

The Value of Education: Digital Care Pathways for Rare Brain Diseases The Case of Phenylketonuria (PKU)

Study Insights | International PKU Day 2024 | June 28

The Intersection of Digital Care Pathways,
Health Literacy and Rare Brain Disease Management:
New Technologies, New Challenges

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Note: all the figures in the document are authors' own elaboration.

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About the Value of Education

The overall goal of the Value of Education project is to understand the needs of increased risk populations (patients with Phenylketonuria) and define the best channels to engage and communicate with them. The project particularly focuses on patients and caregivers.



Digital Care Pathways for Rare Brain Diseases

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About the European Brain Council

The European Brain Council (EBC) is a network of key players in the “brain space”, with a membership encompassing scientific and professional societies, patient organisations and industry partners. A non-profit organisation based in Brussels, its main mission is to promote brain research with the ultimate goal of improving the lives of those living with brain conditions, neurological and mental alike.’



For more information about the Value of Education, please visit:

<https://www.braincouncil.eu/projects-and-initiatives/value-of-education-rare-brain-diseases/>

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Foreword

The opportunities offered by **data and digital health** are multiplying. While barriers remain to unlock their full potential, we are at an unprecedented moment of change. **The European Health Data Space and the AI Act** hold the promise of shaping a digital ecosystem that can accelerate the shift towards patient-centered, outcomes-focused, sustainable healthcare in Europe, improve patient safety and reduce avoidable harm. Patient care is undergoing a significant transformation, and three key factors – **data, patient education and inclusivity** – are at the forefront of this change. To gain a deeper understanding of these trends, we spoke with clinicians, patients and patient associations' representatives. These insights offer a glimpse into the future of patient care.

The Value of Education: Digital Care Pathways for Rare Brain Diseases research project (2023-2024) – The Case of Phenylketonuria was coordinated by the European Brain Council. The Covid-19 pandemic accelerated the healthcare sector's digital transformation agenda. The delivery of telemedicine services instead of many face-to-face procedures has been expanded and many healthcare services shifted online remotely. The study is looking at the **unmet needs** of patients related to information, education and communication in the management and monitoring of Phenylketonuria (PKU) along the digital care pathways. We collected data from patients and caregivers in Ireland, Germany and Spain using a patient survey that was **co-designed** with PKU patient associations, to gather information about where and how can digital tools support PKU diagnosis, treatment, and follow-up. While looking at the **patient perspective**, the **clinician perspective** is equally important. This project examines further what is the current state of digital transformation within healthcare systems and how to address the fundamental challenges that hinder the acceleration of the data-driven revolution. **Results of the study will be published in a scientific journal.**

International PKU Day on 28 June 2024 is an opportunity for policymakers and healthcare stakeholders to take stock of progress made to date, reflect on the lessons learned in shaping new regulations, and discuss key opportunities and challenges ahead.



Suzanne L. Dickson

President, European Brain Council (EBC)

Project background

1. Phenylketonuria (PKU), a rare neurometabolic disorder

Rare diseases typically display a high level of symptom complexity and variability. Individuals diagnosed with the same rare disease may be impacted differently and each person's experience is unique. Phenylketonuria (PKU) is a rare inherited metabolic disorder due to deficiency of the enzyme phenylalanine hydroxylase (PAH) resulting in decreased ability to metabolize the amino acid phenylalanine [1]. In Europe, PKU prevalence is about 10:100,000 newborns with higher rate in Turkey and Ireland, and a very low rate in Finland [2]. High blood Phe levels are strongly linked to neurocognitive dysfunction. Untreated PKU can lead to irreversible brain damage and marked intellectual disability beginning within the first few months of life [3]. In most European countries, the national newborn screening (NBS) programs include blood phenylalanine (Phe) measurement. The aim of NBS is to identify hyperphenylalaninemia (HPA), and this is defined as any blood Phe >120 $\mu\text{mol/L}$ [4]. The early detection of HPA and its treatment can prevent neurological damage. Despite the high and wide application of NBS, there are still late diagnosed patients or undiagnosed patients such as immigrant children born in countries where NBS is absent or not universally applied, or adults born before the introduction of NBS.

