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Health in Algorithmic Terms: A Walkthrough Exploration of Medical App*

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Abstract

This wide range of health-related theories often makes use of algorithms as tools to support diagnoses and the identification of optimal care and well-being pathways. Medical platforms, the algorithms that characterize them, and the digital devices needed to overlap/integrate the digital environment with everyday spaces allow for collecting, sharing, and storing health and well-being data (Lupton, 2015).

In the case of TonicApp[1], a medical device that, in its presentation, recognizes and guarantees the technical and scientific safety of its diagnostic algorithms; data are generated and stored directly by healthcare professionals, who are accompanied by other types of professionals, such as engineers responsible for algorithmic transposition.

How is the algorithmic intervention configured to create and administer medical diagnoses? What is the level of trust of medical personnel in these platforms, and how does the use of these platforms change the practice of medicine and the doctor-patient relationship?

These research questions guide the work in adopting a mixed-digital research design with a sequential-exploratory approach. These questions invite an initial exploration of the context, structure, and environments of TonicApp in Italy. The Walkthrough approach (Light, Burgess, and Duguay, 2018; Decuypere, 2019) allows for direct interaction with the TonicApp interface to identify, select, and dissect the technological mechanisms it comprises and define any cultural references that icons and interfaces may incorporate.

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Following this initial exploratory phase, an in-depth immersion phase will be prepared through a series of semi-structured interviews with the doctor-users of TonicApp to shed light on the platform's usage patterns and how this tool has contributed to changes in the practice of medicine and the relationship with patients.

Keywords: digital health, walkthrough, algorithm role.

1. Introduction: digital health and the changing doctor-patient relationship

In recent years, numerous reforms and reorganizations have affected the Italian healthcare system concerning healthcare professionals and citizens (Giarelli & Giovannetti, 2019). As a result, according to Maturo and Moretti (2021), it becomes essential to adopt solutions capable of moving beyond a hospital-centric approach and better aligning with the figure of the citizen-patient. The adoption of these solutions relies on the support that the medical-pharmaceutical sector requires for scientific innovation processes and research and development investments.

The digitalization of healthcare is considered a crucial support for evolving healthcare processes to improve the cost-quality ratio of healthcare services, reduce waste and inefficiencies, bridge regional disparities, and place the patient at the center of care pathways (Collicelli, 2016). This process inevitably involves education on digital health and the use of technological devices that contribute to the transition from traditional diagnostic and treatment methods.

The so-called digital transformation, where no aspect of daily life transcends direct connections with new socio-technical artifacts, networked sense-making, and digital transpositions of reality, has included the healthcare field. For over a decade, digital health has encompassed all health and medical technologies supporting the regulation and improvement of bodily functions by disseminating specific devices. This enables a significant transformation of practices, such as doctors assisting their patients remotely, as well as self-monitoring processes for patients.

In this context, as seen during the recent pandemic, digital technologies are considered by academics and professionals not just as mere communication or dissemination tools but rather as innovative supports that, by aggregating data from various sources, enable the control of disease outbreaks or epidemics (Lupton, 2014).

On the other hand, patients establish themselves as components of digital environments, constructing narratives, transferring meaning and experiences

through online codes: sharing audiovisual elements through blogs and social media to comment on the effectiveness of a treatment, recount their relationships with doctors, family members, and colleagues, or seek advice on therapies and healthcare facilities (Lombi & Moretti, 2020). As a result, there is an increasing amount of data related to physical activities such as the number of steps, sleep quality, food consumption, and monitoring of arrhythmias and pregnancies (Grew & Svendsen, 2017). This suggests that digital prerequisites for the healthcare system's future will enable user-patients to gain greater awareness of any ongoing symptoms or anomalies and to contact doctors through specific devices for timely diagnoses quickly.

Digital health also includes using text messages posted on social media and apps to disseminate information on prevention and treatments (Lupton, 2014), aiming to raise awareness among specific population targets regarding the behaviors to adopt to safeguard their health.

Health and medical platforms are particularly interesting to social researchers interested in digital health technologies (Lupton, 2017). The process of platformization (Helmond, 2015; van Dijck et al., 2018) contributes not only to new forms of care and prevention for user-patients but also serves as a useful process for user-doctors and healthcare professionals for study, research, information exchange, and personnel recruitment. The functioning of these platforms is based on the use of algorithms capable of handling large amounts of data from which new information or solutions can be derived.

