

# Incorporating New Materials and Techniques into Clinical Practice

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## ABSTRACT

This article outlines the subjects presented and discussed at the December 2012 IADR Dental Materials Innovation Workshop held at King's College London. Incorporating new materials and techniques into clinical practice was considered from 4 perspectives: (1) Accelerating the "research to regulatory approval" process was presented with current developments in the United States, with the National Institutes of Health/Food and Drug Administration process as a working example; (2) intellectual property and regulatory requirements were discussed across the well-established US and EU frameworks, as well as the more recently developed procedures across Brazil, Russia, India, and China; (3) the challenges and opportunities of incorporating innovations into dental education were considered with reference to the future needs of both students and faculty; and (4) the key but difficult and unpredictable step of translating such innovations into routine dental practice was then explored. Constructive and far-ranging discussion among the broadly based Workshop participants (from dental research, education, practice, and industry, as well as environmental organizations and the World Health Organization) mapped out key issues for the future. The focus was on facilitating the more timely adoption of improvements in both materials and techniques to

improve patient health and health systems, while minimizing environmental impact.

## INTRODUCTION

Incorporating new materials and techniques into clinical practice is a major challenge across the health professions the scale of which should not be underestimated (Grimshaw *et al.*, 2012). The focus of this article is on new materials for the management of dental caries developed in the context of phasing out the use of dental amalgam. However, it should be appreciated that linked to such new materials will likely also be new clinical techniques that exploit the superior properties and characteristics of these new restorative (or even therapeutic) dental materials. In other words, clinicians and those in clinical training will be required to do things differently in the future; they will not be asked simply to fill a cavity cut for amalgam using an alternative material. This may add additional complexity that will affect the speed of adoption and the clinical outcomes achieved. However, if the combined talents of those represented at the Workshop can be integrated effectively, future caries management might potentially become simpler and less technique-sensitive.

This article outlines the subjects presented and discussed at the December 2012 International Association for Dental Research (IADR) Dental Materials Innovation Workshop held at King's College London. Incorporating new materials and techniques into clinical practice was considered from 4 perspectives: (1) Accelerating the "research to regulatory approval" process was presented, with current developments in the US process as a working example; (2) intellectual property and regulatory requirements were discussed; (3) the challenges and opportunities of incorporating innovations into dental education were considered with reference to the future needs of both students and faculty; and (4) the key step of translating such innovations into routine dental practice were then explored and far-ranging discussion among the broadly based Workshop participants summarized.

If new materials and techniques are to be introduced successfully, efficiently, and effectively across a wide range of geographical and professional settings, there must be careful consideration of how dental education (across the range from the dental graduate, the dental team, and continuing education) can equip new and current practitioners with the information

## Key Words

dental materials' innovations, implementation of research findings, knowledge transfer, translating research into practice, translating research into education, dissemination of information.

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and skills to best use these new materials as they are introduced and evolve.

There is also a need to explicitly understand and work to optimize the facilitators of beneficial changes and to eliminate or minimize the barriers to adoption of new materials and techniques that can be shown to improve patient health and health systems, while at the same time minimizing environmental impact throughout the life-cycle of the materials concerned.

The Workshop provided a unique forum, since the participants were very broadly based (from dental research, education, practice associations/organizations, and industry, as well as from environmental organizations and the World Health Organization), and they assembled at a time where the pressure from the timetable of the United National Environmental Programme consideration of mercury and dental amalgam gave a concentrated focus.

### ACCELERATING THE RESEARCH TO REGULATORY APPROVAL PROCESS: THE NIH/FDA EXAMPLE

US Federal agencies related to dental materials include FDA, NIST, and NIDCR. FDA is the Food and Drug Administration, Department of Health and Human Services. The FDA mission is to protect the public health by ensuring the safety, efficacy, and security of human and veterinary drugs, biological products, medical devices, the nation's food supply, cosmetics, and products that emit radiation.

NIST is the National Institute of Standards and Technology, Department of Commerce. NIST's mission is to promote US innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life.

NIH/NIDCR is the National Institutes of Health and its National Institute of Dental and Craniofacial Research, Department of Health and Human Services. The mission of NIDCR is to improve oral, dental, and craniofacial health through research, research training, and the dissemination of health information.