PKU is not only a children's disease. On [International PKU Day 2024](#), the E.S.PKU is raising awareness about the lives of adults with early and late diagnosed Phenylketonuria.

2. PKU Care Pathway Analysis

Dietary management of PKU is effective at preventing neurological dysfunction and involves a phenylalanine-restricted dietary therapy. Residual problems relating to psychosocial issues, cognitive and executive functioning and comorbidities may exist. There may be vulnerable individuals with anxiety, which in combination with challenges with their dietary restriction has a significant impact on quality of life. Despite close interaction with metabolic dieticians, it is worth noting a proportion of patients are overweight and/or obese [5]. A European Brain Council paper on the Value of Treatment for PKU "Management of phenylketonuria in three European countries: analysis of patient characteristics, health service use and adherence to treatment guidelines" (Morris S et al., under publication) indicates variability in staffing and resources within Metabolic units under study, the implementation of the European PKU guidelines, the genotype profile of patients and access to novel therapies. Increased availability of certain food products has expanded dietetic options for patients, and access to pharmacological chaperone treatment for some has enabled the easing of their dietary treatment. To assess in detail the value of novel therapies, additional resources are required. This will

enable close patient follow-up, drug dose/supplement adjustments, evaluation of adverse events, and the collection of outcomes data. Patients considered most likely to benefit from novel therapies should have access, but this requires attention to close monitoring and determination of the added value of treatment, beyond dietary management alone.

Today, care pathways are increasingly including digital care pathways. What does that mean for patients and healthcare providers in the era of value-based care? The experience with health care delivery for rare diseases during Covid-19 pandemic requires further investigation, as this has altered routine clinical practice, with the introduction of virtual clinic appointments and reporting of results. The Value of Education, Digital Care Pathways for Rare Brain Diseases – The Case of Phenylketonuria builds on recent research conducted by the European Brain Council and its academic partners, and published on “The COVID-19 pandemic impact on continuity of care provision on rare brain diseases” (Cannizzo S et al., 2023) [6] and “The organizational dimension in rare diseases care management: an application of RarERN Path© methodology in Ataxias, Dystonia and Phenylketonuria” (Cannizzo S et al., under publication).

3. Digital Care Pathways (DCPs)

"Digital Care Pathways" (DCPs) employ digital technologies to follow and support patients through their healthcare journeys. DCPs present healthcare systems with a way to more deeply understand each patient's health and deliver more streamlined, proactive, and patient-centric care. The process of digitalizing care pathways has been in progress for years and is steadily advancing in Europe in line with the call of WHO for urgent investment, innovation and inclusion to reap the rewards digital health has to offer ([WHO Regional Office for Europe, 2023](#)) as well as EU policies to bring about the digital transition ([Europe Consilium, standards & regulations, a digital future for Europe, 2024](#)). In the digital transformation of the healthcare sector, however, EU Member States are advancing at different speeds. According to the [Digital Health Index](#) results showcasing countries of different sizes and with different types of healthcare systems, digital technologies in Spain and Ireland are already commonplace in practices and clinics whereas Germany trails behind. The full potential of digital tools needs to be demonstrated such as the use of patient-reported outcomes measurements (PROMs) in electronic patient files can prevent dangerous drug interactions; telemedicine can provide patients access to medical expertise no matter where they are; health apps can strengthen the chronically ill.