2. Algorithms as new mediators of everyday life

The widespread availability of data, rapid technological advancements, and algorithm implementation are causing significant changes in our society. While the potential benefits of automated decision-making processes are numerous, there is also uncertainty within the scientific community regarding their potential risks. Currently, the dominant concern is the uncertainty surrounding algorithms' short- and long-term implications in our daily lives. It is important to note that algorithms differ not only because they are based on different logic and programming languages but also because they are designed for different purposes (Aragona, 2020). One significant difference lies in the distinction between deterministic algorithms, which consistently execute the same commands, and experiential algorithms, which learn and adapt based on the data and instructions. The concept of an algorithm has evolved over time and

in different application contexts (Beer, 2017)[2]. Here, the concept of an algorithm is used in its modern sense, referring to an automated decision-making process that, starting from specific instructions and input, generates results or solves a particular problem (Aragona and Felaco, 2019). An automated decision-making process necessarily requires input data (in our case, it could be a patient's age, weight, gender, along with a description of perceived symptoms) to autonomously produce outputs (such as a diagnosis or the most appropriate therapy based on the described symptoms). All automated decision-making processes are designed by individuals, which implies a certain degree of human involvement in their correct functioning and, inevitably, a particular responsibility mainly related to the quality of the input data provided to the process to produce outputs that will later be given to recipients. Algorithms are human creations and, as such, they are fallible, incorporating errors and biases, and therefore, they are not neutral. For this reason, algorithms cannot be conceived exclusively as technical tools that work independently and in isolation (Aragona and Felaco, 2018), but rather as a more complex set of steps that involve social and material practices (Dourish, 2016; De Rosa and Aragona, 2017); these are "artifacts" that convey information about the culture of their creators (Aragona and Felaco, 2020). The ambiguity associated with the opaque view of algorithm structures prevents users (those who provide input with their data) from verifying how the provided input is processed and the path that leads to the output. This results in an inevitable sense of disorientation and uncertainty about the protection of their data, the reliability of consulted sources, and ethical aspects related to the treatment of sensitive issues and data during the input-output process. Algorithmic operations within the broad system of relationships in which several elements act simultaneously, and whose side effects can occur due to the absence of human supervision, human errors in code writing, the use of biased or incomplete training data, are the ingredients that make up the so-called "algorithmic governance" (Musiani, 2013), a form of agency that is not always transparent and not always controllable in the input-output process. When private services and government agencies adopt tools that rely on algorithmic logic without adequate transparency, responsibility, and supervision, their use is often seen as a potential risk in exacerbating existing inequalities and biases. As emphasized by Moats and Seaver (2019), in recent years, sociologists, anthropologists, and social theorists have led the discussion about the uncritical use of algorithms and other automated processes in data

[2] For further insights, refer to David Beer (2017) "The social power of algorithms," Information, Communication & Society, 20:1, 1-13; Aragona, B., & Felaco, C. (2018) "La costruzione socio-tecnica degli algoritmi. Una ricerca nelle infrastrutture di dati," The Lab's Quarterly, 20(4), 97-116.

science. These scholars have clarified how systems based on algorithmic logic shape the world in a distorted or unexpected way (Noble, 2018), while their operation remains mostly a "black box" inaccessible to public scrutiny (Burrell, 2016; Pasquale, 2015). Collectively, these criticisms are known as Critical Algorithm Studies, which are part of the broader field of science and technology studies (STS), now a reference literature in algorithmic analysis. Algorithms are increasingly emerging as key mediators of our daily lives, yet we still need to understand their operations and unintended effects. Therefore, there is a need to make progress in studying the ambivalences generated by the uncritical use of these automated processes, raising concrete methodological questions and proposals to deeply understand the functioning of algorithms, which have become pervasive agents of change in contemporary society. The study of algorithms poses new methodological challenges for analyzing socio-technical assemblages in which they are used. To overcome these challenges, new methodological approaches are needed to study digital technologies as socio-cultural artifacts (Aragona and Felaco, 2020; Light et al., 2018).

Social researchers were well-prepared in addressing the challenges posed by the innovations brought about by the Internet. Those engaged in the realm of digital sociology, as highlighted by scholars like Lupton (2015) and Marres (2017), have undertaken robust investigations centered on questions related to change, the emergence of novel research subjects, adjustments in methodological approaches, and the potential risks associated with employing innovative methods such as virtual and digital approaches (Kozinets, 2022).

Moving beyond the notion of exclusivity in User-Generated Content (UGC), a substantial portion of today's information results from algorithmic interventions. These interventions create genuine cultural artifacts that serve as products and generators of social meanings (Schellewald, 2022). Consequently, we can explore new social phenomena as products intertwined with "a systemic process co-created by technical affordances (algorithms and metrics) and cultural affordances (social norms, communication styles) that coexist and substantiate each other" (Gandini and Risi, 2023, p. 12). This perspective equips social researchers to confront the challenges inherent in comprehending the purposes and methodologies of research trajectories in the era commonly referred to as datafication.

As proposed by Flensburg and Lomborg (2021), this era represents a convergence of technology and social practices, characterized by continuous and evolving tensions. When contemplating the interplay between technologies, emerging social practices, and digital platforms, examining the potential repercussions on social relationships, business models, and healthcare becomes crucial.