In the context of innovative dental materials, the FDA is concerned with the safety of the public; it also considers materials claims by manufacturers as either 'equivalent' (to an existing product) or 'new' (in which case a more protracted approval pathway is followed). Within NIST, the Biomaterials Group advances and supports standards (it does not write them). NIST has reorganized recently, reducing its number of laboratories. The Biomaterials Group, in the Division of Biosystems and Biomaterials, is also within the material measurement laboratory. FDA/NIDCR are concerned with diagnostic, preventive, and therapeutic products for use in oral care. Total NIDCR external research (2012) represents 1.25% of an NIH external awards budget of US\$25.5 billion. The 2012 NIDCR external awards budget is currently \$318M, and Biomaterials is approximately 10% of NIDCR grants in various programs (<http://report.nih.gov/>).

### Agreements and Linkages

NIDCR interacts with the FDA and NIST to promote inter-agency cooperation for the advancement of clinical dentistry.

Currently, NIDCR and NIST have an Interagency Agreement with the following objectives:

- To establish clinical, performance-based standards for polymeric restorative materials.
- To develop and produce biologically relevant standard reference materials for calcium phosphate.

The current focus is on:

- Standards development for calcium-hydroxyapatite and carbonated apatite (in the near future, also fluoride-hydroxyapatite).
- Quantifying polymerization stress.
- Investigating biofilm-materials interactions.

Four specific questions were identified for this topic (each was answered in turn in the presentation):

Q1. Who should granting agencies solicit for future materials' discovery and development strategies to shape their funding focus areas?

Response 1: The relative use of amalgam (*vs.* composite restorations) in the United States has dropped from between 70% and 80% in 1991 to 30% to 35% in 2003. There is a current request for proposals open to a wide range of researchers for the development of new resin systems (not improving existing resins). The focus is on increasing the in-service life of composites by a factor of 2 (realizing that material survival does not equate to tooth survival, and that tooth structure often fails) (<http://grants.nih.gov/grants/guide/rfa-files/RFA-DE-13-001.html>). Multidisciplinary approaches are encouraged.

Q2. Should government granting agencies partner more closely with industry in co-funding mutually beneficial research and product testing and evaluation?

Response 2: Funding provided by NIST and the SBIR/STTR programs support industry involvement.

Q3. Should government regulatory and funding agencies co-sponsor symposia and workshops investigating ways to hasten the process of product approval?

Response 3: Product clearance is a task of FDA. A joint NIH-FDA working group fosters Clinical Outcomes Assessments (COAs).

Q4. How do environmental concerns factor into the development of a funding agency's strategic planning and resource allocation?

Response 4: The potential and toxicity of all materials are taken into consideration when funding decisions are made.

It is clear that the example outlined from the United States represents a very complex and multi-faceted web of legally related and inter-twined federal agencies. They are working hard to move forward and accelerate the approvals process. The example also outlined the requirement to balance the core obligations to guard patient safety with minimizing the time and costs required to bring beneficial innovations to market. The

situations obtaining in Europe and elsewhere have their own distinct features and challenges.

## INTELLECTUAL PROPERTY/PATENT AND REGULATORY REQUIREMENTS

This presentation was framed around 3 questions:

- Q1. How do current regulatory processes across the globe negatively affect the development and marketing of new dental materials?
- Q2. Is it possible for industry to partner with academia more closely to develop new products by establishing mutually beneficial “incubators” at research intensive schools?
- Q3. What are the challenges, inconsistencies, and enforcement requirements for a global patent system?

As an introductory statement, it was usefully pointed out that, in clinical practice, the dentist is the polymer scientist who ultimately creates and cures the polymer product as a restoration. Two major regulatory schemes dominate the global requirements: CE certification (EU) and FDA registration (510k, USA). Regulations of many other countries are based on these and often have additional local requirements. It was noted with some concern that the level of local requirements has increased significantly over the past few years. The regulatory issues can be challenging if a new product cannot be considered for 510k approval. There is always an incentive to explore whether a new product can be shown to be similar to another product and so use the 510k. Taking a totally new material to market can take a very long time, and costs may be seen as prohibitive.