Aim of the study

Digitalization is transforming public health, health and social systems, and the health information we receive – as well as how we receive and understand it. New digital technologies offer promising solutions from the patients and the health care providers' perspective to many long-standing health system challenges, such as accessibility, quality and sustainability. They also present us with new issues. The PKU optimized patients' pathway was designed using the application of the RarERN Path© methodology in the framework of [the European Brain Council Value of Treatment project for Rare Brain Diseases](#). Based on these results, the aim of the study is 1) to examine patients' needs along the different phases of the care pathway, in terms of information, education, communication in the management of PKU (also based on the experience of the COVID 19 pandemic) and 2) to understand if and how digital tools can help (see figure 1), how can they be beneficial on information, communication and education from a patient perspective and a healthcare provider perspective. A co-design working group together with PKU experts, patients and patient associations representatives developed both questionnaires. The main targets of the surveys (Q4 2023 – Q1 2024) are PKU patients and caregivers as well as healthcare providers, in Germany, Ireland and Spain. By digital tools, it means programs, websites, applications, and other internet and computerized resources that facilitate, enhance and execute digital processes and overall digitization efforts.

Figure 1. Co-designed & structure of the survey

General goal of the survey:

To understand if and how digital tools can help, along the different phases of the care pathway, in terms of information, education, communication in the management of PKU (also based on the experience of the COVID 19 pandemic).

Perspectives:

- Patient/Caregivers
- HC Professionals
In Germany, Ireland and Spain

A. RESPONDENT PROFILE

PKU adult patients and PKU patients-children

B. INFORMATION, COMMUNICATION and EDUCATIONAL PATIENT' NEEDS

C. ACCESS, DIAGNOSIS, TREATMENT and MONITORING of PKU

Organisational phase: access Organisational phase: diagnosis/staging Organisational phase: treatment Organisational phase: monitoring

1. **ACCESS** refers to the contact phase with the specialised metabolic centre (a clinic or a centre that is experienced with PKU care).
2. **DIAGNOSIS** of PKU refers to the main procedures from blood sample until the confirmatory diagnosis that the patient experiences at the clinic he/she was initially referred to for specialised care (specialised metabolic centre or any other healthcare facility).
3. **TREATMENT for PKU** dietary phenylalanine monitoring, novel therapy.
4. **MONITORING of PKU:** the periodic follow-up with the support of a multidisciplinary team (metabolic nurses, metabolic dietician, genetic counsellor, psychologist and metabolic consultant) for both children and adults and a specialised metabolic laboratory. The follow-up includes home blood sampling, outpatient visits, dietary assessment, a multidisciplinary team member visit (for example: psychologist).

D. FINAL COMMENTS and SUGGESTIONS

Source: Authors' own elaboration.

Study insights

1. Importance of Data and Information in Clinical Practices

The landscape of patient care is being reshaped by an unprecedented surge in data. There is a paradigm shift as information about patient data, provider data can accelerate the advance of personalized medicine and can directly address unmet needs for better health outcomes. The use of real-world data and insights holds the power to optimize the patient care pathway, predict disease progression, and proactively identify health risks. This data-driven approach also offers a route to therapies tailored to individual needs.

Survey results

Receiving reliable information about PKU and about the correct behaviors is extremely important for the majority of patients with PKU and parent respondents to the survey, specially targeted not only to patients directly but also to their families (parents, partners, siblings, grandparents), as well as their caregivers (see figure 2a and figure 2b).

This is confirmed also by the HC professional experts in PKU, and information activities on the nature of PKU, on synthetic protein substitute, low protein foods, available therapies, clinical trials are needed (see figure 3a and figure 3b).

