Chapter 1
A "P5" Approach to Healthcare and Health Technology

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1 Introduction

The main challenge faced by healthcare systems worldwide is not the cure of specific diseases but the management of chronic illness emerging from diseases that are treatable but incurable. This scenario requires the health providers to maintain long-term relationship with the patient, who has to learn how to manage symptoms, organize treatment adherence (e.g., taking medications regularly), and cope with stress and negative emotions as well.

The literature agrees that patients themselves should not be seen as passive recipients of care, but rather they should become "active" (Hibbard et al. 2007; Remmers et al. 2009), "empowered" (Anderson and Funnell 2010; Pravettoni 2016; Renzi et al. 2017), or "engaged" (Barello et al. 2012; Graffigna et al. 2016) in their own care in order to recover a positive approach to everyday life issues and to the management of illness and the treatment as well.

This theoretical approach to healthcare lays its own roots in the patient-centered approach to medicine. Patient-centered medicine emphasizes the limitations of a disease-centered approach to medicine, namely, the idea according to which health practitioners should focus their activity on the recognition and treatment of the symptoms only. On the contrary, patient-centered medicine attributes importance to the recognition and appreciation of patients' values, desires, expectations, personal objectives, and lived experience in general.

On this basis, patients deserve to be made active participants in the decisions related to their own care plan. Historically, patient-centered medicine emerged during

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G. Pravettoni, S. Triberti (eds.), *P5 eHealth: An Agenda for the Health Technologies of the Future*, https://doi.org/10.1007/978-3-030-27994-3_1

ing the second half of the 1900s (Balint et al. 1970); Levenstein (1984) elaborated some of the most important theoretical principles of the approach, namely, the belief that both physician's and patient's *agendas* should be recognized and integrated in medical care. Specifically, the patient's agenda could be described in terms of three main domains:

1. The cognitive sphere or the patient's ideas about his/her own condition and the "folk models" about health and illness.
2. The emotional sphere or patient's feeling, emotions, and affective reactions to illness and care.
3. The expectation sphere or patients' objectives and desires about the processes and the outcomes of care.

Today, patient-centered medicine is worldwide recognized as a fundamental component of the healthcare system or better as the correct, desirable, and more ethical approach to healthcare; however, there is still uncertainty around the actual meaning of "patient centeredness" for health practitioners, patients, and health organizations (Bardes 2012; Hanyok et al. 2012; Miller et al. 2015). According to Liberati and colleagues (Liberati et al. 2015), a review of patient-centered interventions highlights at least two main approaches, namely, the dyadic and the organizational ones.

The dyadic approach to patient-centered medicine includes those interventions focused on strengthening and empowering patient-doctor communication or in other words those interventions that focus on individual experience of illness, therapy administration, and treatment management, for example, basing on a "narrative medicine" approach (Fioretti et al. 2016). Dyadic studies are usually centered on clinical encounters and individual interactions/communications; they explore innovative ways of creating a positive alliance between the patient and the health provider, and they report outcomes showing how the interventions influence (or not) therapy effectiveness and well-being outcomes.

On the other hand, organizational interventions move the focus of inquiry from clinical encounters to the overall healthcare context; in other words, they intervene at the level of procedures, practices, policies, organizational boundaries, and roles and the communication of the medical offer in order to improve patient centeredness at the level of organizations and their services.

Both these approaches have specular strengths and limitations. Dyadic patient-centered approaches may fail to recognize organizational factors that influence patients' well-being and/or effectiveness of illness management independently of the quality of the communication with the health provider (e.g., complex time schedules in the care facility), and also they do not consider additional important figures (e.g., caregivers); on the other hand, organizational patient-centered approaches do not address how practitioners carry out care in their local context nor do they capture what patients perceive as actually significant along their care path.

On this basis, it appears evident that a mature approach to patient-centered medicine should encompass both dyadic and organizational aspects; probably, this could be done by adopting a different stance, not focused on the specific type of intervention but rather on general features healthcare interventions should have in order to promote patient centeredness. The P5 approach to medicine does exactly that and will guide the contributions featured in this book.