Two suggestions were made for improving current arrangements:

- *Local level*: up-to-date information exchange between local researchers and health authorities (local testing; document review).
- *International level*: information exchange between health authorities internationally. Harmonization of registration requirements is facilitated by the International Medical Device Regulators Forum (IMDRF).

### Classifications for Medical Devices

Dental filling materials are in class IIa. The essential requirements are safety and efficacy (note: not efficiency) of products. Proposed claims testing may take up to 5 years, and post-market assessment starts immediately after launch.

Risk management systems are well described, used, and accepted (ISO, etc.). For biocompatibility assessment, there are numerous challenges, including ambiguity in the application of the same regulations.

In terms of chemical legislation, the challenges are that there are different situations by country/region:

- US: FDA-regulated products are not EPA-regulated.

- EU: Medical devices must fulfill most chemical legislation requirements (REACH).
- EU: New legislation for nanomaterials is in progress. The broad definition of nanomaterials includes basically all powders/fillers used in dental materials. This will be a huge problem if they are classified as therapeutics (Class III).

Suggestions for improvement included intensified interaction between dental academia/organizations and health & environmental authorities.

- Tailor needs for dentistry.
- Align goals through collaborative workshops.
- Encourage global harmonization.

### Intellectual Properties

A clearly stated personal view was offered here that patents are *enablers* rather than *hurdles*. The World Intellectual Property Organization (WIPO) ([www.wipo.int](http://www.wipo.int)) is a United Nations agency dedicated to the use of intellectual property as a means of stimulating innovation and creativity for the economic, social, and cultural development of all countries. Countries currently taking a leading role are the United States, EU, Japan, Russia, India, China, and Brazil.

Intellectual properties considerations include: determining what is known already, which features should be protected by a patent, what can/cannot be protected, and where IP protection is needed. Developing new materials without new IP involves determining what IP is protected by others, if the IP is valid and enforceable, and whether a license is reasonably possible. Shared inventions complicate matters, as do international collaborations.

### Intellectual Property Challenges

Joint ownership IP – Good IP coverage is work, and cost-intensive, joint ownership can complicate matters significantly.

Sometimes there are contradictory international requirements (WIPO: World Intellectual Property Organization should reduce this tendency).

There are increasing numbers of counterfeit products.

New product development involves, first, the technology, then the product and its approval. Challenges beyond the formal approval include extended registration times in countries such as Brazil, Korea, Taiwan, and China, which can be 2 years. There also may be additional labeling and testing (*e.g.*, storage and transport at higher temperatures) to consider in getting a new product into some markets.

The conclusion of this element of the Workshop was that there was a huge potential role for intensified collaboration among dental academia/organizations/industry and health authorities. It was suggested that workshops such as the present one can help in developing/enabling collaboration and much-needed open discussions among academia, industry, and health authorities

and that these processes can facilitate the introduction of new materials. Finally, for this section it was suggested that there was a need to (1) tailor rules and regulations to the needs of dentistry, and (2) industry and academia should focus on new technologies and new ways of doing dentistry, including:

- *Technical/chemical/biological science*: look at novel materials and easy *in vitro* tests
- *Clinical departments*: look at clinical relevance

## INCORPORATING NEW MATERIALS AND TECHNIQUES INTO DENTAL EDUCATION

In many countries there is believed to be a shortage of dental teachers, particularly of those capable of teaching modern, evidence-based cariology and operative caries management (Schulte, Buchalla *et al.*, 2011). It is also believed that there is a need for more “joining-up” of the caries prevention and management education agendas for the graduating student as well as for the post-graduate or continuing education participant (Pitts *et al.*, 2011a). At the same time, there is a range of new Web-based opportunities for sharing material, but also fundamental challenges to the funding and dynamics in dental education.

The material presented in this section sought to define an oral health care provider, look at the requirements for future faculty and funding, and examine the sharing of information and the potential interactions between research and education.

There are now more than 1,600 dental schools in the world and a great but uneven need for dentists/dental professionals. The needs and competencies differ across regions and countries, which leads to a wide variation in the missions of dental schools. Existing competencies are increasingly being defined in US and EU countries, and these must be adjusted to local needs and circumstances.