3. Algorithmic Intervention in Medical Practice. The Research Design of the TonicApp Case Study: From Walkthrough to In-Depth Interviews

Web platforms, specifically those related to healthcare, constitute one of the primary interests of social researchers focusing on the structures and usage practices of digital technologies in the healthcare domain (Lupton, 2017). As clarified by Ienca and Vayena (2020), healthcare professionals and hospital staff primarily resort to digital technologies to save resources, enhance the utilization of medical resources, and facilitate a more efficient and cost-effective work environment, including the management of hospital processes (Bardhan et al., 2020; Biancone et al., 2023).

Recently, there has been a growing proliferation of platforms that gather and analyze information about patients' health status and therapeutic journeys, offering these patients the opportunity to engage with others on therapies, symptoms, and various health issues (Lombi & Moretti, 2020).

Considering the evolving usage practices of platforms in the practice of medicine, the initial research inquiries that have piqued the curiosity of social scientists interested in this topic are aimed at comprehending how the work activities of healthcare professionals, particularly in terms of performance, have changed (Lyng et al., 2021; Bardhan et al., 2020).

Based on these premises, this work seeks to understand the role of algorithms in medical practice and raises questions about:

- how the use of these platforms contributes to the creation and administration of medical diagnoses;
- the level of trust healthcare professionals place in these platforms;
- how the utilization of these platforms impacts the doctor-patient relationship;
- the aspects in which medical practice has changed following the adoption of these platforms.

To achieve this goal, the study delves into the TonicApp platform.Developed and launched in Portugal in 2016, it is one of the most widely used digital medical platforms in Europe. The concept for the platform, born from the collaboration of scientists, engineers, designers, and marketers, relies on the capabilities of artificial intelligence and is aimed at general and specialist medical professionals. The platform's mission is succinctly and specifically presented as the development and provision of a tool for healthcare professionals to prevent diseases, diagnose, and treat patients as quickly as possible. TonicApp claims to be a certified medical device, and in the

description of its web interface, it immediately assures that the application guarantees that all calculators and clinical scales are secure and operational according to specific original algorithmic formulas that have been specified and developed by external medical consultants with specialized training in the field and relevant specializations. This structural foundation is regularly supervised by an internal medical team in compliance with ISO 13485:2016 regulations, ensuring the technological and scientific quality of its algorithms.

Considering these premises, the research questions guide this work towards adopting a mixed-digital research design, characterized by an exploratory approach aimed at integrating emerging results from two distinct and sequential research phases.

Therefore, it is essential to gain clarity on the purely structural aspects and the usage opportunities that TonicApp offers doctors who utilize this tool. In this regard, the concept of practice should not be seen as a collection of individual actions but rather, according to Shove, Pantzar, and Watson (2012), as a series of interconnected elements and suggestions among users. These elements materialize into "forms of physical and intellectual action, objects and their use, understanding processes based on a background of prior knowledge, competence, emotional states, and motivations," considering generalist and specialist doctors' knowledge and typical professional characteristics (Reckwitz, 2002). In this sense, the initial part of the inquiry is realized through the adoption of the walkthrough method. This approach paves the way for future investigations into user responses. It demonstrates the broader applicability of this theoretical approach to identify human and technological influences on building authenticity with digital media (Cavagnuolo et al., 2022).

As relatively closed technical systems, platforms and their associated apps present new methodological challenges for social research concerned with digital environments and ecosystems (Light et al., 2018). Computational data collection methods and the accompanying procedures that follow Application Programming Interface (API) query paths neglect all those symbolic elements of an app that can influence the social interpretations of its users (Rieder and Röhle, 2012).

Analyzing an app requires attention to the socio-cultural representations it conveys as much as its technological features or the data results that can be extracted. This is because apps reflect cultural values and communicate meanings that shape our daily practices. The walkthrough technique introduces an approach to app studies that draws on concepts from Science and Technology Studies (STS) and cultural studies to examine these representations (Light et al., 2018). The aim is to find "a way to interact directly with interfaces to examine embedded technological mechanisms and cultural references and to understand how the app guides users in shaping their experiences" (Light et al.,

2018, p. 882). In the specific case of this case study, this technique allows the identification of the app's context, highlighting the vision, operational model, and algorithmic governance that characterize TonicApp. Through interaction with the app, a detailed process was systematically implemented to observe and document step by step:

- technical aspects, such as positioning or the number of icons;
- symbolic elements, such as images and text;
- functionalities and activity flows;
- the operational model and governance of the app.

Following the results of the app exploration through the walkthrough, a second phase of the investigation is realized based on the initial findings related to the characterization of the environment and usage opportunities and purposes of TonicApp.