2 P5 Medicine

The approach to medicine that is taken as a main guideline for theory and practice in the present book lies its roots in the evolution of medicine as a scientific activity. Professor Leeroy Hood, a pioneer in systems biology, theorized that modern medicine was evolving from P0 to P4 medicine (Hood and Galas 2008; Hood 2009, 2013); from a biological point of view, P0 medicine or the traditional approach was focused on individual analysis of "one cell or one protein," while the availability of technology-conveyed data around diseases and patients allows researchers and health providers to adopt a systems, holistic approach to diagnosis and treatment. Hood thought that future medicine would become more and more predictive, personalized, preventive, and participatory. Already in Hood's writings, but also in subsequent studies on the topic, these concepts transcended systems biology to embrace multiple disciplines and approaches involved in promoting healthcare (Cesario et al. 2014; Pulciani et al. 2017).

The **preventive** (cfr. Chap. 3) property of medicine refers to its ability to proactively (not only reactively) address diseases. According to Hood, by knowing the molecular picture of the patient and by using a systemic approach to its condition, it is possible to anticipate diseases as well as relapses or other modifications to overall health status. In the P5 approach, such characteristic extends to environmental, social, and psychological aspects of patients' experience; indeed, not only biological events can be anticipated but also changes in environment or psychological status (e.g., onset of depression, emotional reactions to the diagnosis, etc.), so to project therapy interventions that address pathology and issues before they actually manifest themselves.

Personalized medicine (cfr. Chap. 4) was originally proposed in the field of genetics, in the sense that by the application of nanogenomics and nanoproteomics, it is possible to tailor medical interventions to the specific molecular picture of the individual (Eisen et al. 1998; Nicolini et al. 2012); also this concept has evolved toward a consideration of the patient as a whole, so that "tailoring interventions" on people means designing them by taking into considerations patients' abilities, contexts, needs, and decision-making priorities (Cutica et al. 2014; Renzi et al. 2016).

Medicine should become more and more **predictive** (cfr. Chap. 5) which means it will employ the information arising from genome sequences and longitudinal molecular, cellular, and phenotypic measurements to provide baseline values that can be defined as health/wellness and then used to identify subsequent transitions to disease. Consistently with its original formulation in terms of systems biology, it should be highlighted that predictive medicine is necessarily evidence-based (Domenighetti et al. 1998; Hood and Flores 2012), and it is typically characterized by the usage of equations, formulas, and models to elaborate multiple variables in order to approximately describe future health-relevant events.

Medicine is **participatory** (cfr. Chap. 6) in that it does not operate in a social vacuum. Despite this, traditional medicine was perceived as an activity abstracted from the everyday social life of the patient, such as patient, doctor, and the disease interacted among themselves only (Gorini and Pravettoni 2011; Kabat-Zinn 2000). On the contrary, the process of care involves a number of additional stakeholders and influencers, such as caregivers, other patients, and different types of health providers (Gorini et al. 2018). This aspect of health should not only be made explicit but exploited, in that an effective alliance between the multiple actors of the care process is expected to strengthen its effectiveness.

As explained above, the 4 Ps in Leeroy Hood's model emerged from a conception rooted in systems biology and were then extended to social and ethical aspects. Doing so, the original model could not ignore another aspect which very much deserves to be included among its main pillars as well.

On this basis, recently Pravettoni and Gorini (Gorini and Pravettoni 2011; Pravettoni and Gorini 2011) proposed to add a fifth P to the model, namely, the **psychocognitive** one. Psychocognitive medicine (cfr. Chap. 7) emphasizes that the patient, considered as a person and not only as a recipient of care, is characterized by emotions, attitudes, and cognitive processes which have specific relations with his/her own care process. By embracing the fifth P, this approach has a conception of value in healthcare that goes beyond the evidence-based medicine approach (Marzorati and Pravettoni 2017; Riva and Pravettoni 2016); while evidence-based medicine is regarded as the results of clinical trials to identify the most desirable medical procedures and interventions, P5 considers the impact on quality of life as an additional fundamental marker of effectiveness.

Moreover, the fifth P has important methodological consequences for healthcare: future medicine should be able to design a psychological and cognitive profile of the patient, instead of a mere diagnostic classification; in this sense, P5 medicine leads to an assessment with psychometric tools that include cognitive, decision-making, and mental aspects, as well as clinical ones.

Specifically, to sum up, the fifth P proposes some activities to be considered fundamental in healthcare interventions (Pravettoni and Gorini 2011):

- Development and testing of new psychometric instruments, devoted to provide a complete medical profile of the patient.
- Promotion of the active patient's decision-making about therapy and healthcare process as a whole.
- The right for the patient to develop an empathic relationship with the physician.
- Assessment of quality of life and its inclusion among the criteria necessary to perform evaluation of clinical procedures and practices (value-based medicine).

