients about the importance of oral hygiene in reducing the risk of developing dental infections and hence minimizing the need for antibiotics (see ***Figure 8***).

Figure 8. WHO World Antimicrobial Awareness Week (WAAW) dental poster. Reproduced with permission of the World Health Organization: https://whowcms-digital-agency.s3-eu-west-1.amazonaws.com/whoantibioticawareness2019/img/posters/download/who-antibiotics-3-3.jpg.

4.3 Infection prevention and control

Infection prevention and control (IPC) is a scientific approach and practical solution designed to prevent harm caused by infection to health workers and patients.[51] IPC occupies a unique position in the field of patient safety and quality universal health coverage since it is relevant to health workers and patients at every single healthcare encounter. Within dentistry, examples include hand hygiene, sterilization of equipment and sharps handling.[52] In addition, preventing the development of infections by maintaining excellent oral hygiene and following dietary advice to reduce sugar consumption are important contributions dentists can make to the global fight against ABR (see ***Figure 9***). More detail about IPC is included within the FDI Policy Statement on Infection Prevention and Control in Dental Practice (see ***Appendix 2***).[5] A selection of materials to support this aspect are available via the online library of resources.

4.4 Stewardship

Dental antimicrobial stewardship (AMS) means optimizing prescribing so that dental procedures are delivered whenever possible and antimicrobial drugs are only used when necessary. The concept of 'stewardship' is about 'careful and responsible management of something entrusted to your care'. As there is no word for stewardship in many languages (see ***Box 4***), this concept is not easily understood by all.[53] This highlights one of the many cultural issues that must be considered at every stage of developing approaches to AMS.[54]

As a result, a plethora of definitions of AMS exist that represent a divergence of perspectives on responsible antibiotic use:[55]

- Coordinated interventions designed to improve and measure the appropriate use of antimicrobial agents by promoting the selection of the optimal antimicrobial drug regimen including dosing, duration of therapy and route of administration.[56]
- A system-wide approach to promoting and monitoring judicious use of antimicrobials to preserve their future effectiveness.[57]
- A coherent set of actions that promote using antimicrobials responsibly.[51,53]

The 2019 FDI Policy Statement on Antibiotic Stewardship in Dentistry[4] has adopted the following definition of antibiotic stewardship:

"Antibiotic stewardship is a coherent set of actions which promote appropriate use of antibiotics, i.e. in ways that ensure sustainable access to effective therapy for all who need them."