This second phase, carried out using the in-depth interview technique, aims to understand the actual usage practices of TonicApp by Italian doctors, shedding light on the potential benefits and challenges that the adoption of this tool entails, as well as any innovations that this platform brings to the daily professional practice of its users.

To achieve the final objective and enable a proper inquiry of the results from these two distinct phases of work, the traditional ethnographic perspective of this research phase is structured around the following dimensions of significance, based on which the lines of questioning were constructed:

The interview plan involves the careful selection of five doctors who use the app, reached through direct access to the app's user list.

Specifically, the selection criteria for interviewees have followed a balanced involvement of doctors:

- operating in both the public and private Italian sectors;
- with career seniority of less than 10 years, between 11 and 20 years, and over 21 years;
- practicing in both general medicine and medical specialization.

4. Exploration of TonicApp

Light et al. (2018) propose two moments that should characterize the analysis of an app using the walkthrough technique: the analysis of the usage environment and the analysis of technological mechanisms conveying meaning. As the authors argue, the first moment draws recognition from the work of van Dijck (2021), who suggests that, in addition to analyzing users, content, and devices, researchers should also consider the socio-economic and cultural

aspects of platforms. The first moment is, therefore, the reconstruction of the mission, operational model, and governance of an app, which enables researchers to understand how developers, publishers, and owners expect users to receive and integrate it into their daily usage practices. The second moment pertains to the technical procedure. This is the central data collection procedure of the method. It involves the researcher interacting with the app's interface, navigating through screens, tapping buttons, and exploring menus. Exploring the app requires the researcher to assume the role of a user but with an analytical eye on the app's acquisition process, registration, access to daily features and functionalities, and discontinuation of use.

The first moment includes:

1- Identification of the Mission, i.e., the purpose, target user base, and scenarios of app usage. The app communicates these elements through the organization of its digital spaces (e.g., logos, color combinations, images) but also through descriptions in the app store, websites, company blogs, press releases, and statements from the organization's representatives providing the app. These elements constitute the "discursive and symbolic representation of an app" (Light et al., 2018) transmitted to its technical interface. An app's vision tells users what it should do and, by extension, implies how it can be used and by whom. While users often may not realize this, this kind of analysis provides a baseline for identification.

2- Reconstruction of the Operational Model. This refers to the application's business strategy and revenue sources, which, according to Light, Burgess, and Duguay (2018), also imply the underlying political and economic interests of the owning company. To understand the operational model, one must look at revenue generation; this can involve payment for the app or in-app purchases that grant higher levels of access (e.g., unlimited swipes on Tinder). As well-documented by van Dijck (2021), many apps allow access to services in exchange for personal data that can be sold to external companies; in this case, revenue might not depend on a monetary exchange but on the amount of data provided by users or the interactions a user generates (e.g., the opportunities Instagram offers to users with over ten thousand followers). Data exchange becomes visible during registration for those app companies that collect basic information (e.g., email, name, date of birth) and intensifies when users encounter features that require more data (e.g., location, connections to social media platforms).

3- Analysis of Governance. This involves how the app provider seeks to manage and regulate user activity to support its operational model and

> realize its vision. Governance is reflected in the rules and guidelines of the app, which delineate the types of activities users can perform on the app and even the types of users allowed on an app. Governance can be expressed in the app's features, such as through recognition mechanisms that prevent posting certain content, or it can extend to enlisting users themselves in applying governance through mutual surveillance facilitated by reporting systems (as occurs on Facebook). Governance is formally implemented through the Terms of Service (TOS) documents and informally in the Frequently Asked Questions (FAQ) section, which generally articulates community rules and tolerated user practices.

Starting with the Mission, the platform's slogan "Medicine for Doctors" immediately conveys the service's objective, which is to provide technological support to medical professionals for diagnosing and treating their patients. The app promises to assist doctors in dosage, titration, interactions, and conversion of medications, as well as in formulating diagnoses, how to treat them, and whether to recommend specialist consultations. The formulation of diagnoses is based on decision-making algorithms related to various medical conditions, which, based on the patient data input by the doctor, provide a diagnosis, treatment, and potential referral to a specialist. Every Wednesday, the app is updated with the publication of an algorithm for a new medical condition. Additionally, through the platform, the user doctor can conduct medical visits wherever it's most convenient for them without requiring their patients to download the app.

Exploring the services offered by the app, we can say that it positions itself as a true "social community" for professionals in the field. Services such as searching for national and international medical conferences are available, filtered based on participation fees, location, and specialty, with the option to share and recommend events to colleagues. The platform also provides professional opportunities: every Monday, the main job offers are posted and updated, both in Italy and abroad, filtered based on each user's profile (location, specialization, etc.). Regarding the job market, the app provides services for job seekers and those seeking medical personnel, utilizing "social recruiting," which means using social platforms to identify, connect with, and hire candidates.