For the sake of completeness, we could report that also a sixth P was proposed in the literature, namely, **public**; Bragazzi (2013) analyzed the famous case of Salvatore Iaconesi, a patient diagnosed with cancer who made his medical records available on the Internet and social media, inviting "everyone" to find a cure for his disease (not only in medical but also in emotional and spiritual terms). This case is interesting in that, according to Bragazzi, it shows how healthcare is evolving from a private and dyadic, paternalistic relationship between patient and physician to a public issue that extends the therapeutic alliance to multiple actors within the social context.

Anyway, this highlights again the importance of considering the patient as a whole person, not only a passive recipient of medical care but an active individual looking for meaning and personal actualization. Although some aspects of human experience (e.g., happiness, self-fulfillment, spirituality) should probably not be considered objectives of medicine, healthcare providers should take into account that patients with a chronic disease are not only combating a physical illness but also they are engaged in a personal journey whose final objective is the pursuit of happiness and fulfillment *besides or independently of* the presence of a chronic health condition.

Starting from these premises, healthcare providers of the future should be able to design, develop, and implement care projects and tools that, as first, do not prevent people to chase their own personal objectives but also, when possible, include affordances and opportunities to actively pursue them. New technologies could be a resource for such aims.

3 eHealth

In 2001, eHealth has been defined by Eysenbach (2001), who explained that the delivery of information to patients and stakeholders could be enriched by the intersection of medical informatics and public health business. On the other hand, he pointed out that not only a technical development is involved in the emergence of eHealth but also a new state of mind marked by a global-thinking attitude and by the intention to improve healthcare locally, regionally, and worldwide. In general, eHealth should be distinguished by medical informatics or the inclusion of computer and software in medical treatments and management, in order to improve care effectiveness: this discipline is way more “ancient” than eHealth; according to Mihalas and colleagues (2014), the history of medical informatics can be traced back before the 1970s, with pioneer work on signal analysis, modeling and simulation of biological processes, and the first attempts to develop decision support systems. It is around the 1980s that medical informatics acquired international recognition by means of funding, the development and sharing of methodologies, and the foundation of specialization schools. However, at the same time of the next generation in technology development, a first distinction is made between the use of computers for healthcare (to elaborate and process health-related information) to the communication features of technologies: this is the rise of “telehealth” and telemedicine” as concepts more focused on technological properties able to overcome boundaries and distances, this way promoting and strengthening communication between health providers and patients (Krol 1997; Palazzini 2007; Rubel et al. 2004; Wade et al. 2010).

In this context, eHealth should be considered another third evolution of the concept; according to Della Mea's editorial (Della Mea 2001), it could be considered the "death" of both medical informatics and telemedicine, in the sense that it encompasses them but also goes further and is more inclusive. Specifically, according to other opinions (Allen 2000; Rosen 2000), the focus of telemedicine was on hardware properties, while eHealth has a broader interest in how services are delivered; similarly, the "actors" of eHealth are the patients or better the health consumers, and not only the physicians or health providers. Reviews on eHealth definitions (Oh et al. 2005; Pagliari et al. 2005) highlighted that common aspects of different conceptions of eHealth still emphasize the usage of technologies for promoting healthcare, not only in terms of strictly clinical outcomes but also well-being and quality of life.

But what technologies should be considered typical of eHealth interventions? Actually, this question is not so easy to respond to; as what previously happened to other fields (such as "commerce"), the addition of "e" (electronic) referred to the use of the Internet and highlighted the new ways of performing activities, thanks to connection features represented by the web. This is certainly true for eHealth too, but some authors (Gorini et al. 2008; Riva 2000) also include in eHealth experiential technologies which are not connected to the Internet, such as Virtual Reality for the simulation and training of healthy behaviors and lifestyles. Conversely, others consider advanced "technical" technologies (i.e., for the analysis of clinical data and for supporting diagnosis, such as big data applications) examples of innovative eHealth applications (Luo et al. 2016).

