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How can we deliver on the promise of precision medicine in oncology and beyond? A personal perspective

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Anna-Maria Nagel, | Benedetta Mitsopulos, Sandra Ebert, Ingeborg Hallay, Tanja Fehm, Sergio D. Yanez, Ralf Bendes, Gunter Von Minckwitz, Sara Y. Brucker, Markus Wallwiener

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Corresponding author: 12 June 2024

Abstract

Background

Precision medicine (PM) is a form of personalized medicine that recognizes that individuals with similar characteristics may respond differently to medical interventions. Implementation to provide optimal treatment for individual patients with improved outcomes and transition from through-favorable risk/benefit ratios, evidence of ineffective treatments and overtreatment, to evidence-based PM. Although PM is being implemented in various disciplines including oncology, challenges including ethical issues, diagnostics, and therapies, however, the potential benefits of PM have yet to be fully realized.

Discussion

There are many barriers to the implementation of PM in clinical practice, including fragmentation of the healthcare system, clinical approaches to address shared challenges, unwarranted variation in availability and access to PM, lack of standardization, and limited access to molecular diagnostics and targeted therapies. Although PM is being implemented in oncology, chemical modification/modification collaboration, with three main pillars of activity: generation of data to demonstrate the benefits of PM education to support clinicians and patients, and implementation of PM in clinical practice. Implementation of PM requires the development of a range of tools and resources, including multidisciplinary tumor boards, molecular profiles, research platforms, polypharmacotherapies, and industry collaborations. Implementation of PM in oncology has been a success, and there is a strong foundation for the approach. However, many challenges remain in clinical trials and approval of new therapies, including ethical issues, the need for standardization, access to molecular diagnostics, and sustainability of the approach.

Conclusion

We propose a practical and iterative roadmap to advance PM and call for all stakeholders across the healthcare system to employ a collaborative, co-created, patient-centered methodology to move past PM and realize the promise of PM.

Key points

- The potential of precision medicine (PM) approaches to transform patients' lives has been demonstrated in cancer and beyond, but its implementation has been slow and fragmented.
- Barriers to PM implementation include fragmentation of the PM pathways, siloed approaches, unwarranted variation in access to PM, lack of standardization, and limited understanding of the patient experience and needs throughout the PM pathways.
- Collaboration between different PM stakeholders, including patient communities, is essential to realize the potential of PM and make it an accessible reality for all those who need it.

1 INTRODUCTION

The term "personalized medicine" has a broad definition that incorporates many factors, including a desire to maximize the benefits of medical interventions and minimize the risk of expected that patients even with the same disease can have different underlying factors influencing their response to medical interventions, including genetic factors, environmental factors, and lifestyle factors, and therefore, personalized medical interventions, including information gateway, transcriptomic, proteomic, and metabolomics that can help determine the optimal treatment for individual patients [1, 2]. Precision medicine (PM) approaches potentially deliver expected benefits to patients, including improved quality of life, improved treatment efficacy by reducing trial and error prescribing and ineffective interventions, leading to improved outcomes, and reduction in the risk of adverse events and toxicities, thereby reducing high-risk treatment options and improving risk/benefit ratios for patients. This ultimately drives a shift toward patient-centered care and leads to possible healthcare savings [3].

Proof of concept for the potential of PM is been demonstrated in oncology, where there has been significant progress in the development of molecular diagnostics and targeted therapies and medicine is helping and approaches to PM have been implemented in various disciplines to transform tailor targetable mutations. [4–6] Therefore, we focus primarily on oncology as an example of implementation of PM approaches, although there are many other examples of PM approaches in other disciplines, such as the use of pharmacogenomic testing in psychiatry to optimize medication selection and dosing [7], pharmacogenomic or genotyping-based subtypes of autoimmune disorders, breast and ovarian cancer, and cardiovascular disease, and the use of genetic testing in pediatric medicine to transform lives by helping to provide a better quality of life, as well as more efficient and safer healthcare for children and their families. [8–10] Although PM is being implemented in various disciplines, including oncology, PM approaches have not been implemented with the capabilities to evolve into the standard of care in more diverse contexts. [11, 12] However, the potential benefits of PM have yet to be fully realized. Challenges including ethical issues, diagnostics, and therapies have been identified as barriers to the implementation of PM, and there is a need for a roadmap to encourage a collaborative, co-created approach to work together. However, for patients, PM is a reality, and there is a need for all stakeholders across the healthcare system to work together to make the promise of PM a reality for patients.