In addition to services dedicated to doctors, the app offers a feature reserved for hospital companies, allowing them to increase hiring, reduce costs, and interact directly with candidates who match their selection criteria. The app also serves as an aggregator of news, not only from the medical field - but there is also a "health news of the week" section where a summary of the most relevant healthcare news is published every Friday, as well as daily updates from the Higher Institute of Health and scientific societies. It also provides weekly

updates on the various services offered by the platform. The regular updates suggest a specific interaction strategy developed by the app's owner company to encourage users to make the platform their primary source of information and interact with it as often as possible.

Regarding the Operating Model, it is important to specify that the app is entirely free for doctors who wish to use it. However, the platform reserves the right to charge the user for sending and receiving communications. If the user decides not to pay, TonicApp reserves the right to cancel their access immediately. In addition to these charges, the platform can be supported by advertising revenue and may contain ads and/or promotions. Finally, a source of income undoubtedly lies in the provision of data. Although the platform does not claim ownership of any uploaded content, as stated in the Privacy Policy, the app collects data concerning the user and their use of the platform. The collected data falls into three different categories:

1- Information provided by the user.
2- Information collected automatically when the user uses the platform.
3- Aggregated personal data and information collected by the partners of the owning company of the app.

These data are collected by TonicApp and its service providers and by partners or affiliates. As stated, the user grants the platform an irrevocable, worldwide license to access, collect, store, disclose, and use any data, information, records, and files uploaded, transmitted, or entered on the platform. Finally, the information, statements, data, and content (such as photographs) the user may upload on or in the groups they choose to join may reveal gender, ethnic origin, nationality, age, and other personal information about them. Therefore, the user acknowledges that presenting this information, statements, data, and content is voluntary.

In terms of Governance, the app periodically updates its Terms of Service (TOS) and - except as prohibited by applicable law - reserves the right to change any information, material, or content included or provided through the platform at any time and without notice. It is assumed that if the user continues to use the app after any changes to the TOS, these changes are automatically and tacitly accepted. The user is responsible for regularly checking the TOS for any changes. As a condition of using the platform, the user must ensure that:

- They are an adult of legal age.
- They are licensed doctors or healthcare professionals with valid registration numbers.
- They will not infringe on any rights of Tonic App, such as intellectual property rights, copyrights, or trademark rights.

The user must ensure that the registration data provided is true, accurate, and complete, and that they will maintain and update the data to keep it as such. The user also has obligations towards other users they communicate with, commonly accepted in the TonicApp community that shares the same vision. These obligations include:

- Anonymizing all user-generated content on the platform, removing information that can identify a person.
- Respecting all intellectual property rights belonging to third parties (such as images and videos).
- Avoiding disclosing information that may be considered offensive, defamatory, violent, harmful, racist, sexist, xenophobic, or that may otherwise violate the purpose and spirit of the application and its user community. The user cannot provide information to the app or other users that may be offensive or harmful to their personal, professional, or social status.
- It is refraining from using customer contact selection to send spam. The app reserves the right to deny access to the platform temporarily or permanently for violating any aspect of its guidelines.

Regarding the platform's obligations, it can provide links to third-party websites without endorsing the information on them and without guaranteeing the information's quality, accuracy, reliability, completeness, or currency. The content of any site linked to the platform is not under the platform's control, transferring the responsibility to the end user in choosing whether or not to access such sites. Moreover, the platform always considers the user responsible for establishing a personal, professional, or business relationship with products, services, and advertisements advertised on the platform. It therefore disclaims any liability for damages the user may incur due to this relationship. Finally, concerning confidentiality, the app does not guarantee the confidentiality of communications made by the user through the platform. Although it claims to adhere to industry best practices regarding data transmission security to, from, and through the platform, app users acknowledge and accept that the security of transmitted data cannot be guaranteed.

In the second stage of the walkthrough, the researcher adopts an STS approach to gather data through screenshots supporting empirical documentation (Troeger and Bock, 2022), screen recordings of the phone, and/or audio recordings. During this stage, information is acquired on how the app attempts to configure relationships between actors and may include:

- User interface layout, i.e., how the app guides users through activities by positioning buttons and menus.

- Functions and features, the arrangements that enforce or enable an activity (e.g., pop-up windows).
- Textual content and tone of text embedded in user interfaces.

The second stage of the walkthrough begins with the first necessary action: creating a user account. To access TonicApp, it is required to enter, in addition to personal information, personal email, and contact number, the registration number related to the relevant medical board. The successful exploration of the app was made possible through the collaboration with a regular user registered with the medical board. In three exploratory sessions, this user signed up and accessed the app through their personal devices, sharing the key aspects of the walkthrough procedure with the researchers.