However, *all* new graduates should be competent critical thinkers; the unifying challenge dental educators face is how to teach students to think.

Dental schools should no longer prepare dentists for a future just 3 or 4 years away. They should be equipping dentists with critical thinking skills to enable them to use knowledge and evidence to make their own decisions about which materials or techniques to use – or not use – in oral health care delivery. We also need to teach students to be willing to change what they will do as they practice in the future, not to just keep doing what they were doing when they graduated. To achieve this, students need not necessarily spend all their time in lecture halls and classes, since new technology unlocks opportunities for individualized and small group learning and study. The challenge is to get students to ask the right questions – that is the responsibility of today’s faculty.

Typically, faculty members have been trained in the old way, by ‘regurgitation’. The changes increasingly in place are to train students to ‘search for information and to think’. Many faculty need to change their teaching mode to teach students to ask the right questions, so they can continue to solve problems

themselves in the future. All faculty (including adjunct clinical faculty) should be prepared to ask challenging questions and to be engaged. There is an urgent need to develop future faculty to teach in this new environment. Many schools have spent considerable sums in educating faculty for research. Schools need to reflect on how well they equip faculty to be prepared to be educators.

To become critical thinkers, students need to be engaged in research/scholarship. Not *all* students necessarily need to be engaged in bench research. Schools do need to provide them a challenge, so that they will look at a problem and the literature and systematically give their opinion thereof and comment on the quality of the literature. Students should be able to read, analyze, and come to a judgment.

IFDEA (the International Federation of Dental Educators and Associations) is a virtual organization ([www.ifdea.org](http://www.ifdea.org)) which started around 30 years ago. It is a global community of dental educators seeking to improve oral health by sharing knowledge and raising standards. It has over 1,000 members and receives over 1M hits/month. The organization seeks to exchange ideas and bring convergence. Anyone can be a member, and it is free. The web site ([www.ifdea.org](http://www.ifdea.org)) provides a platform for the sharing of information. Anyone can add educational content that can be shared as open courseware resources. IFDEA is continuing discussions with the IADR about working together to support better oral health care. A specific challenge at many dental meetings is that those who most need to be at the meetings cannot afford to be there. Provision of content directly through the web wherever possible helps negate this disadvantage.

There is a variety of ways to introduce new materials into an educational system, and there are several key issues that have to be considered explicitly. These include:

- Faculty resistance
- Treatment philosophy
- Faculty/student calibration
- Patient indications
- Complexity of use
- Quality of supportive evidence
- Patient acceptance
- Cost

Once again, a series of questions was posed, answered, and discussed in this section of the Workshop:

- Should dental schools teach the latest materials being promoted by key opinion leaders to best prepare students for future dental practice?
  - *Yes, but more importantly, teach them how to evaluate the materials.*
  - *If clinical data are available and it is cost-effective, ‘yes’ to incorporating the materials into curricula (lecture, lab, and clinic).*
  - *If clinical data are not yet available or convincing, introduce in limited way until proven [lecture, lab (hands-on), electives; isolated clinical cases].*

- Should dental students become a testing ground for new material types and brands to gain insight about the technique-sensitivity of new products?
  - *No, students are not reliable testers, so this would not be appropriate due to the variability of outcomes resulting from students' overall lack of experience, the inefficiency of clinic operations, lack of faculty acceptance, philosophical differences, etc.*
  - **But** students can be generators of evidence for many existing materials/procedures, if controlled.
- Should dental students be required to participate in research during dental school to emphasize the importance of this process in materials' development and use?
  - *Yes, research helps to create critical thinking skills. It is a good idea for promoting critical thinking and the understanding of evidence, as well as the importance, and feasibility, of incorporating evidence into everyday practice.*
  - *Must tailor experiences to students (simplicity) and minimize impact, similar to some models for investigators in practice-based research networks.*

The distilled advice on how to introduce new materials into the educational system (Ben-Gal and Weiss, 2011) is that schools should:

- Develop a clear policy for use
- Provide supporting evidence
- Solicit experiential data from faculty and practitioners
- Provide training to faculty
- Conduct periodic evaluations of new materials
- Not simply follow current practice trends

## INCORPORATING NEW MATERIALS AND TECHNIQUES INTO CURRENT PRACTICE

This section was presented from the perspective of the informed general practitioner and covered: the various "types" of dentists now being observed, how best to communicate new developments to general dentists, the influence of the care system, accelerators, inhibitors, and the future.