Figure 2a. Patient information needs

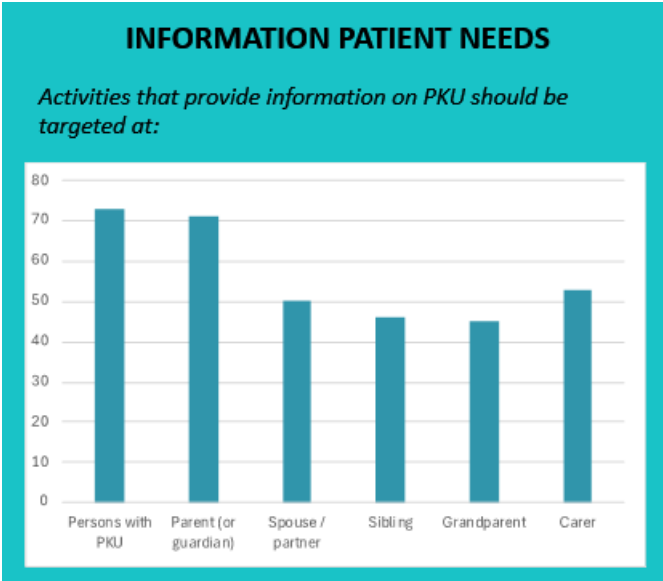


Figure 2b. Unmet information needs

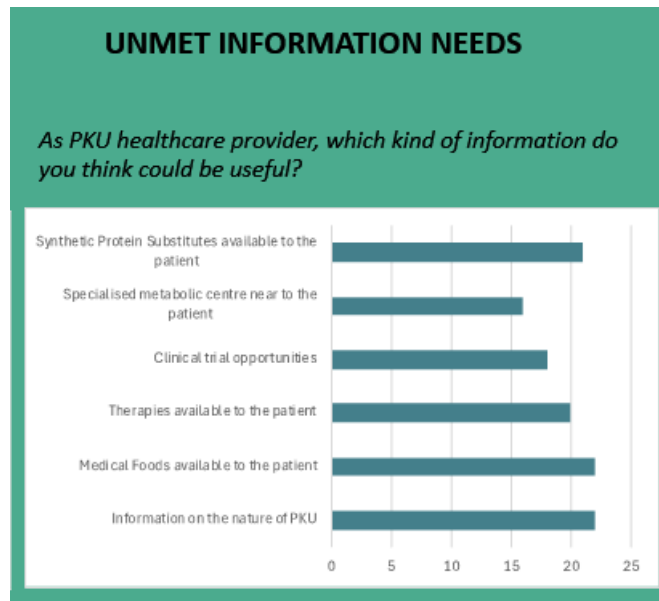


Figure 3a. Patient communication needs

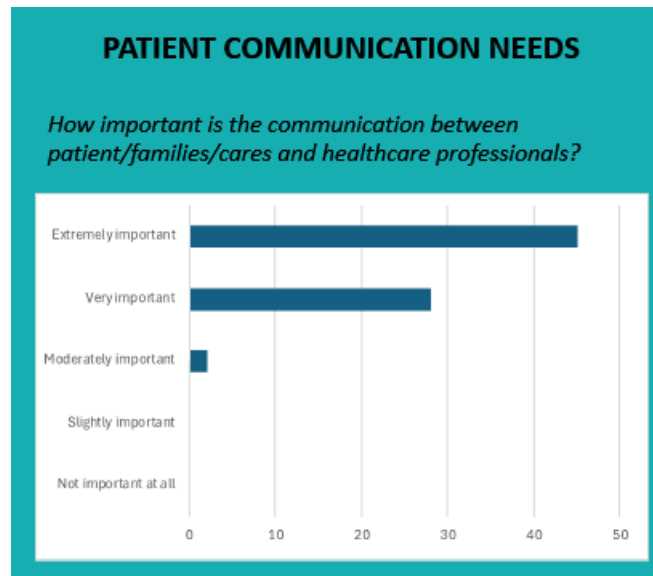
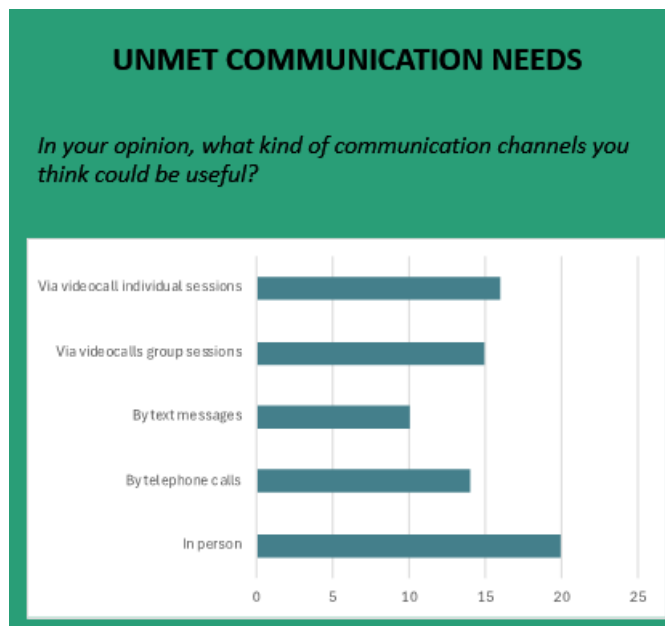


