

The Evolving Role of Technology in Shaping Professional Standards in Dentistry and its Educational Answer

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Abstract

Dentistry is one of the most interesting and challenging occupation. It deals with different types of problems - pain, destruction of living tissues, loss of function and even risk of de-socialization. It provides solutions to this multitude of issues applying methods, materials, techniques and technologies to relief pain, restore defects, functions and aesthetics, assist re-socialization of individuals and assure quality of life at individual, group and social levels.

Dentistry is a profession operating under a social contract based on self-obligation: moral, legal and practical commitments stated in a code of ethics, system of licensing and registration regimes. Professional autonomy in decision-making gives to professional group social authority while requiring from them to take responsibility for diagnostic, planning and treatment, follow up and prevention of autonomous individuals at different stage of vulnerability in a fast changing social, political, and technological environment.

Dentistry today, as a multifaceted domain of social activity, is an autonomous professional occupation, evolving global market of services, and integrated part of National Health Systems. To keep its respectable social position in the fast changing environment the ability to keep the human touch and technology together has to be recognized.

On one hand, the dental profession in lately decades got access to the latest technological tools and equipment, including AI, but on the other hand, the patients' expectations to integral, individualized, and accessible care are growing fast. Therefore, dentistry and dentists face challenges and has a number of limitations when taking professional decision.

Professionalism is a crucial skill that every dentist must possess in the dental profession. However, the question arises of how dental educators can teach and evaluate professionalism to their under and postgraduate dental students to answer the public expectations and the new challenging factors of technological and social aspects. Educate dentists today for an integral human-to-human care and respect to the liberal character of dentistry in a digitalizing anonymous medical environment represent both a challenge and prerequisite for schools and educators. Educational answer in the era of AI can consist of enhancing critical thinking as a cognitive process that involves actively analyzing and synthesizing information not just consuming the ready to use decisions, provided by the AI sources and keep the shared values of responsibility and empathy.

Keywords: *Dental Profession; Decision-Making Process in Dentistry; Patient/Doctor Relationship; Dental Education; Critical Thinking; AI in Dentistry*

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1. Dentistry as a healing art and a profession. Professional standards.
2. Social and technological prerequisites and challenges dentistry faces now.
3. Impacts of technology on dentist/patient and dental profession/society interactions.
4. Educational answer.

Dentistry as a healing art and a profession. Professional standards

Dentistry as a healing art is one of the most interesting and challenging one. It deals with different type of problems - pain, destruction of living tissues, dysfunctions or loss of function, and even risk of de-socialization. Dentistry provides solutions to this multitude of issues applying relevant methods, materials, techniques and technologies to relief pain, restore defects, functions and aesthetics, assist the re-socialization of individuals, and improve the quality of life at individual, group, and social levels [1].

Dentistry as a profession diverged from medicine and obtained its own identity by the first half of the 19th century. This became possible with the implementation of a formal academic course of dental education. The second half of the 19th century, along the stormy socio-economic development including the trend toward industrialization and urbanization, is known as the period of establishment of the modern healthcare systems and professional organizations [2]. Dentistry today is characteristic by autonomous professional regulation, evolving global market of services, and inclusion in the National Healthcare Systems.

Dentistry is a profession operating under a social contract based on self-obligation: moral, legal and practical commitments stated in a code of ethics, system of licensing and registration regimes. Professional autonomy in decision-making gives to professional group social authority while requiring from them to take responsibility for diagnostic, planning and treatment, follow up, and prevention of autonomous individuals at different stage of vulnerability in a fast changing social, political, and technological environment [3].

Professional standards of dentistry include a set of competencies in providing oral healthcare services, acquired during a formal course of higher education and continuing education and a set of ethical norms of relationship with patients and society [4]. Professional standards has socio-professional, cultural and technological aspects. By presumption, professional code of ethics, apart the requirement of moral conduct, predispose quality performance of the art of healing based on appropriate application of clinical knowledge and training. In addition, ergonomically organized healthy and safe working environment (tools, time, and team management), and patient's comfort is relevant to the professional standards [5]. Having in mind that the product dental profession provides the society with represents a "service", dentist are expected to keep professional standards while "selling" dental treatments.