Dentists are now recognized by some in a series of various professional and behavioral "types"; it is important to understand their differences and the impact that these have on their ability and enthusiasm to update their practices.

### • "Young Blood"

'Young blood' dentists are ready to accept change in their career. Their propensity to do so may depend on attributes or prejudices which derive from the dental school at which they trained. Enthusiasm is important – it makes them receptive to change. Critical appraisal skills are key.

It should also be noted that their attitudes to the work-life balance are often different from those of more senior colleagues.

The major question for the profession is: How can we maintain their enthusiasm and commitment to dentistry throughout their careers?

### • "The Workers"

These dentists generally continue to practice what they were taught. They seek to do the best for their patients, but are conservative and need to be persuaded that any change is effective, is low-risk, and will not damage the financial viability of their practices.

### • "End Gamers"

'End gamers' can start at any age....they comfortably "cruise to retirement". They are not motivated to keep up-to-date or to change. We hope, for many dentists, that we can prevent this stage from ever starting, or we can delay the onset. The approach to clinical care can be quite "dangerous". These dentists can be gradually developing practices that do not provide appropriate oral health care.

## Communications with General Dentists

Access to timely and authoritative information is important. While some practitioners are over-burdened with information, many practitioners in some parts of the world do not have sufficient or appropriate access. "Word of mouth" between dentists is a powerful influence, but this can also be biased and "dangerous" in terms of understanding the evidence and the ways forward. These challenges have to be balanced by the more general "information explosion" – so much information is now available through so many channels, how does one sort out what is important and what is accurate?

Advertisements for materials and company representatives are known to be important means of communication, but it is fair to ask if the best/most appropriate product performs as presented in the ad. How a dentist works with the material is important, as are the qualities of the material itself. Critical assessment skills are also important, yet, for many practitioners, they are not intuitive.

New knowledge and published information should be more readily available and more digestible. The use of short, independent guidance overviews (as *per* those produced by clinical research associates for many years) are a powerful tool. Short evidence-based reviews from a trusted source are also needed – an example is the journal of *Evidence-Based Dentistry*. It is always an important challenge to keep this information updated and to communicate significant changes in the weight of evidence. Hands-on courses are expensive but do help to bring about change more than just reading about new methods. Traditional distance learning can cause dentists to miss out on important social interactions and peer review elements, but modern blended learning – combining meetings with imaginative use of IT and communication tools – offers a very timely way forward as well as convenience for practicing dentists.

Information transfer *via* post-graduate courses and CPD (continuing professional development) schemes helps fulfill the obligation for dentists to stay up-to-date. In the near future in the United Kingdom, there will be regulatory requirements to do this 'through revalidation of knowledge and skills'. However, care is needed, since compulsory topics in CPD take up what

had been free time for many practitioners. They need the free time to take courses of professional interest.

### The Care System

The system of care, and specifically its funding and payment procedures, influences the potential drivers and choices of treatment by the individual practitioner. Probity—that is, showing that a service has appropriately spent the money allocated—is a key driver of system design. However, a recurrent problem is that it is perceived to be more difficult to show or “prove” that prevention has been done, as opposed to verifying whether a filling has been placed. This is a paradox when compared with the payment systems for prevention used for many primary care physicians. Having caries recognized within the NCD (non-communicable disease) agenda is helping to change mindsets among those who design systems (FDI, 2013).

The public has both needs and demands which should be reflected in the design of the care system. These may include some “fashion-related” treatments (*e.g.*, whitening, demand for perfectly aligned teeth, Botox treatments), but the public should also be expected to take responsibility for self-care (*e.g.*, with respect to smoking, alcohol, diet, and oral hygiene behaviors). Public demand can influence standards of care, *e.g.*, whitening. Peer pressure is also a factor, as is each person’s comfort zone in terms of a treatment technique with which they are confident. Learning a new technique may not result *per se* in good use of it in all clinical cases, *e.g.*, CAD/CAM. Students and practitioners should be taught the decision-making skills needed to do the right thing, right, at the right time, for each patient.

