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Bracing for impact: on-going digitalization of healthcare requires urgent characterization of impact on environment and beyond

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Medical research and practice are undergoing a surge in the use of digital technology. There is a political will for accelerating digitalization in France with a regularly updated roadmap for *Information and Communication Technologies* (ICT) in healthcare [6], accompanied by the publication of an ICT in healthcare doctrine [1].

However, with these increased usages also come increasing impacts (environmental but not only). The global carbon footprint of the ICT sector is continuously rising [20, 11, 14, 3]. A governmental report [5] has estimated that more than 5% of the total carbon footprint of an average French University Hospital is due to ICT. Furthermore, this report also estimates the total carbon footprint of the IT systems of all French hospitals at 190,000 tCO₂e in 2018.

Healthcare roadmaps and reports (implicitly) justify the increased ICT environmental impacts by the expected benefits of digitalization: "This report chose to believe in a positive promise for ICT in healthcare"¹ [16]; "Thus, limiting the environmental impact of ICT in healthcare by limiting its uses is not a conceivable solution because it would lead to reduce its benefits"² [5]; "Convinced by the soundness of AI implementation in healthcare and of the necessary promotion of innovation in the benefit of healthcare"³ [8]; "The professional services package will allow them to gain time and easily access a maximum of existing services"⁴ [6]; "The rapid development of ICT usage in healthcare is an important factor for the improvement of healthcare quality"⁵ [1].

The digitalization at full speed of the healthcare sector prevents any rigorous study of impacts from being conducted to properly evaluate the potential of such a drastic change in how the healthcare system works. This situation may recall the controversy on regulating chlorinated chemicals studied in [12]. Indeed, North American legislation operated in a "risk paradigm", prohibiting only the individual chlorinated chemicals proven to be harmful. On the opposite side, civil society asked for a "precaution-based paradigm", taking action against the whole class of chlorinated chemicals because of the properties they share with the known dangerous chlorinated chemicals. Similarly, French digital health regulation instances are operating in a "risk paradigm"⁶ where the role of impacts research is *ad-hoc* identification of digital applications that are harmful: "Legal regulation is the basis of our society but, facing the rapid evolution of possibilities, auto-

¹*Ce rapport a choisi de croire à une promesse positive dans le numérique en santé.* in the text p107

²*Ainsi, limiter l'impact environnemental du numérique en santé en limitant les usages n'est pas une option envisageable car cela conduirait à réduire les bénéfices* in the text p26

³*Convaincus du bien-fondé de la mise en œuvre de l'IA dans le domaine de la santé et de la nécessaire promotion de l'innovation au bénéfice de la médecine*" in the text p7

⁴*Le Bouquet de services aux professionnels leur permettra de gagner du temps et d'accéder simplement à un maximum de services existants*" in the text p22

⁵*Le développement rapide de l'usage du numérique en santé constitue un facteur important d'amélioration de la qualité des soins*" in the text p20

⁶It is to be noted that there exist some regulation initiatives to ensure health benefits, like the EU 2017/745 (19) regulation that qualifies some digital solutions as Medical device and therefore requires a clinical trial before deployment

discipline [...] is a prerequisite for system operation”⁷ [7]. On the contrary, we call for a ”precaution-based paradigm” with an *a priori* identification of safe and essential digital solutions.

Some initiatives exist on the ethics and impacts prevention/mitigation of digital solutions for healthcare [5] and particularly on the ethics of AI solutions for healthcare [8, 4]. A chart of ethics principles for digital health was created at the European level [10]. However, we can draw criticisms on these initiatives. The ethics principles adopted are broad and do not have any enforcement possibilities. Furthermore, they focus on adding ethics over the digitalization of healthcare and thus focus on *how* to build better technology rather than on *what* technology to build, or even if it should be built. Digitalization is seen as inevitable: ”Convinced by the necessary speedup in the deployment of ICT in healthcare”⁸ [1]. These criticisms are similar to the one devised by Green on Technology Ethics [13].

Therefore, we believe there is a need to pause and reflect, before undergoing even more digitalization, on evaluating the consequences and environmental costs. This process would allow the presentation of rigorous arguments to political deciders for effectively performing the risks/benefits balance so crucial to the medical decision process in general.

In this work, we propose a framework to characterise three different levels of environmental, social and societal impacts of ICT in health inspired by [17] and [19]. On the first level are the life cycle impacts of ICT equipment in healthcare (Hardware manufacturing, software and data storage...). These impacts can be modelled and understood using a life cycle assessment method. On the second level are the impacts on the healthcare system (changes in organisation, changes in clinician/patient relationships, loss of skills...)[2]. Finally, on the third level are the final impacts on public health (Is the population on average healthier? How are the gains (and losses) in health distributed...)⁹. It is this level that really motivates political decisions.

We take first steps towards better understanding the impacts at the first two levels. We focus on the digitalization enabling *Natural Language Processing* (NLP) research and use in healthcare. In France, one particular example of undergoing digitalization is the development of *Clinical Data Warehouses* (CDW) ([18, 15]) that make health information readily available for digital processing. Textual data are thus increasingly in demand for processing to exploit information that exists only in this form [9].

We approach the first level of impacts by developing a new tool aimed at AI researchers to estimate the potential impacts over the whole life-cycle of the hardware they mobilise, attributable to the experiments they are willing to make. This tool estimates multiple impact criteria, mainly *Global Warming Potential* (GWP) and *Abiotic Resource Depletion* (ADP) and presents them in perspective with different sustainability targets.

We explore the second level of impact through a series of semi-structured interviews to better understand the current state of NLP research and its use in healthcare, its expected evolution through CDW projects, the questions it poses and the current state of regulation. The main conclusions from these interviews are as follows: 1) ICT are ubiquitous within French healthcare (healthcare organisation, clinical practice, and public health research). 2) The new availability of clinical data warehouses places the system at a turning point towards new deployment/uses of ICT in healthcare. 3) We are still at the beginning of the reflection on the sustainability of ICT in health.

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⁷”la régulation par la loi est la base de notre société, mais devant l’évolution rapide des possibilités, l’autodiscipline [...] est un prérequis au fonctionnement du système” in the text second *edito*

⁸”Convaincus de la nécessaire accélération du déploiement du numérique en santé” in the text p29

⁹See for instance Valérie d’Acremont’s conference accessible at https://www.youtube.com/watch?v=oKcy_cY0Q0w

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