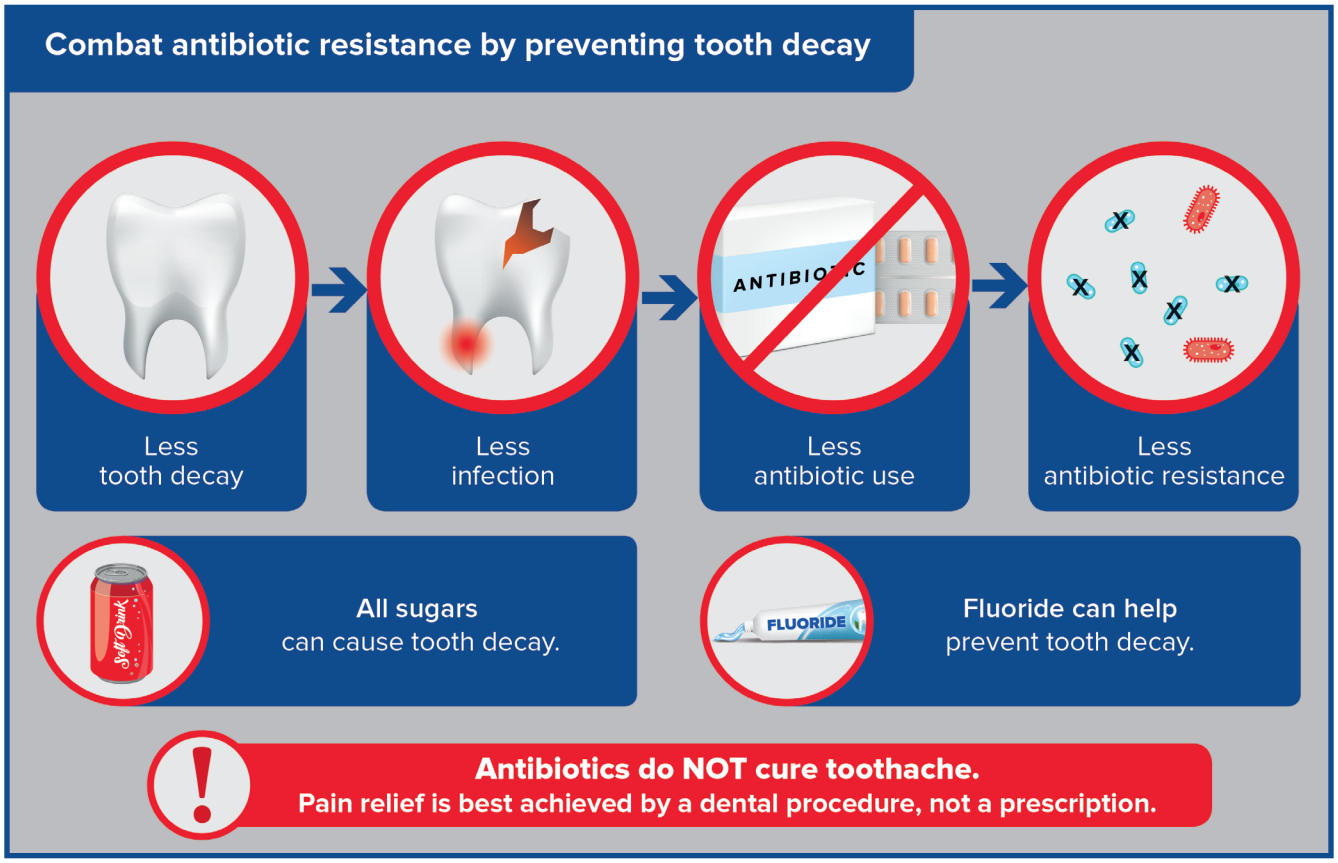


Figure 9. Combat antibiotic resistance by preventing tooth decay. Courtesy of FDI World Dental Federation.

BOX 4 – DID YOU KNOW?

No word exists for 'stewardship' in some languages

Antibiotic stewardship programmes were first developed and implemented in the 1990s, often led by pharmacists in the United States and by infectious disease/clinical microbiology specialists in Europe. These programmes were not always called antimicrobial stewardship programmes, in part due to the lack of an equivalent for 'stewardship' in many languages.[53] Examples of translations include:

- (programme de) bon usage des antibiotiques (= programme of good antibiotic use) in French
- Strategien zum rationalen Einsatz von Antiinfektiva (= strategy of rational use of anti-infectives) in German
- rationeel antibiotica beleid/gebruik (= rational antibiotic policy/use) in Dutch.

4.5 Antibiotic stewardship programmes

An antibiotic stewardship programme (ASP) is a set of interventions aimed at promoting the use of antibiotics appropriately, i.e. in accordance with existing guidance.[57] Historically, ASPs have been developed and implemented in hospital settings, yet most dental prescribing takes place in primary care/community settings.[59] Understanding where the most potential exists for reducing unnecessary use is an important element of planning a dental ASP.

Core elements for ASPs have been identified in various contexts, including hospitals, nursing homes and community settings. For dental ASPs, a range of antibiotic stewardship (ABS) interventions in community and hospital settings have been developed, tested and reported.[50] A framework for dental ABS programmes has been proposed (see ***Table 2***), which includes four elements: guidelines about appropriate clinical indications for antibiotic use; educating members of the dental teams (not just prescribers); undertaking audit and feedback of prescribing against the guidelines (accountability of organizations and individual prescribers); and providing patient-facing material to help deliver key messages in relation to ABS in dentistry and beyond to the wider community. For example, an academic dental practice in the United States undertook a needs analysis to develop an ASP that included clinical guideline development, patient and provider education, and an assessment of the antibiotic prescribing rate per urgent care visit before and after the educational intervention (see ***Box 5***).[59]

In some countries, dental ABS resources have evolved separately, but have then been brigaded together to be made available as online toolkits. Such a toolkit was introduced in England, and antibiotic prescribing by dentists reduced by more than 25% between 2013 and 2017.[60,61] Examples of dental ABS resources from around the world are provided in this white paper's online library.