According to a number of systematic reviews in the field (Barello et al. 2016; Black et al. 2011; Elbert et al. 2014), these appear to be the most frequent technologies used in eHealth interventions:

- **Informational websites**, that is, patients are given access to web resources that are either created or monitored by health providers, to guarantee reliable health information and promote health literacy.
- **Telecommunication technologies**, ranging from telephone to social media features, in order to improve communication between patients and the health providers.
- **Web platforms and "ePrescribing,"** bespoke web resources that include services for monitoring, signaling, and supporting treatment administration and adherence on patients' side.
- **Wearable technologies and mobile technology (*mHealth*)**, any use of portable technologies to monitor patients' health status over time and/or sending daily reminders to take medications or to perform health-related activities.
- **Online support groups**, social media for peer support and peer education (Gorini et al. 2018).

- **Decision support systems**, algorithm-based dedicated software that helps the physician and/or the patient to make decisions about the care path, by making explicit the possible choices and their consequences.

Other technologies appear considerably less often in eHealth literature but could be considered evolved tools, especially because they are based on more complex conceptions of technology's potential influence on users' everyday life and personal abilities. The design, development, and implementation of these technologies are often more expensive and require specific competences (Gorini et al. 2008; Riva 2000; Riva et al. 2006; Rizzo and Kim 2005; Triberti and Barello 2016; Triberti and Chirico 2016; Triberti et al. 2019):

- **Ambient Intelligence (AmI)**, which is an umbrella term identifying computers embedded in users' environment (e.g., the home) supporting everyday activities and health monitoring.
- **Video Games and Serious Games**, which proved to be effective both as training of abilities and health education and coping or stress/emotion management.
- (Immersive) **Virtual Reality**, usually for rehabilitation or relaxation purposes
- **Virtual Worlds**, internet-based two-dimensional or tridimensional virtual environments (that can be accessed by personal computer or mobile devices), explored by multiple users at a time, thanks to the use of digital avatars, including opportunities both for communication/peer support and for training/health education.
- **Robotics,** the employment of more-or-less humanlike robots to help patients, for example, assists them in life tasks when at home.

Consistently, Moen and colleagues (2013), who conducted surveys among national member associations of the European Federation of Medical Informatics (EFMI), classify eHealth services in three main categories:

- **Technical and social eHealth infrastructures**, namely, services for secure, seamless transmission of health information between home care/primary care, hospitals, and GPs and between public and private health.
- **eHealth repositories**, services that allow patients and health providers to securely access information and resources for coordination and self-management,
- **eHealth applications** (cfr. Chap. 4), specific services permitting communication between patients and health professionals.

A critical approach to the eHealth phenomenon requires recognizing its potentials but also its shortcomings; the next sections will explore the eHealth scenario in detail, in order to explain which aspects of healthcare technologies should be exploited or avoided in future implementations.

3.1 Strengths of eHealth

A number of studies explored positive aspects of eHealth, especially its effectiveness in improving physical (Norman et al. 2007; van den Berg et al. 2007) and psychological (Eland-de Kok et al. 2011) health outcomes.

Another fundamental aspect is related to cost-effectiveness or, better, the ability of eHealth interventions to reduce overall costs of managing disease and treatment in specific cases. Although methodological problems exist and there is always a quote of uncertainty in such evaluations (Bergmo 2015), data coming from simulations suggest that eHealth is able to sensibly reduce costs on healthcare systems (cfr. Chap. 4) (Smit et al. 2011; Stroetmann et al. 2006).

Additionally, it is well known that one of the main strengths of eHealth (and of telemedicine already) is its ability to overcome distances and periods of time (Drury 2005; Ray et al. 2015); for example, communication technologies for healthcare may be useful to reach patients living in rural areas and/or patients who, due to symptoms of their conditions or limited availability of caregivers, experience significant difficulties to move around places and so to reach medical facilities or other locations that are important for treatment adherence (e.g., rehabilitation, pharmacy, etc.).

For the same reason, eHealth and telemedicine permit “democratization” of patient-doctor communication and healthcare in general (Brandt et al. 2018; Brown et al. 2015), in that some health services could be made more accessible for everyone, more or less independently of the availability for the patient of economic resources.

eHealth is demonstrated to have a strong relation with engagement, on the one hand with *user* engagement, that is, patients are more likely to use technologies when these are designed to be pleasant, involving, or even funny (Craig Lefebvre et al. 2010; Graffigna et al. 2014); an example of this is the utilization of *gamification* or the inclusion of features typical of games and video games in health-related technological interfaces (McCallum 2012; Sardi et al. 2017); for instance, patients are invited to report their adherence behaviors such as their game achievements and the positive feedback and prizes they received.