Upon receiving an SMS containing the security code and, simultaneously, verifying the email address and selecting the country where they practice medicine, the initial interface includes an icon for potentially uploading a profile picture and a mandatory field to enter their medical specialization.

As specified, the walkthrough phase is based on the researcher's interaction with the app's interface to analyze the following aspects: user interface composition; functionalities and features; tone and textual content; symbolic representation (Light et al., 2018).

The user interface consists of a main page with three windows: Updates, Messages, and Community, which are visible by scrolling the menu to the right. In the top left corner, the user's name appears in uppercase bold, along with the profile editing option, followed by the "Invite colleagues" section, editing tools (adding or changing the pin), and "Help," where brief app descriptions appear briefly in large characters with warm-colored backgrounds that succeed each other as you scroll to the right.

Regarding the functionality and features, the main screen is divided into three sections: 1) medical tools; 2) prevention, diagnosis, and therapy; and 3) kiosk.

In the first section, a large yellow quadrant appears, indicating the possibility to play a medical word guessing game of the day. Immediately following, you can see 8 red and purple quadrants. The first quadrant relates to video consultations, allowing the doctor to call their patient, schedule an appointment, all without the need for the patient to download any application. The second quadrant is for calculators and scales (for adults and pediatrics) that can be quickly accessed, with the option to create a list of favorites for different diagnoses and to find reliable scientific references. Then there's the "TNM and Lugano Staging" quadrant related to the staging of malignant tumors according to the TNM and Lugano classifications. Next is the quadrant about drug conversion, followed by quadrants related to clinical analyses, reference

databases (such as VaccinarSI, PubMed, etc.), and summaries of scientific articles, along with information related to COVID-19.

The second section, Prevention, Diagnosis, and Therapy, consists of 7 quadrants characterized by shades of blue within which it is impossible to capture screenshot images. The first quadrant on the left, "How to diagnose," involves consulting clinical algorithms that support the doctor's diagnosis, always accompanied by scientific references. The second quadrant, "How to Treat," contains a series of treatment algorithms to help the doctor set up therapy more quickly and easily. The third quadrant, "How to refer," suggests specialized centers or specialists based on pathologies and clinical decision algorithms. Quadrant 12, named "Medical Emergency," consists of clinical algorithms that help manage major medical emergencies such as anaphylaxis or radiological and nuclear emergencies. Quadrant 13, "Clinical Nutrition," is a section where resources and recommendations can be found for underweight, normal weight, overweight, and obesity patients, followed by the "Health Education" quadrant, which allows the doctor to send informative brochures or videos to patients via email. Regarding nutrition, in 2021, TonicApp, in collaboration with a well-known pharmaceutical company, supported 1,500 doctors for a year in the care of obesity in their patients. To do this, they provided several algorithms: a diagnostic one based on the body mass index (BMI) calculator, a treatment algorithm, and a patient profiling algorithm (Figure 1). The algorithms generate diagnoses and treatment plans starting from the data entered by the doctor (e.g., weight and height) and supported by data provided during the model's implementation phase. According to TonicApp's 2021 report[3], this resource was mainly used by general practitioners but also by anesthetists, gynaecologists, and endocrinologists. Except for the body mass index and the data entered by the doctors, what kind of data did the algorithms work with? Unfortunately, this analytical approach cannot answer this question.

Lastly, the last quadrant in this section, labeled "RCP and more," contains summaries of drug evaluations approved by the European Medicines Agency (EMA).

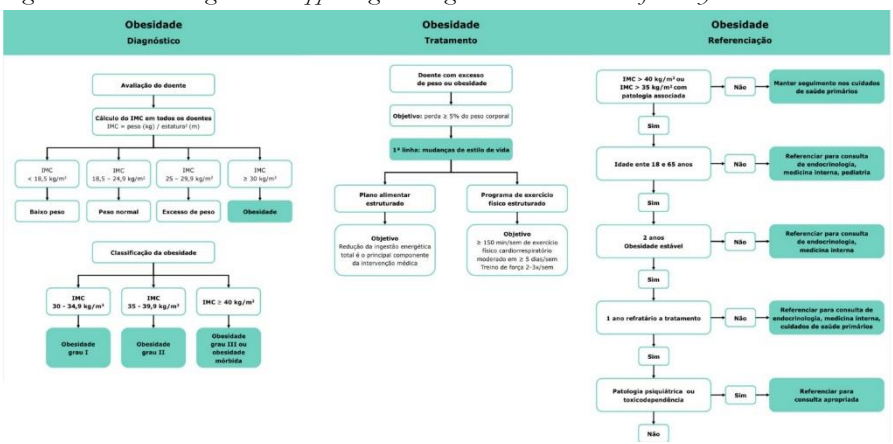
The third section, Kiosk, is reminiscent of small commercial enterprises found in public places that serve food, sell newspapers, and more, often serving as a meeting point and social hub. There are 8 quadrants ranging from yellow to purple that involve sharing information and opportunities, as discussed in the section on app environment analysis.