WHO Objectives[3]	FDI Policy Statements[5]
Guidelines	• Establish national antibiotic stewardship (ABS) guidelines for dentistry–it may be appropriate to adapt/adopt international ones. • Make available updated, evidence-based guidelines on infection management in dental practice (prevention, diagnosis, treatment).
Audit and feedback	• Clinicians benefit from quantitative and qualitative data on their own prescribing practices. Monitoring in several ways: • automated surveillance and feedback via electronic data; • manual data collection by dental teams via clinical record card review.
Education of dental teams	• Best if associated with other ABS interventions. There should be: • identified sources of experts who can provide advice, education and training; • consistent AMR teaching in undergraduate curricula; • continuing professional development available throughout professional life in contextualized infection management to include antibiotic prescribing, stewardship, feedback mechanisms. Communication skills must be taught to achieve: • management of patients' perceptions, concerns, beliefs and expectations; • management of clinicians' own behavioural tendencies.
Education of patients	• As members of the wider healthcare community, dentists can assist in delivering ABR messages. Messaging specific to oral health should include: • "antibiotics don't cure toothache"; • pain relief is best achieved by procedure, not prescription; • dental surgeons are the first line of care for dental problems—they provide procedures; • prevention of oral disease reduces the likelihood of oral infections.

Table 2. A framework for antibiotic stewardship in dentistry. Adapted from Sanderson & Williams, 2019.[58]

BOX 5 – GOOD PRACTICE STORY

Implementation of an antibiotic stewardship programme in an academic dental practice[59]

In the United States, dentists prescribe antibiotics for several indications, including prophylaxis before dental procedures, post-surgery, and for the treatment of oral infections. There exists a significant potential to reduce antibiotic use by dentists: 80% of antibiotics prescribed by dentists in the outpatient setting have been assessed to be sub-optimal or not indicated. Furthermore, clindamycin is among the highest-risk agents for C. difficile infections, and dentists are the leading prescriber of clindamycin in the US. This account summarizes a research team's experience implementing an antibiotic stewardship programme (ASP) in a US academic dental practice.

The ASP was implemented in dental practices at the University of Illinois at Chicago College of Dentistry (UIC) in partnership with the University of Illinois Hospital and Health Sciences System (UIH). It was based on the Centers for Disease Control and Prevention Core Elements of Outpatient Antibiotic Stewardship and used data from the organization's electronic systems to assess diagnosis and treatment.

The result of the dental ASP was a reduction in the rate of antibiotic prescribing by dentists in UIC dental clinics. In addition, clinicians reportedly became more conscious of appropriate antibiotic prescribing since the implementation of the educational interventions.

The ASP evolved through an iterative approach as a collaboration between UIH, the College of Dentistry and the College of Pharmacy. It comprised the following points:

- Education – a 1-hour continuing education session for clinical providers was held and weekly emails were sent with brief messages focused on ABR and stewardship (late 2016)
  - Clinical providers were urged to commit to a dental ASP (mid-2017)
  - The UIH Annual Plan included a strategic aim to support a dental ASP (2017)
  - A baseline audit was undertaken and data on antibiotic use was analyzed by dental specialty (late 2017)
- Areas for improvement were identified, addressed, and implemented (early 2018):
  - guidelines on antibiotic use for acute dentoalveolar conditions;
  - staff discussions included dental antibiotic use.
  - Audit and feedback were undertaken and data on antibiotic use was fed back in clinical meetings (mid-2018)
  - Nudge messages were displayed as posters chair-side and in staff areas (late 2018)

Further details are available from an open-access paper by Gross et al (2019).[59]

Research based on behavioural theory has shown that the decision whether to prescribe dental antibiotics is both multifaceted and complex.[62] For example, whilst most dentists know about ABR, a key factor relating to their decision whether to prescribe antibiotics for acute dental conditions was found to relate to their beliefs about their ability to provide operative procedures during unscheduled appointments.[42] This suggests that dental ABS interventions should focus on supporting dentists to optimize care for patients with acute conditions (such as extractions and treating pulpal disease) rather than concentrating only on antibiotic prescribing. Assessment and diagnosis of acute dental conditions (including using appropriate tests and investigations) may be important to address, as well as shared decision making/consent for the care provided and safety netting advice to highlight what a patient should do if the symptoms worsen or do not resolve.