It should be appreciated that, with respect to dental caries, payment systems support both “over-treatment” (premature or unnecessary surgical intervention) and “under treatment” (failure to control or restore active progressive caries extending deep into the dentin-pulp complex).

### Accelerators and Inhibitors

It is important to maintain personal professional drive and motivation throughout a dentist’s career.

*Accelerators to embrace beneficial change* are deemed to include: money, time, public demand, personal professional drive, and peer pressure. Ease of use can also drive the adoption of new methods. Ideally, new materials should be less technique-sensitive and be “better/quicker/more inexpensive”.

*Inhibitors to embrace beneficial change* are deemed to include: the information explosion (which makes it difficult to sort out what is important), lack of a trusted independent assessment, cost, leaving a personal comfort zone, good intentions and relapse, perceived public attitudes to the *status quo*, and a demoralized profession.

### The Future

On behalf of all national dental associations, the FDI World Dental Federation has outlined a new direction for dentistry – Vision 2020 (FDI, 2013). To bring this vision to life, the FDI has defined 5 areas of priority as cornerstones of a new, responsive, and fair model: (1) Meet the increasing need and demand for

oral health care, (2) expand the role of oral health care professionals, (3) shape a responsive education model, (4) mitigate the impacts of socio-economic dynamics, and (5) foster fundamental and translational research and technology. It is clear that, in the context of this Workshop, areas 3 and 5 are already seen as key priorities, and this transition should help to change both education and the translation of research findings into clinical practice. However, as a cautionary note, organizing dentists has been likened to “herding cats”.

For new materials and techniques to be incorporated into clinical practice more rapidly and predictably in the future, attention should also be focused on:

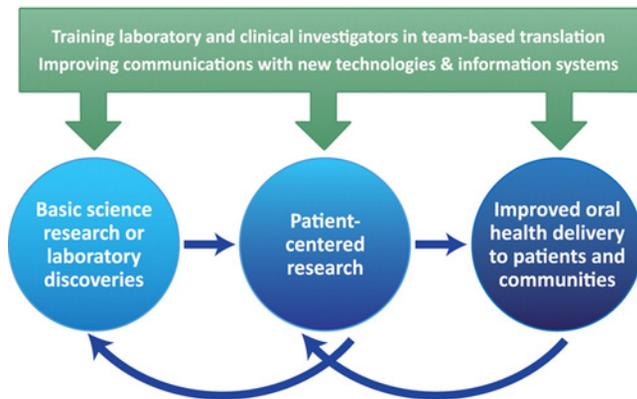
- critical appraisal skills;
- comparative data, presented in easily digestible formats;
- the primary care research agenda – involving the practicing profession and thereby conferring ownership of evidence and change;
- education of the public – who need to understand the responsibility for their own self-care and well-being and need to be willing to pay for effective prevention;
- involvement and ownership of the profession in the design and evolution of systems of care – quality of care, in addition to numbers of treatments, should be rewarded; and
- rewarding the professional outlook of those who move their practice forward in line with the latest evidence-based techniques.

### DISCUSSION

It is being increasingly appreciated that translating new treatments and prevention strategies more efficiently for improving oral health is a complex process which needs to involve the systematic linkage of those involved in basic science, in patient-centered research, and in the provision of oral health delivery at both the individual patient and community levels (Fig. 1) (Giannobile and Joskow, 2012). In this field of developing novel materials for caries management, phasing down restorative care and phasing up prevention, the translational continuum of basic discovery science to “chair-side” practice and adoption does not stop at the first use in a dental school clinic. We need to plan to reach an enduring and financially viable way to bring new materials and techniques to patients and communities on a global scale.

There is now an urgent need for the development of new materials and techniques for caries control and restoration which are suitable for use in 3 types of clinical delivery:

- (1) for high-end practices, embracing materials with superior mechanical properties for use by highly skilled operators delivering materials-assisted complex restorative procedures in developed countries where price is not a major driver;
- (2) for those seeking to push forward the boundaries of effective caries prevention, control, and restoration, with the preservation of sound tissue and the ability to be used by those with a range of clinical skills in challenging and sub-optimal clinical environments; and



Giannobile W, Joskow R J DENT RES 2012;91:633-636

**Figure 1.** Translating new treatments and prevention strategies more efficiently for oral health. Source: Giannobile and Joskow (2012).