Professionalism consist of several core competencies of an individual to lead an ethical personal and professional life in promoting and providing benefits to society [6]. Professionalism is a commitment to a set of values, behaviors and relationships, which underpin the trust of the public in professionals' community. It is a complex, multidimensional construct, which has individual, interpersonal and societal dimensions. These are context dependent and encompass competences within areas relating to: ethics, regulation and professional behavior. Knowledge of the ethical, legal/regulatory and professional basis of dentistry is essential to clinical practice. The undergraduate curriculum should reflect this and integrate student learning about professionalism throughout the curriculum to facilitate the development of high standards of professional practice (GDC, 2017).

Dentists must make the care of patients their primary concern. They must be reflective, clinically competent and keep their knowledge and skills up to date by engaging in continuing professional development. They must establish and maintain good relationships with

patients and colleagues, communicate effectively, and treat each person as an individual. They should work in partnership with patients, respecting patient choice and each patient's right to privacy and dignity. It is expected that dentists are committed to high personal and professional standards, being responsible, accountable and acting within the law. They must seek to protect and improve the oral health of their community and work to maintain the trust the public has in the profession, by raising concerns where necessary [7] (Figure 1).

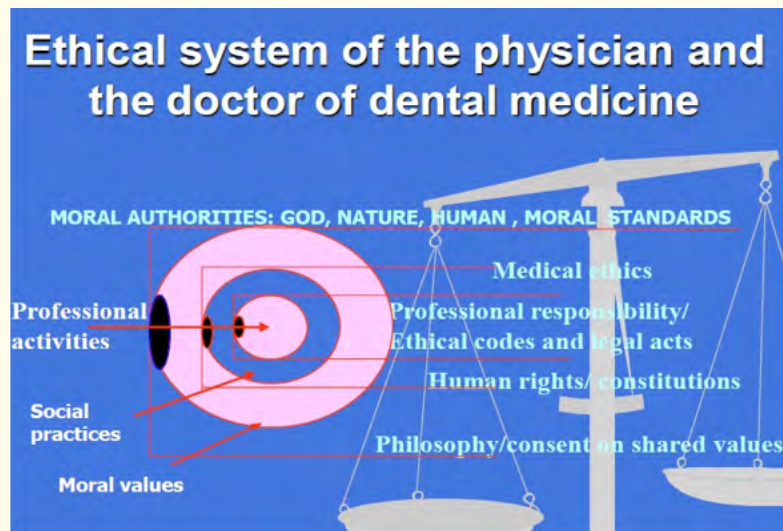


Figure 1: Ethical system of the physician and the doctor of dental medicine.

(In: Lydia Georgieva Katrova *Essentials of Social Medicine and Medical Ethics* ©Sofia, 2017 ISBN 978-954-90363-5-0 Editor: Lydia Katrova, *Leading technologies in dentistry*' company).

Social and technological prerequisites and challenges dentistry faces now

Sophisticated dental materials, digital technologies, effective communication and ergonomic organization of the dental practice transformed dental medicine into one of the most advanced fields of medicine and medical sciences and the dental services' delivery in one of the most dynamic specialized markets with billions of customers. Apart the advances of the methods of treatment and the dental materials, the dental curricula and dental research demonstrated a considerable and evolving progress as well. This process allowed the establishment of criteria for a healthy functional dentition, painless treatment methods, but also the prevention of oral diseases and the oral health promotion.

The digitalization in all domains of social life and healthcare organization assist the sustainable optimization of system and organization management and thus cause positive effects in short and medium term but the long-term effects are unpredictable. Concerning the application of new technologies, especially AI evolving fast, the Amara's Law – named for its creator, Roy Amara - highlights the complexity of this social process: "We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run" [8]. Digital dentistry offers numerous benefits but also diverse potential limitations and challenges associated with its implementation. One limitation is the initial cost of adopting digital technologies, as well as the cost and time of additional training for dentists and dental staff for mastering new digital tools and techniques. In addition, the high initial cost and further maintenance fees for the equipment including the relevant software will enhance the process of corporation of dental medicine and thus challenge the autonomous character of the profession.

Second, the risk of technical malfunctions or system failures exists including the leakage of patients' data compromising the patient care [9].

There are social and market-borne limitations for the choice and application of new technology as not all dental procedures can be fully replaced by digital technologies, neither the existing social stratification, requiring adequate approach in assuring access to healthcare services for large social groups, could be ignored.