In the broader context, access to dental care has an important influence on dental antibiotic prescribing.[42,62] In those countries/contexts where dentistry is treated as a business, the ASP must address the 'time is money' paradigm. Dental teams will often make 'quick fixes' (like prescribing a course of antibiotics) unless they have appropriate incentives to favour longer appointments and comprehensive treatment.[63] Notably, this may include the role of the practice/clinic manager as well as the dentists in influencing the type of treatment provided.[64] Additionally, the practice/clinic front-desk team facilitate access for people with acute dental problems to see members of the dental team; the timing and length of an unscheduled appointment may have a significant impact on the care provided.[62,65] Thus, exploration of the wider factors that influence the decision whether to prescribe antibiotics in different settings may support the identification of additional elements for the local ASP.

As shown in ***Box 6***, by understanding what influences the decision whether to prescribe dental antibiotics in a specific context, new dental ABS interventions can be developed or existing interventions can be re-aligned to optimize prescribing.[62, 66-68]

BOX 6 – DID YOU KNOW?

Understanding influences on prescribing decisions presents opportunities for antibiotic stewardship programme solutions

Before deciding on interventions to include within an antibiotic stewardship programme (ASP) to tackle unnecessary antibiotic prescribing in dental practices and clinics, the reasons driving inappropriate use should first be considered. A UK study[62] identified 31 potentially modifiable factors associated with dentists' decisions whether to prescribe antibiotics for adults with acute conditions during urgent dental appointments in primary dental care (general dental practice or out-of-hours clinics) with the government-provided National Health Service England. To assist identification of interventions for inclusion in the ASP address, the factors are presented in the Capability, Opportunity, Motivation, Behaviour (COM-B) Model (***see Figure 10***).[68] Further details of the factors can be found in Thompson's doctoral thesis, 2019.[61]