The three sections and their respective panels are part of the first "tent" in the menu, as we mentioned at the beginning of this paragraph, related to

[3] Available at: https://tonicapp.it/wp-content/uploads/2021/09/Tonic_App_Obesity_2021.pdf

"Updates." Scroll the menu to the right. You can find the "Messages" window, which allows you to start a discussion among doctors, create a discussion group, or invite other doctors if you consent to TonicApp accessing your contact list. Finally, if you continue scrolling the menu to the right, the last screen "Community" appears, listing the names and surnames of all the doctors registered in the app (belonging to the same country where they practice) along with their respective specializations. Finally, the "Dr. Tonic" service, a virtual assistant created by Tonic App, based on the language model trained by OpenAI, the creator of ChatGPT, has recently been added. It has been trained on over 500 GB of texts found in articles, books, and websites and can answer your questions on a wide range of topics.

Figure 1: Decisional algorithms supporting the diagnosis and treatment of obesity.



In conclusion, thanks to the versatility of the walkthrough, this initial research phase has provided a background overview of the features of the digital field in which the user doctors operate. Through this technique, it was possible to understand the platform's mission, which is oriented towards continuous interaction with the doctors registered on the platform so that they use it as not only a medical but also an informative and friendly support. Since the app allows creating a network of contacts starting from the lists of doctors in the "community" section, this places the app halfway between a social media platform and a medical healthcare device. As we have seen, the platform collects, stores, discloses, and uses any data related to the user doctors and the health data of the patients they enter into the platform for diagnosing and treatment processes. However, it needs to be clarified whether and how patients are informed about the use of their personal data by the platform. Despite this,

user doctors must adhere to numerous rules to avoid being banned, primarily concerning the accuracy of personal information and patient data entered on the platform. Attention to accuracy, however, is not dedicated to the information sources: the platform disclaims any responsibility for the accuracy, reliability, completeness, and updating of the information that the community of user doctors comes into contact with.

Finally, the algorithms that underlie the entire platform infrastructure are presented as a tool to simplify the work of doctors, but at the same time, there is no information about their audit (Aragona, 2021), that is, the processes of evaluation and checks on the output of the algorithms to avoid potential biases that could affect the decision-making process.

It is clear that a careless and uncritical use of the algorithms made available by the platform (especially the data provided to them) and a lack of control over the correct functioning of the algorithms can pose potential risks to doctors who are not adequately informed, neither about the algorithmic potential nor about the limits and biases they can generate. For this reason, the second part of the investigation focuses on these sensitive aspects that need to be addressed through a direct inquiry of the user doctors of the app.

5. Analysis of the Interviews

From the interview plan, the common element shared by all the doctors concerns the strength of the bonds between colleagues. The solidity of the relationships between the interviewed doctors and their respective colleagues in the department or the same specialist field is a significant factor that every interviewee emphasizes in the initial interview stages. The most significant connections are reinforced when, in the pursuit of ongoing opportunities for scientific and operational discussion with colleagues, the theme of technological innovations supporting medical research and clinical practice is addressed. On the topic of innovation, following the pattern of the dichotomy between apocalyptic and integrated, all the interviewees distinguish medical professionals into two broad categories: On one hand, there are conservative doctors, with several years of professional seniority who view the integration of devices and platforms in their practice with skepticism, reducing the debate to a man-machine substitution logic; on the other hand, there are more curious colleagues interested in embracing the challenges that innovations present for the advancement of the profession, especially in terms of therapy.

In the first instance, almost all the interviewees acknowledge having had their initial contact with the app through the spontaneous sharing of comments

and opinions about its functioning by other colleagues or after being reached by strategic advertisements promoted by TonicApp through social media.

The interviewees describe the relationship between users and the app, emphasizing the sporadic use, limited in part to merely downloading the app for an initial exploration of its features. The use of TonicApp appears to be sporadic, mainly limited to the exclusive use of its features in specific situations. This does not include the use of diagnostic functions, which are considered less valuable. The use of the app is therefore primarily limited to consulting the most recent literature regarding updates to therapeutic plans.

> Well, to be honest; regarding diagnostic algorithms, it's not bad, mainly because, in the end, the diagnosis is always the same as twenty years ago, it doesn't change. More than that, the treatment protocol is what changes a bit. (RP, 30 years old, male, less than 10 years of practice).