On the other hand, eHealth has proven to promote *patient* engagement (Ahern et al. 2008; Barello et al. 2016), which is, as written above, patients’ commitment to their own healthcare journey and ability to manage life commitments (e.g., work) despite illness (Riva et al. 2015). This is also related to the possibility for technology to promote knowledge/literacy and empower decision-making (Kondylakis et al. 2012, 2013; Norman and Skinner 2006; Wozney et al. 2017); indeed, information on health, therapy, and disease are made more accessible and easy to understand, and decisions to be taken may be represented and explained in the context of technology-enhanced decision support systems.

Finally, eHealth could provide opportunities to *structure* the participation to healthcare of multiple actors, not only patients and physicians but also caregivers, stakeholders, and multiple types of health providers; indeed, in the context of social media platforms, any figure important for patient’s health and wellness could be his/her own profile and online presence, in order to actively and positively participate in the care process.

3.2 Criticalities of eHealth and Emerging Challenges

When considering eHealth, it is important to recognize also the shortcomings appearing in a number of technology implementation in healthcare and its possible risks and limitations.

One recent review (Granja et al. 2018) explored the factors determining success or failure of eHealth interventions: their results focused on category costs, specifically the authors highlighted that, from an organizational point of view, eHealth could enhance workload for healthcare professionals and cause workflow disruption, as well as complexify role definition and undermine face-to-face communication.

As abovementioned, eHealth is expected to reduce costs, but additional costs may develop regarding the technology design, maintenance, or possible redesign after negative results emerging from evaluation (Chaudhry et al. 2006). Consistently, the implementation of eHealth may require health providers to include additional, specific competences to make it work in the long run (e.g., technical assistance).

Moreover, although generally eHealth has potentialities in terms of user engagement, it should be recognized that patients and users in general may not have a positive attitude towards it (Currie et al. 2015; Légaré et al. 2010); *technology acceptance* is an important issue in this field, in that people may not be prone to actually use it, or sometimes they could even refuse to. Such behavior can be related to various forms of digital divide (Voelker 2001), for example, patients do not have (or think they have not) basic knowledge and competences in technology usage. It can also happen that users have an initial positive attitude towards technology, but they cease to use it after a given period of time; that is the reason why technology acceptance and technology adoption should be considered two separate issues, the last one pertaining to long-term usage and adherence to the system (Triberti et al. 2018). For this reason, the design of eHealth, and especially of its interfaces (i.e., the part of the technology which is in direct contact with the user), should be conducted giving high importance to usability and user experience, to the point that the gold standard for eHealth design is found by many authors in user-centered design (UCD) techniques cf. chapter 9 (Holzinger et al. 2009; Triberti and Barello 2016; Vorderstrasse et al. 2016). UCD refers to any design process where final users have an important influence on how the design itself takes place (Garrett 2010; Lowdermilk 2013); usually, this means employing qualitative research methods to analyze users’ behavior, needs, and context to inform design and not only as a guide for evaluation, as it is done in the traditional usable approach. UCD may be costly as a first phase of an intervention, and also designers/engineers should be inclined to base their own work on the research data; however, when correctly applied, this approach could effectively eliminate usage issues that typically intervene at later stages of the intervention process.

Other important criticalities to consider in eHealth are related to privacy, in that various kinds of patients' data should be adequately preserved and protected, and ethics, because eHealth implementation should not become an excuse for physicians to "transfer" clinical care from themselves to software and machines; such an automatization of the healthcare process could be partly achieved, thanks to eHealth technologies, but could not be an objective for a patient-centered, P5-informed approach to patients and their illnesses.

4 Conclusion

This contribution briefly presented the P5 approach to medicine as an innovative perspective on how future medicine should evolve; numerous factors in patients' healthcare journey still have to mature in order to reach their full potentialities in terms of preventive, personalized, predictive, participatory, and psychocognitive properties. Taking this aim into consideration, we then proceeded to explore the concept of eHealth and its various incarnations in contemporary scientific literature; it has been shown how technologies for healthcare still hold tremendous potentialities to renovate the healthcare scenario globally, but also challenges and criticalities get in the way of progress.

For this reason, the subsequent contributions in the present book will explore a range of solutions to eHealth implementations issues, in order to give hints about the evolution of healthcare in general.

Five chapters will explore the 5 Ps one by one, focusing on guidelines for their implementations within technologies devoted to enhance the healthcare process; secondarily, other chapters will address specific issues such as the use for innovative technological resources for diagnosis, or common ethical dilemmas related to eHealth implementations.

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