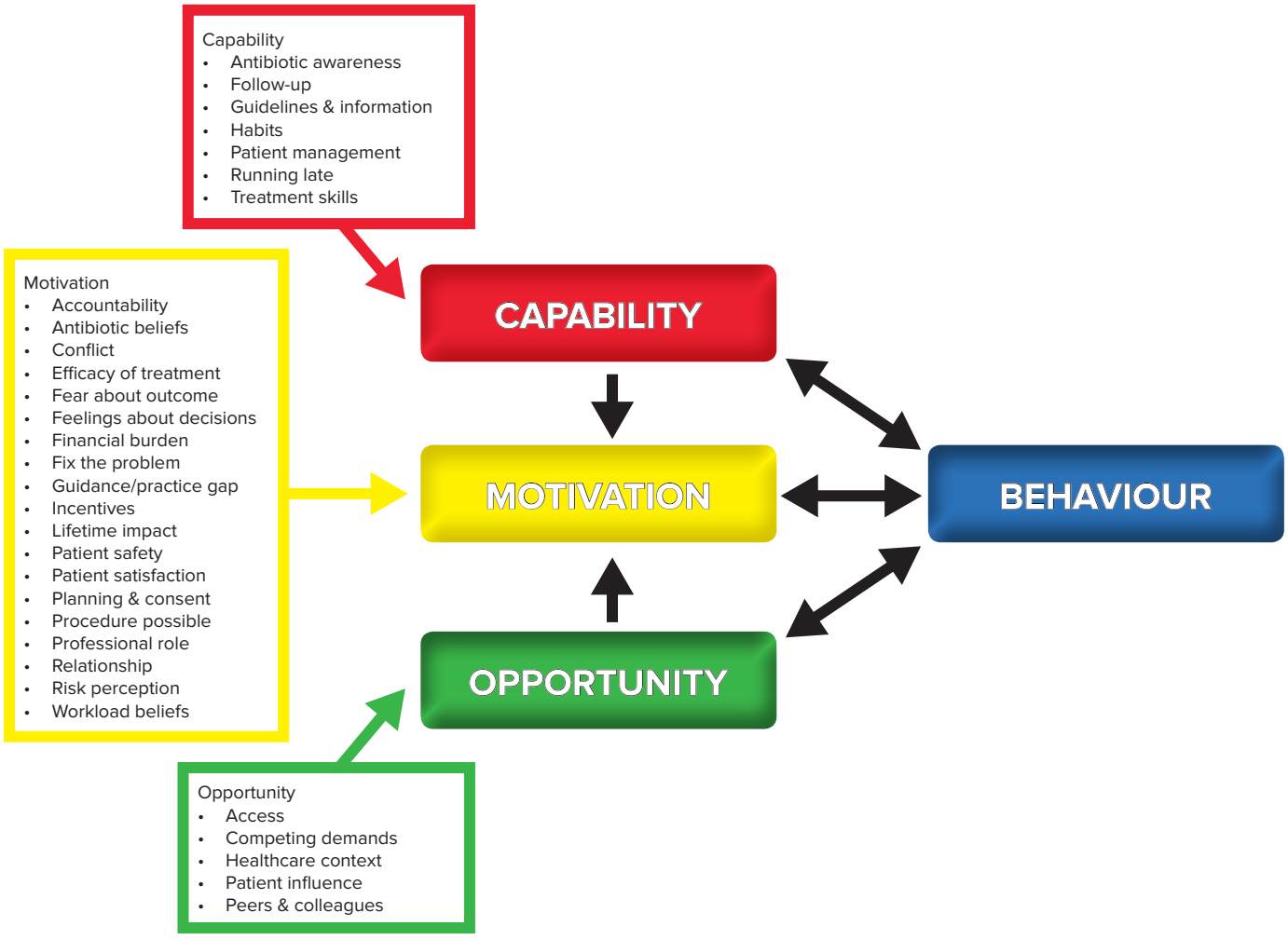


Figure 10. Factors influencing the decisions whether to prescribe antibiotics for adults with acute conditions. Adapted from Thompson et al[42] and Thompson[62] and presented using the Capability, Opportunity, Motivation, Behaviour Model.[68] Reproduced with permission of W Thompson.

4.6 What can I do?

When designing an ASP and solutions to tackle ABR, the first step is to understand what factors are important in your local setting. General dental practices may need different solutions than hospital-based teams and domiciliary care, e.g. in nursing homes. Those working in secure settings, e.g. in prisons or detention centres, may have different needs than charities, e.g. working with people who are homeless, refugees, asylum seekers, or working in remote parts of the world. Your ASP should include elements of your country's NAP (if one exists) that you judge to be most important for your setting. Additional elements should be included that your analysis of the local context has identified as important to address local needs.

Motivated individuals have been making a real difference in delivering dental antibiotic stewardship. You are encouraged to identify your role in tackling ABR. This white paper provides a framework to assist your endeavours and its online library offers examples of good practice that you are invited to use or modify to deliver your ASP.

5. Conclusion

Everyone is vulnerable to ABR and everyone has a role in tackling it. Due to the strategic value of antibiotics to the health and well-being of citizens, governments are responsible for ensuring NAPs, systems and processes are in place to support the optimal use of antibiotics. National dental associations are responsible for advocating for dentistry within NAPs and driving forward dental antimicrobial stewardship initiatives. Organizations providing dental care are responsible for creating an environment conducive to appropriate management of patients. We are all responsible for using antibiotics only when necessary.

Appendices

Appendix 1 - FDI Policy Statement on Antibiotic Stewardship in Dentistry

Context

Within the global threat of antimicrobial resistance (AMR), the spread of antibiotic resistance presents a world-wide major health risk due to prolonged illnesses, longer hospital stays and mortality, with the prospect of antibiotics becoming ineffective in the treatment of even simple infections.[1] It is calculated that 700,000 people already die each year as a result of AMR and it is predicted the rate will rise to 10 million deaths globally by 2050 if effective steps are not taken.[2] The wide availability of low-quality medicinal products, self-medication, inappropriate or unnecessary antibiotic prescribing and poor infection prevention and control all contribute to the development and spread of antibiotic resistance. Attention is now being given to this very serious situation by human and animal health communities, agriculture, manufacturing and research communities and, increasingly, by wider society.

Dentists are responsible for about 10% of antibiotic prescribing for humans (depending on the country). Studies have shown that despite efforts to reduce the number of unnecessary or inappropriate prescriptions, too many are still being written by dental professionals.[3] The dental profession thus has a vital responsibility, globally and nationally, to contribute to the reduction of antibiotic resistance.