According to the interviewees, the perceived utility of the diagnostic functions of the app can be attributed to a lack of necessity due to two main factors. The first is what several interviewees repeatedly call the "obsolescence of the function." As highlighted in the previous field note, this obsolescence is not so much about the logic of diagnosing as it is about the well-established diagnostic process. The second factor is doctors' full responsibility in the clinical process. In this case, even doctors with less experience share elements related to the man-machine duality and the need to keep algorithmic substitutions of the doctor's intervention at a distance, also to avoid misunderstandings with patients.

> I have never used the diagnostic function. I don't need it due to my personal preparation. I have 22 years of experience, and I have never let a diagnosis be done on my behalf. (EM, 50 years old, male, more than years of practice)

As it emerges, the idea of one's doctor using a digital tool in their practical activities is a particularly stigmatized theme. In this regard, the interviewees describe the idealization processes of the doctor as an expert scholar to turn to and rely on in case of difficulties:

> For patients, a doctor has a certain credibility that could be compromised by the idea of using such devices. (RP, 30 years old, male, less than 10 years of practice).

On the practical use of the app, what is consistently criticized by the interviewed doctors is the chaotic presentation of the interface, considered

excessively rich in functions and purposes. The richness of functions, in fact, leads to information overload that affects the user. The disorientation experienced by the interviewees, related to these chaotic aspects of interface presentation, is considered one of the reasons for not using the app. According to the doctors interviewed, a medical app, like several others they claim to use, should focus on a specific functional aspect, whether it's diagnosing, promoting updates in scientific literature, or serving as a hub for disseminating therapeutic guidelines validated by the WHO, etc.

During the interview sessions, the researcher did not reference the algorithmic logic underlying the platform. This was done to understand the extent of the interviewees' awareness of the structure and agency of TonicApp. Algorithmic awareness - understood as the awareness of algorithm use in various digital contexts and knowledge of how these algorithms work (Hamilton et al., 2014; Eslami et al., 2015) - is considered an essential requirement for interacting with algorithmic systems in an informed and critical manner (Felaco, 2022). Therefore, with reference to Felaco's (2022) framework concerning the procedural dimension of algorithmic awareness, in this specific case, it was investigated to understand how aware doctors are of the platform's functioning and, consequently, the opportunities, risks, and ethical implications in the practice of medicine. In this regard, the interviewees have demonstrated some awareness of the automated logic underlying the app, but they seem disinterested in the processes, dynamics, and potential impact associated with them.

> As for the app's mechanism, apart from the developers and all the mini-marketing part, there's certainly the work of colleagues in the core of the application. You can see that a doctor is behind this situation, although I don't think there is a specialist behind every specific protocol. (AG, 30 years old, male, less than 10 years of practice).

This aspect is enriched by the idea of an exclusively human intervention in the development and updating of functionalities, which cannot meet the user's demands. On several occasions, the interviewees describe the superficiality or complete lack of information regarding specific pathologies in certain specialized areas. The absence of information or content elements on these aspects completely invalidates the opportunities for use by entire medical sectors. While general practitioners do not suffer from this gap due to the limited interest and utility associated with basic medical work, this aspect is considered by the specialists selected for this phase of the investigation as the central problem that developers should focus on to make TonicApp a virtuous tool.

6. Conclusions

The proposed research design considered, on one hand, the methodological paths suggested by the research questions and, on the other hand, current reflections on how digital methods can incorporate other methods (both digital and non-digital) to expand and compare the analyses of a phenomenon (Light et al., 2018). In this sense, the combination of the walkthrough method with other forms of investigation was essential to understand the overlap between the physical environments of hospitals and the privacy of medical practices within the digital field of TonicApp

By integrating the walkthrough with the ethnographic phase, it becomes clear how the relationship with patients has changed following the adoption of the platform and, at the same time, how common practices in the field of medical profession have changed after using TonicApp.

In this regard, the technical and scientific reliability of the diagnostic algorithms that the app assures in its presentation could not be empirically controlled through a single-method application linked only to the walkthrough.

It is evident that inattentive and uncritical use of the platform's algorithms (especially regarding the data they are provided with) can entail potential risks stemming from the lack of data control. As revealed in the interviews, it is important to investigate processes that provide doctors with adequate information about the capabilities and risks. It should be noted that the input contribution is initially given to the developers and only later to the doctors.

While interesting findings emerged regarding scientific reliability, especially concerning therapeutic update functionalities, for what concerns the clarification of technical assumptions, further investigation space needs to be granted to the present study, which currently suffers from considerable limitations. The exploratory nature of the approach, focusing on a single case study, allows the identification of significant dimensions and initial results for contextualizing the relationship between the medical profession and the use of digital platforms. However, it does not allow these initial empirical findings to be tested regarding stability, accuracy, and result reproducibility. In this sense, future advancements of the study should not overlook the need for direct engagement with the app developers and, at the same time, a comparative design among medical platforms to investigate the criteria for choosing and adopting apps depending on the needs and purposes of medical use.

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