Figure 3b. Unmet communication needs



Patient's statement

Using the digital tools before the clinic visit in sharing the information and for communicating could help in making the experience of the medical appointment more effective. For a more understandable and effective diagnosis phase, a more extensive/better use of digital tools could enhance understanding of what healthcare professionals tell the patients about PKU and afford the opportunity to ask questions and clarifications.

Healthcare provider's insight

Healthcare providers can play a key role in providing inputs and offer valuable information and efficient communication about the different steps and different procedures of the care pathway.

Digital tools could be useful for understanding the information that the dietician provides to the patient, the parent and the caregiver about the dietary treatment and the monitoring of PKU.

2. Patient Education and Involvement

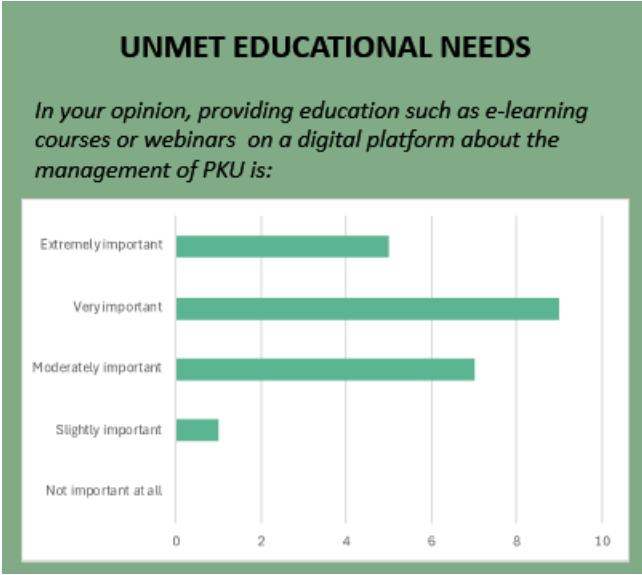
Empowering patients with knowledge and instilling a sense of ownership over their healthcare decisions is fast becoming a cornerstone in the management and monitoring of the disease. Patients

become active managers of their treatment plans. This shift towards patient engagement holds transformative potential, from improving medication adherence to enhancing diagnostic accuracy. Education goes beyond comprehending one’s medical condition; it also encompasses the need for knowledge and resources to communicate effectively with healthcare providers. Education is the starting point for access. And the scope of education isn’t limited to patients alone, it extends to healthcare providers in the integrated healthcare systems too.

Survey results

Focusing on the management of PKU, the education on a digital platform is very important for many of the respondents, specially targeted not only to patients directly but also to their families (parents, partners, siblings, grandparents), as well as their caregivers. Moreover, educational activities on digital tools should be targeted to general practitioners, social services providers, pediatrics, educators and school teachers (see figure 4).

Figure 4. Unmet educational needs



Patient’s statement

Digital tools could help in terms of education as a part of the management of PKU. Educational activities and programs tailored to different target users could help the patients, the parents, and the caregivers to be better prepared during the clinical visits.