Scope

This policy statement highlights the crucial role that dentists, their teams, and national dental associations (NDAs) have in proactive engagement in antibiotic stewardship to ensure appropriate use of antibiotics.

Definitions

Antibiotic resistance (ABR): Change of bacteria, when exposed to antibiotic, in ways that render ineffective those previously efficient antibiotics

Antibiotic stewardship (ABS): Coherent set of actions which promote appropriate use of antibiotics, i.e. in ways that ensure sustainable access to effective therapy for all who need them

Antibiotic stewardship programme (ABS Programme): Detailed set of actions/interventions planned and implemented by all stakeholders, aiming at promoting and improving the appropriate use of antibiotics by targeting the diagnostic, prescribing and behavioural steps of the whole infection management process

Infection prevention and control programme: Detailed set of actions/interventions in health care planned and implemented by all stakeholders aimed at preventing infections and reducing the transmission of micro-organisms and their resistance genes to patients and health workers[4]

Principles

The One Health principle proposed and adopted by many agencies to tackle antibiotic resistance worldwide in all sectors (humans, animals, environment) requires the active engagement, commitment and contribution of the dental profession.

There is an overwhelming case for improved antibiotic stewardship, with the aim of restricting the use of antibiotics to that which is strictly necessary. This will require the development of government policy and clear guidance on antibiotic prescribing coupled with effective surveillance and more studies on antibiotic stewardship.

It has been demonstrated that antibiotic stewardship programmes in dentistry can be effective in optimizing antibiotic prescribing.[5]

Policy

- FDI supports the improvement of knowledge and understanding of antibiotic resistance and stewardship through further research, better information, intelligence and data, and the promotion of epidemiological work at regional and national levels.
- FDI encourages research and development of additional solutions for prevention and treatment of dysbiosis of oral microbiota.
- FDI acknowledges that dentists should ensure their knowledge is up to date on antibiotic resistance and stewardship and that their antibiotic prescribing is in line with best practice.
- FDI encourages the development of educational programmes on antibiotic resistance, prescribing and stewardship that are suitable for the continuum of the professional lives of dentists and dental teams.
- FDI strongly encourages dentists to provide the necessary information for their patients regarding antibiotic resistance and appropriate use of antibiotics.
- FDI acknowledges that, along with antibiotic stewardship programmes, infection prevention and control programmes should be implemented as fundamental components of good clinical practice.

- FDI encourages and supports NDAs to actively engage in their AMR national action plan framework and to plan and implement antibiotic stewardship programmes in dentistry at local and national levels. NDAs can assist the improvement of dentists' antibiotic prescribing practices by making scientific evidence available to them.
- FDI encourages NDAs to advocate their policy makers to ensure that a robust national action plan to tackle antibiotic resistance is in place.
- FDI encourages major stakeholders (pharmaceutical companies, scientific journals, policy makers, NDAs) to provide information and communicate about antibiotic resistance and stewardship, in particular in scientific and professional journals but also at the practice and patient levels.

Disclaimer

The information in this Policy Statement was based on the best scientific evidence available at the time. It may be interpreted to reflect prevailing cultural sensitivities and socio-economic constraints.

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Appendices

Appendix 2 – FDI Policy Statement on Infection Prevention and Control in Dental Practice

Context

Although the principles of infection prevention and control remain unchanged, new technologies, materials, equipment and updated data require continuous evaluation of current infection control practices[1] and continuous education for the oral health team.

Scope

This policy statement provides the basic principles of infection prevention and control. More detailed information can be found in the references and in relevant legislation.

Definitions

Infection prevention and control (IPC): scientific approach and practical solution designed to prevent harm caused by infection to patients and health workers.[2]

Standard precautions: Guidelines for the prevention of transmittable diseases including nosocomial infections. Standard precautions combine universal precautions and body-substance precautions for all patients regardless of diagnosis or possible infectious status.[3]

Principles

It is the responsibility of dentists to establish a protocol that prevents or limits the spread of infection in dental practice for their patients, their staff and themselves. This can be accomplished by following the recommended infection control work practice procedures.

