# Implementing Ethics in e-Health Applications through Adaptation: reflection and challenges

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***Abstract*—The present contribution opens a reflection on what can adaptation mechanisms, inherent to multi-agent systems, bring for the implementation of ethical principles during the design and the implementation of e-health applications. Several works propose ethics approaches. But, since ethics values differ from one culture to another, it is not possible to have a general approach which can be used every time. The intuition is that adaptation capabilities is a good start. This aim of this paper is to raise ethics challenges in eHealth and discuss across interdisciplinary debate questions such as: which ethics to adopt for eHealth applications? How to implement ethics in eHealth applications? How can adaptation features help implementing the identified ethics challenges and questions?**

***Keywords-ethics; e-Healtn; adaptation.***

## I. INTRODUCTION

The development of e-health, particularly thanks to machine learning methods and the use of Big Data places this type of application in the field of complex systems. In addition to the distributed aspect of the data and their heterogeneity, care units also require to be modeled as a complex system. The ethical issues inherent to the use of patients' personal data on the one hand, and the need to treat patients in an individualized and transparent way in the other hand, suggest that adaptation of paramount importance. Indeed, ethics requirements differ greatly between jurisdictions, institutions and cultures, while technological infrastructure is increasingly global and connected.

Multi-agent system paradigm provides instruments to represent and manage distributed and/or heterogeneous entities characterized by autonomy, interaction, cooperation and proaction. So, adaptation characterizes such systems which are suitable for modelling complex systems. We think that Multi-agent systems provide a good omen as a tool for the design and implementation of ethic in eHealth applications.

The aim of this paper is to raise ethics challenges in eHealth and discuss across interdisciplinary debate questions such as:

- Which ethics to adopt for eHealth applications?
- How to implement ethics in eHealth applications?
- How can adaptation features help implementing the identified ethics challenges and questions?

The next section illustrates why adaptation is needed in healthcare applications. Section III gives definition of ethics. Section IV gives a summary of existing computational approaches about ethics. The paper concludes by open issues.

## II. E-HEALTH

E-health applications have been developed in many aspects of health. This concerns areas such as telemedicine, prevention, home care, remote chronic disease monitoring (diabetes, hypertension, heart failure, etc.) or electronic medical records. It is seen as a solution to major challenges such as the aging of the population and the management of dependence, universal access to quality care and the significant increase in expenditure and the explosion of chronic diseases. Therefore, many challenges await researchers and application developers in this area. The diversity of situations and the need to propose solutions adapted to individuals, populations and hospital practitioners opens the question of the adaptability and ethics that must be implemented [12].

## III. DEFINITION OF ETHICS

Ethics requirements differ greatly between jurisdictions and institutions, while technological infrastructure is increasingly global and connected. Moreover, ethics is not simply about compliance, but requires active reflection during the design process, especially for e-health applications.

We adopt the definition of Cointe and his colleagues [5] because it explicitly states the ethics in a formal and easy way to implement when most authors remain vague.

According to Cointe and his colleagues, ethics is a normative practical philosophical discipline of how one should act towards others. It encompasses three dimensions:

1. Consequentialist ethics: an agent is ethical if and only if it weighs the consequences of each choice and chooses the option which has the most moral outcomes. It is also known as utilitarian ethics as the resulting decisions often aim to produce the best aggregate consequences.
2. Deontological ethics: an agent is ethical if and only if it respects obligations, duties and rights related to given situations. Agents with deontological ethics (also known as duty ethics or obligation ethics) act in accordance to established social norms.
3. Virtue ethics: an agent is ethical if and only if it acts

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and thinks according to some moral values (e.g., bravery, justice, etc.). Agents with virtue ethics should exhibit an inner drive to be perceived favorably by others.

## IV. IMPLEMENTING ETHICS AND ADAPTATION

Almost all papers referring to the implementation of ethics in Artificial Intelligence (AI) focus on societal and legal aspect of the challenges. Very few works are done for implementing ethics values in AI. In [14], the authors have performed a survey from AAAI (Association for the Advancementof Artificial Intelligence) conférence on AI, AAMAS (International Conference on Autonomous Agents and Multiagent Systems), ECAI (European Conference on Artificial Intelligence) and IJCAI (International Joint Conference on Artificial Intelligence), as well as articles from well-known journals. They propose a taxonomy which divides the field into four areas:

1. Exploring Ethical Dilemmas: technical systems enabling the AI research community to understand human preferences on various ethical dilemmas [1][4] [9];
2. Individual Ethical Decision Frameworks: generalizable decision-making mechanisms enabling individual agents to judge the ethics of its own actions and the actions of other agents under given contexts [3][6][7];
3. Collective Ethical Decision Frameworks: generalizable decision-making mechanisms enabling multiple agents to reach a collective decision that is ethical [8][10][11];
4. Ethics in Human-AI Interactions: frameworks that incorporate ethical considerations into agents which are designed to influence human behaviors [2][13].

This study offers an interesting overview of recent works on ethics. However, the adaptation dimension is not addressed when it is essential, especially for individualizing eHealth approaches.

## V. CONCLUSION AND PERSPECTIVES

This article has outlined the elements that will help to draw some challenges and questions that could be raised about ethics, adaptation in healthcare domain. The state of the art in the domain of ethics in AI reveals that adaptation has not been addressed. Future works will concern the questions and scientific issues, such as adaptation mechanisms, raised at all the stages of the modeling, development, testing and deployment of e-health applications, in particular in multi-agent system domain.

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