Healthcare provider's insight

The digital tools could help in terms of information and education as a part of the management of the clinic visits: collecting the data in advance, sharing more information before the visit, could help for a better interaction patient/clinician and leaving more valuable time during the visit.

3. Assisting Patients in Understanding Treatment Options: A Digital Technology Perspective

The digital technology aspect of treatments, particularly for patients with rare diseases, poses a significant challenge. Patient education and digital accessibility are not secondary concerns but integral components of enabling patients to actively engage with the healthcare system and advocate for their unique needs. The transformation is not solely about medical procedures; it is about empowering patients with the knowledge and resources they need to make informed decisions and access the necessary care.

Survey results

Digital tools (e-mail, mobile Apps, WhatsApp messaging, virtual calls) for sharing information and for communicating between patient/parent and the healthcare professionals before the clinic visit (75%), can enhance the understanding of the information provided about treatment or monitoring (90%). On day-to-day PKU management, digital tools (Apps, wearables, e-mail, telephone call) could be useful for understanding information the patient receives from the metabolic care team and for communication outside of the in-person clinics (90%) (see figure 5a and figure 5b).

Patient's statement

The phase of the contact, and the phase of managing the main procedures for the confirmatory diagnosis that the patient experiences at the clinic he/she was initially referred to for specialized care (specialized metabolic centre or any other healthcare facility) could be improved by means of the digital tools; digital communication and information are very important to make the outpatient visit more effective.

Education on dietary management could be facilitated by adoption of digital tools.

Parents and adults with PKU shared comments, thoughts, and examples of how digital tools could help in terms of information, education, communication as part of the management of PKU (see figure 5a and figure 5b).

Healthcare provider's insight

In the day-to-day management of PKU: digital tools could be useful in the information on daily implementation of nutritional therapy; digital communication tools have a high potential for improving the day-to-day care, in the support for tracking phe levels, and have a high potential for better understanding of HCP's and dieticians' perspectives.

Figure 5a. Parents' suggestions

PHE level management/ Food and meal management	Educational tools	Communication patients/ metabolic centre	Information	Peer to peer networking
Home blood monitoring tools Tracking app for day to day management and education. Wearable devices	Gaming tools (food management).	Real time communication channels for special needs (illness, sports.).	Quality information about accessing clinical trials.	Tools facilitating communication among PKU patients.

Figure 5b. PKU adults patients' suggestions

Food and meal management	PHE level management	Communication patients / metabolic centre	Information	Peer to peer networking
A low protein food information tool (macronutrients composition of commercial foods, searching markets). Tracking tools for food and day to day meals management, meal planners; for inventory of PKU products.	Home blood monitoring tools. Devices for PHE levels measurements personalised targeting different needs (pregnancy, feeding, weaning). Wearable devices.	Real time communication channels for special needs (illness, sports).	Quality information about innovation in treatment, in foods products, in research projects)	Tools facilitating communication among PKU patients.

4. Comparing the importance and utility of face-to-face and digital healthcare

The results of a complementary patient survey in Ireland, Spain and Germany show that overall, patients and their families and caregivers still consider face-to-face healthcare to be more important and more useful than digital healthcare tools. Nevertheless, almost all of them would use a differently balanced combination of face-to-face and digital healthcare if both were available. Only a diminutive minority would exclusively prioritize one of healthcare models over the other, and only for them, there is a strong correlation with the distance to the closest metabolic center.