On one hand, the dental profession during the last decade got access to the latest technological tools and equipment, including AI, but on the other hand, the patients' expectations to integral, individualized, and accessible care are growing fast. The market aspects of dental services represent another challenge but also an important prerequisite for advancement of the art of healing without putting on risk the image of the profession in the society [10].

Impacts of technology on dentist/patient and dental profession/society interactions

AI is an evolving branch of science and technology. AI refers to a field of computer science in which a machine can perform tasks that typically require human intelligence, such as pattern recognition, learning from it as a supplementary tool to human decision-making for clinical questions (Zawiah, *et al.* 2023). The rise of advanced technologies with human-like cognitive and non-cognitive capabilities gives place to a new model of patient/dentist relationship and teamwork organization in the dental office. Ergonomics is the science of designing the workplace, organization of working process, development of equipment (machines, tools and assistive devices) so as they correspond to the peculiarities of working process. Its methodology comprises time measurement, anthropometrics, medical, physiological, psychological and social evaluations accumulating data and giving recommendations for improvement. Dental ergonomics applications influence both the working environment and the services excellence [11-13].

Expert systems, yet largely applied in orthodontics, three D printing of prosthetic devices elaboration, simulation for training and decision making in esthetic dentistry, using precision tools and LAZER machines could be defined as predecessors and sustainable fundament of the now a day technological revolution in digitalization of medicine and dentistry [14-16]. As far as the database of expert systems are now, due to the AI assistance and open access, accessible both for patients and professional staff, the decision-making process will be different. Professional responsible decision may be challenged by an alternative taken by a competent (in the meaning of informed consent) patient following the AI assistance and ignoring the recommendation of the doctor.

Therefore, dentistry has a number of prerequisites to increase its social importance and technical improvement but also faces some challenges and limitations to implement technology. Risks of loss of individualized and empathetic relationship between dentist and patients and possible loss of autonomy under the trend of conglomerate of dental care delivery organizations exist.

By acknowledging these limitations and addressing potential concerns a continuous evaluation of the impact of social, technological, moral and market factors have to be proceeded and critical thinking has to be supported, taught and trained for dental students and graduates long life, following an agile, adaptable strategy to integrate critical thinking in dental education. "Critical thinkers can approach complex problems with clarity, precision, and an open mind, allowing them to arrive at well-reasoned conclusions" (Berg 2023). Critical thinking allows healthcare professionals to navigate uncertainties, address potential risks, avoid errors, provide patient-centered, evidence-based care, and adapt to the rapidly changing social environment. Inadequate application of critical thinking may increase the risk of AI misuse, and overreliance on AI" [17-19].

Educational answer

Educate dentists today for an integral human-to-human care and respect to the liberal character of dentistry in a digitalizing anonymous medical environment represent both a challenge and prerequisite for schools and educators. Dental education today has a multitude of

favorable conditions to rationalize the teaching and to prepare the new graduates for the evolving market of dental services, to deal as liberal practitioners and/or part of corporative structures. Its ability to keep the human touch and technology together; the user-friendly usage of ready to use patterns with the uniqueness of the healing act is challenged [20].

To answer this contemporary challenge it is important to be able to redefine, the social and occupational identity of the dental profession. We have to ask ourselves and to be able to answer the following questions: What is the product we provide the patients? What are we now? How both users and provider's goals could be achieved simultaneously, and last, but not least: Are the values we share - autonomy, non-maleficence, beneficence, trust, and justice, still the same?

Complexity of the product dentists deliver now to the public increases, including the social and professional contracts the profession and individual professionals are involved. The process of profound transformation in dentists to society relationship is especially demonstrative with the change of the social status of dentists in the former socialist countries of Eastern and Central Europe a couple of decades ago. The profound reforms in their healthcare systems and the restauration of the autonomy of professional organization predisposed transformation in the dental curricula as well. During the same period, the traditional structure of dental education institutions all over the world is slowly but steadily changing and problem-based learning, inter-professional and interdisciplinary approaches implemented [21-23].