- (3) for those with the same needs as in (2), but for use in “developing” countries – with materials which can be affordable and tolerant of extremes in conditions of both use and storage.

These types of contrasting uses and needs have implications for global practice, global education, and global continuing education. All 3 types of clinical needs were argued for at the Workshop. The future development agenda requires to be more tailored for different market segments, and, as the materials’ scientists new to dentistry emphasized, a more precise and comprehensive set of specifications will be needed in the future. It is clear that there is a need expressed by WHO and others for developments to serve those in types (3) and (2) as a priority for public health and to meet several government agendas. Recent work with standardized evidence-based caries management systems developed with the help of the research, education, and practice communities, such as ICCMS™ (Pitts *et al.*, 2011a,b; Pitts and Ekstrand, 2013), the FDI Caries Matrix (Fisher and Glick, 2012), and tooth-preserving caries pathways (Ismail *et al.*, 2011), also supports implementation in delivery setting (1), (2), or (3).

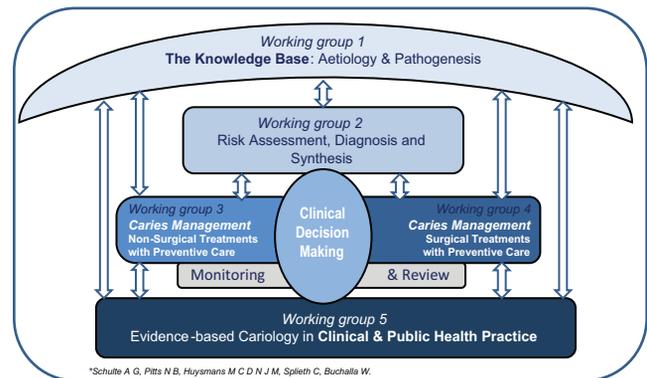
**Novel Materials’ Developments**

The cost of development of a brand new restorative material from scratch was debated, and the estimates were in the significant millions of US dollars, depending on manufacturing requirements which could increase costs further, requiring longer to achieve a return on investment. The time required for generation of a new product and bringing it to market was estimated to be between 2 and 10 years, depending on the novelty of the technology; regulations may also be a big factor.

**Development of Therapeutic Materials**

The potential value of developing a therapeutic, pharmaceutical approach under Class III product requirements was debated. Some could see strategic health and commercial advantages of the

**European Core Curriculum for Cariology\***  
essential elements for education in 2013



\*Schulte A G, Pitts N B, Haymans M C D N J M, Splieth C, Buchalla W.

**Figure 2.** European Core Curriculum for Cariology: in which caries management by non-surgical or surgical treatments (both combined with Preventive Care) are given comparable importance. Source: Schulte, Pitts *et al.* (2011).

approach, while others cautioned that the higher regulatory threshold and costs may make companies less enthusiastic about taking technologies forward. Potentially, added health benefits may be lost in this scenario because of greater development costs.

**Collaborative Developments in Education**

It was believed that, although controversial in some countries, inter-professional education will diversify the workforce (and access-to-care issues might be eased). In many countries, we will be hearing more and more about collaborative efforts to training in health care. For example, with nurses addressing the diagnosis of oral health, inter-professional education will become increasingly more prevalent – and relevant. It was also believed that there will be further moves toward improved communication about sharing educational resources. An example discussed was the European Cariology Curriculum originally developed by ORCA/ADEE (Fig. 2) (Schulte *et al.*, 2011b). This is now being shared much wider globally, with online materials and this type of model (where research and education organizations are working together with industry support) could perhaps be extended in the future, as in the Alliance for a Cavity Free Future (<http://www.allianceforacavityfreefuture.org/en/us/home>).

The focus of the presentations and the quite optimistic discussions at the Workshop were clearly around facilitating the more timely adoption of improvements in both materials and techniques to improve patient health and health systems, while minimizing environmental impact.

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