How do technical and ethical knowledge about applied AI systems influence dentists' therapy decisions?

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1. Background: The detection of carious and apical lesions, prosthetic and endodontic restorations as well as anatomical morphologies and pathologies (e.g. course of the inferior alveolar nerve, bone resorption, etc.) from dental X-ray images using artificial intelligence systems has been commercially available in Germany since 2020. The programs used are often based on deep learning and neural networks, which must be fed with large amounts of training data in order to be able to process new data as reliably as possible. The use of such software can pose ethical hurdles for the dentists who use it and, as a result, for the patients as well.

2. Purpose: With the help of an online survey, we want to find out what knowledge about the applied AI technologies is available to dentists to make informed and ethical decisions, and which impairments still exist due to technical or study-related knowledge gaps. Particular focus will therefore also be placed on the explainability/ explicability of applied AI, as it has a major impact on all four bioethical principles according to Beauchamp and Childress.

3. Methods: An online survey created with SoSciSurvey will be designed to determine the level of knowledge and relationship to the three topic areas of ethics, technology, and treatment decision-making. Then, specific ethical questions will be applied in the survey, e.g., the so-called "black box character", the "peer disagreement", or even disclosure about the use of AI to the patient. The intention is to triangulate where exactly respondents see intersections between the three topics and to establish a relationship to the answers given to the specific ethical questions. This survey will be sent via eMail to chamber-member dentists nationwide (Federal Republic of Germany). 12 weeks are scheduled for the completion of the online survey, with email reminders sent at three-week intervals if the survey has not been completed by then. All information collected will be completely anonymized. The results of this online survey will be framed within the four bioethical principles according to Beauchamp and Childress in combination with the complementary principle of explicability to determine the current state of informed ethical decision making.

4. Hypotheses:

a) The majority of the dentists interviewed could probably have a low level of knowledge regarding AI/ DL systems. This would include ignorance of the "black box" character of used neural network modules and thus a critical part of informed decision making. Possibly, this will also be the reason for attributing rather subordinate tasks to the AI/ DL systems, because the lack of knowledge could lead to low trust. However, the same result could also occur for the opposite reasons: Even if practitioners knew exactly how the systems worked, this could give rise to attributing low trust to the systems.

b) Ethical or moral decisions in relation to AI/ DL systems may be assessed by the respondents largely intuitively in accordance with the four bioethical principles, but knowledge of these concretely formulated principles is not to be expected, since

medical ethics is not sufficiently taught in dental studies at most medical universities in Germany. The principle of explainability/ explicability will probably also tend to be a problem for only a few respondents with regard to AI/ DL systems, since most of them are most likely hardly aware of the problem of the "black box" character of neural networks.

c) In dentistry, treatment decisions are often tied to biophysical criteria, which are usually uniformly defined in university teaching. It is the interpretation of the available information about the patient that can lead to a wide range of final therapy decisions. This fact is taught early in dental school, as members of different clinics with different focuses would sometimes even take contrary therapeutic paths. This could perhaps lead dental students to think critically about therapy decisions more often. With this information in mind, it is possible that
    i) AI/ DL systems may have a strong influence on treatment decisions and that practitioners believe they know about this influence and can consciously control it, or that
    ii) the AI/ DL systems are more likely to make the practitioner react critically to markers or recommendations once more and perhaps make an even more critically thought-out therapy recommendation.

5. Discussion: German dentists are probably aware of and accept the development and application of medical AI systems. However, as the complexity of the tasks increases, acceptance might decrease due to a lack of information about how the systems work and because there will always be a residual uncertainty associated with their use. More comprehensive information for dentists about the functioning and possible sources of error of the AI systems would ensure a more objective and ethical handling of the software output.