Conclusions: Connected Health

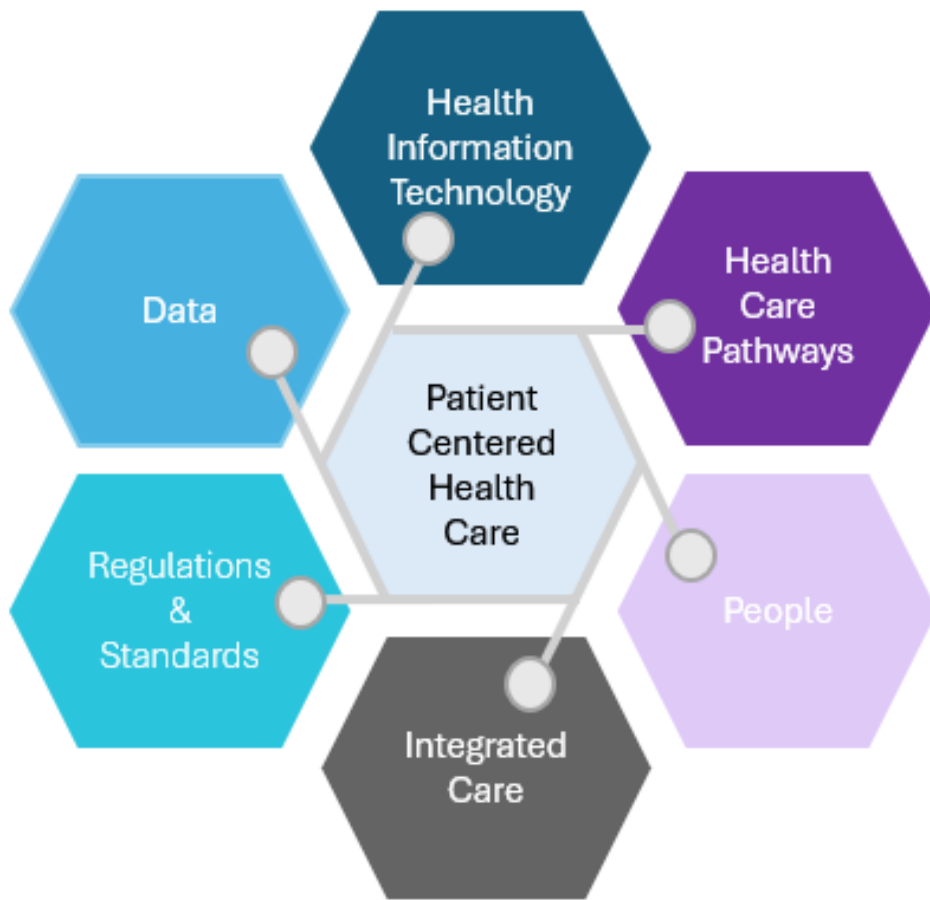
Digital and personal healthcare must complement each other for better care. Efficacy is a key driver; digital healthcare doesn't substitute personal healthcare. Overall, treatment management and care delivered to patients with PKU demonstrated the benefits and interest for increased use of digital tools in the management and follow-up. Results provided valuable insight into understanding the needs of patients with PKU (pediatric or adult) and defining the best channels to engage and communicate with them.

The patient community together with patient associations have a role in the broader ecosystem. Inclusivity and providing means with digital tools enable to break down barriers and empower patients. There is a paradigm shift as patient care is evolving into a more personalized, patient-centric domain. This transformation has the potential to unlock the full potential of digital care pathways and patient care, making it more accessible and representative of the patient experience (see figure 6). In addition, new value promises in daily life with the condition arise by the use of digital tools themselves; objective biosensing data capturing alleviating reporting pressure, real-time digital signals enabling immediate care, real-time digital interventions alleviating impact of the condition on daily life. More patient centric and family involved research and development is needed.

As the care pathway is increasingly digitized and integrated, this has an impact on information, communication and education. HCPs and healthcare systems also benefit when DCPs are enabled. The efficiencies provided by digitization give HCPs the ability to effectively monitor and refer patients.

In the not-too-distant future, many parts of the care pathway will be digitized and integrated to maximize ease and efficiency, as well as quality of care. In the meantime, concerns about confidentiality, patient consent on information shared and data protection need to be addressed carefully.

Figure 6. Connected Health



Source: EBC The Value of Education. Digital Care Pathways for Rare Brain Diseases, the case of Phenylketonuria, 2024.

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