Policy

FDI supports the following statements:

1. Recommendations, guidelines and regulations should be developed in consultation with the dental profession.
2. Recommendations, guidelines and laws affecting standard precautions required of dental practices must be evidence-based or based on international best practices and receive adequate financial compensation for the additional costs that are incurred.
3. Local/regional dental associations should educate the public on the importance of proper infection control in the dental office, the effectiveness of such recommended procedures and consequently the absence of a significant risk of contracting transmittable diseases through the provision of dental care.
4. Dental educators must incorporate current infection prevention and control recommendations in healthcare settings into the curriculum and during clinical activities. This should include a blame-free critical incident reporting and learning system.

General

Members of the oral health team are obliged to keep their knowledge and skills up to date with regard to the diagnosis and management of infectious diseases that may be transmitted in the clinical setting, adhere to standard precautions and where necessary transmission-based precautions as set forth by the relevant authorities and to take appropriate measures to protect their patients and themselves against infections.

These measures include:

- adopting the principles of cleanliness and disinfection of all exposed surfaces in the work environment;
- following protocols accepted and/or recommended by relevant authorities for the decontamination, disinfection, sterilization and reprocessing of reusable instruments and disposal of clinical waste;[4]
- assuring that sterile instruments are protected from recontamination by using appropriate barrier packaging;
- using single-use instruments if sterilization is not possible;[5]
- exercising special care with the use of sharps; removing them from the work area after use and disposing them in a clearly labelled puncture-resistant container;
- adopting disinfection principles for devices, prostheses, impressions, instruments and applicable items transported to and from the dental laboratory;
- handling biopsy specimens with care and placing them in leak-proof containers according to the recommended guidelines.

Health Professionals

FDI urges oral health professionals

- to be physically protected (surgical masks, gloves, protective eye wear and outerwear) as appropriate for the care being provided;
- to be appropriately vaccinated against infectious diseases according to current guidelines issued by the relevant authorities;
- immediately to initiate appropriate postexposure prophylaxis for occupational exposure of blood-

borne pathogens, including HBV, HCV and HIV;[6]

- to be personally aware of signs and symptoms which indicate the possibility of blood-borne and other infectious diseases and undergo the necessary diagnostic tests when infection is suspected. FDI opposes any legislation that makes universal screening of oral health professionals for blood-borne pathogens mandatory;
- to comply with medical advice and relevant regulations regarding continuation of clinical practice if an infection is diagnosed.

Patient

FDI believes that all patients with communicable infections should disclose their status as part of their medical history. It is unethical for patients to be denied oral healthcare solely because of their blood-borne disease status.

FDI urges all oral health professionals

- to be alert for signs and symptoms of blood-borne and other infectious diseases in their patients;
- to advise all patients with a relevant medical history or condition suggestive of infection to undergo appropriate evaluation and treatment in a supportive environment with full regard to privacy;
- to have an appropriate protocol, in accordance with applicable relevant laws, for the confidential handling of information about patients;
- to make patients aware of the privacy policy in all settings where dental care is delivered;
- to share information pertaining to the patient's medical condition with other health workers as permitted by relevant regulations and with the patient's consent.

Disclaimer

The information in this Policy Statement was based on the best scientific evidence available at the time. It may be interpreted to reflect prevailing cultural sensitivities and socio-economic constraints.

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Glossary of Terms

Antibiotic resistance (ABR): Change of bacteria, when exposed to antibiotic, in ways that render ineffective those previously efficient antibiotics.

Antibiotic stewardship (ABS): Coherent set of actions that promote appropriate use of antibiotics, i.e. in ways that ensure sustainable access to effective therapy for all who need them.

Antibiotic stewardship programme (ASP): Detailed set of actions/interventions planned and implemented by all stakeholders, aiming at promoting and improving the appropriate use of antibiotics by targeting the diagnostic, prescribing and behavioural steps of the whole infection management process.

Dysbiosis of oral microbiota: Change in the composition or structure of the oral microbiota leading to the loss of the host's homeostasis.

Infection prevention and control programme: Detailed set of actions/interventions in healthcare that are planned and implemented by all stakeholders and are aimed at preventing infections and reducing the transmission of micro-organisms and their resistance genes to patients and health workers.

One Health: an approach to designing and implementing programmes, policies, legizlation and research in which multiple sectors communicate and work together to achieve better public health outcomes.

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