It is evident that complexity of the profession and the evolving scientific and market environment makes difficult to put all the new knowledge in the programs and thus predisposes continuity in lifelong learning, starting from the first day in dental school. One solution of this problem is the application of a more liberal educational plan for undergraduates giving them the full freedom to navigate in the net to prepare for the basic level of professional education, expecting they will complete their competencies through formal continuing education courses and LLL after graduation [24]. Because of the pressure of the rising volume of information, we have to put the students in a bigger pool of information relying on AI assistance in summarizing of information. Even most motivated and intelligent students rarely think about what is behind the ready to use information. The question arise: do we really help our students and de we really believe that the "free" access to information (including AI) could fully replace the traditional set of textbooks assisting the teaching-learning process? It is not evident that the process of obtaining some relevant information from a virtual reality can give to students the perception of human-to-human touch leading to integrity and professional conduct after graduation. In addition, the comparability of professional education in different countries needs consensus on the core competencies to be achieved by dental students [25,26].

Our experience with implementation and evaluation of the new dental curriculum harmonized with the "Competences of the European dentist" and the "Covid 19" online teaching period showed that the information was only one element of the process of learning and it rarely remain for longtime in the memory of the students. Knowledge, skills, and training obtained throughout different forms of teaching and self-directed learning after graduation may enhance but not teach professionalism.

Professionalism is a crucial skill that every dentist must possess in the dental profession. However, professionalism core features need definition and how dental educators can teach and evaluate professionalism to their under and postgraduate dental students. This bring the need to rethink the form, volume and access to instructional resources and critical thinking education. A core-structured material is necessary not only to guide students in the search of knowledge but also to educate them in focusing their efforts in advancing to graduation [27].

The dental profession and the dental education recognizes that clinical expertise, scientific knowledge, and interpersonal skills are vital components, a combination of soft and hard skills is crucial for successful practice and for achieving health care organization goals. The development of ethical and critical thinking skills is essential for students to balance competing interests in the profession while maintaining professionalism, such as dedication, accountability, competence, dependability, and respect for others. Health care

professionals, including dentists, must cultivate soft skills to effectively guide and treat patients. Dental professionals who excel in interpersonal skills can listen to and communicate with their patients with empathy, allowing them to understand their dental health and articulate their needs [28-34].

Implementing a set of relevant topics under the label “Essentials of professionalism in dentistry”, we tried to assist our students and graduate dentists to recognize, assess and solve problems through better communication and organization of work. In this relation, we produced a series, of three textbooks to refer to core facts and the newest findings relevant to the dental profession and the practice of dentistry. The text aimed to stay focused, balanced and concise, giving opportunity for upgrade and adoption, according to national particularities while keeping in view the adequate global and longstanding professional performance worldwide. The content and sequence of the chapters are primarily meant to keep and develop professional autonomy, encourage the development of professional knowledge and science, ensure a decent professional realization, inspire humanity and responsibility, and lifelong interest in perfection and safety at the working place. The major educational objective of the “Essentials” was to provide the graduating doctors of dental medicine with appropriate knowledge, skills, and attitude relevant to their socio-professional role as liberal practitioners, while collaborating with the public healthcare system, especially:

- Understanding of social and public health phenomena and processes, which take place at the individual, group, and community levels;
- Analysing health status determinants and health indicators;
- Making decisions based on critical evaluation of evidence;
- Solving technological, medical, legal, and ethical problems through better communication and organization of work [3,4,12,23,35,36].

Conclusion

Dentistry is a profession based on a social contract that includes social, moral, and political aspects in addition to the duty to provide care for vulnerable individuals and meet their needs through ethical practices. The healthcare industry, including dental care, is constantly evolving with new products, techniques, technologies, and services. Dental treatments are now more preventive and less invasive, with the use of smart technology, including AI. However, today, more than ever before, the active participation of patients from the beginning of the treatment planning process to its successful completion is a “condition sine qua non”. This partnership requires consent based on the patient’s understanding of the proposed treatment procedures and the dentist’s knowledge of the market and moral limitations. Shared decision- making is an important factor that influences the choice of dental treatment by private general practitioners and prevents risks of litigation. The evolving impact of AI as a tool in decision- making process, shaping both the professional expert opinion and the patients’ demand, rise the need of deeper reflection. The access to AI “decisions” is sometimes easier to patients than to doctors. Last, but not least, AI, as product of scientific nature is morally impartial while moral code is essential feature of the professional conduct. The integration of evidence-based and ethical decision-making into dental education acquiring critical thinking and decision- making skills is important. A comprehensive appraisal of the advantage and challenges AI could bring to dentist-patient communication, which addresses the conflict between what patients really need and the options “suggested” by AI could assist in avoiding overtreatment or neglect of a patient’s need and thus adequately answer the professional and market-born challenges.

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