2 WHY IS A NEW APPROACH TO PM NEEDED?

Challenges and barriers to the implementation of PM in cancer clinical practice exist across the healthcare system, including in research, diagnostics, and therapies. [13–15] PM is a complex, but time for cancer clinical practice, with many different components that need to be coordinated and strong alignment and movement across multiple disease areas. In contrast, the development of PM approaches in other disciplines, such as psychiatry, has been slow and fragmented. [16] Although there are many barriers to the implementation of PM, Multiplex Precision Medicine in Oncology Initiative, formed to advance the application of PM for Dresden cancer as diabetes, will outline a roadmap for the implementation of therapeutic pathways identified for single-gene variants as well as complex type 2 diabetes. [17] Although there are many challenges to implementation of PM, there is a strong foundation for successful PM approaches, including heterogeneous cancer genomics is individual, and tailored biomarker guided targeted therapies. [18] In rare diseases (e.g., inherit errors of metabolism), there is a need for a PM approach to ensure that patients receive the right treatment at the right time, however, access to high-quality genomic testing is a barrier to the development of therapies and therapeutic combinations. [19, 20] Despite these advances, there is little coherence between the different PM approaches in different disciplines, and there is a need for a coordinated approach to ensure that patients receive the best care and that there is a strong foundation for future priorities. It is possible for organizations to work together, however. For example, patient communities have been instrumental in the development of PM approaches in cancer, and there is a strong foundation for collaboration between patient communities and healthcare providers. Patient-led oncogenic groups are also active in promoting education as well as promoting and driving research and development of therapies, including in rare cancers, rare diseases, and solutions, which means they can work collaboratively, thereby synergizing efforts for improved outcomes.

Challenges in PM can only be overcome with solution-driven, innovative thinking and through collaboration between all stakeholders across the healthcare system, including healthcare providers (HCPs), medical researchers, policymakers, patient advocacy groups, patient representatives, and implement, patient communities. All parties must come together, collaborate, and co-create solutions to ensure that patients receive the best healthcare. Although there are many challenges to implementation of PM, there is a strong foundation, and it is also critical that patient voice is present from the outset, that patients and HCPs are involved in the development of PM approaches, and that PM approaches are driven by and authorized by patient needs and priorities. Patient-led oncogenic groups have been active in cancer research, diagnostics, and therapies, and therefore, there is a strong foundation for collaboration between patient communities and healthcare providers. It is possible for organizations to work together, however. For example, patient communities have been instrumental in the development of PM approaches in cancer, and there is a strong foundation for collaboration between patient communities and healthcare providers. Patient-led oncogenic groups are also active in promoting education as well as promoting and driving research and development of therapies, including in rare cancers, rare diseases, and solutions, which means they can work collaboratively, thereby synergizing efforts for improved outcomes.

Rapid increase in PM developments has led to a highly fragmented PM landscape, including in oncology, with many different approaches in different disciplines and different areas. There have unwarranted consequences for different stakeholder groups, including patients, whose access to PM is dependent on factors such as where they live, and healthcare providers, who might be overwhelmed by the quantity of PM approaches and the need to keep up with and have siloed approaches to PM. Fragmentation also means that attempts to implement PM are not coordinated, and there is a need for a roadmap to ensure that PM approaches are implemented in a coordinated way. This will minimize without overwhelming healthcare providers and ensure that patients receive the best healthcare.

Box 1. The consequences of fragmentation. A patient perspective

With advances in research, we now understand some of the oncogenic driver mutations and other factors that underpin cancer. This has led to the development of precision medicine approaches, including targeted therapies and immunotherapy, resulting in improved outcomes for patients. However, these approaches are not benefiting. The fragmented nature of the delivery of PM in lung cancer can lead to very different outcomes for patients. For example, the following two patients with advanced lung cancer and quality of life:

Example 1 PM implementation

- People where tumors are tested have undergone testing, have not been at risk of waiting, resulting in improved outcomes and improved quality of life.

Example 2 PM implementation

- People who have experienced poor prognosis have had their tumors changed significantly due to the progression of their cancer, resulting in poor outcomes.
- Testing is available but not the drugs and, resulting in poorer outcomes due to overwhelmed healthcare providers.
- Patients who are able to access PM are able to access the drugs but not the diagnostic to support.
- Previous testing results are not available, resulting in poor outcomes due to lack of appropriate diagnostic testing and delays to treatment for patients and HCPs.
- Patients being diagnosed with lung cancer who are not able to access PM are not benefiting from the advances in research and development of PM, and are disproportionately affected by the lack of access to PM, and are impacted by the lack of access to PM, and are impacted by the lack of access to PM, and are impacted by the lack of access to PM.

Box 2. Patient experience of precision medicine is variable

Example: Variation in experience reported through a focus group of patients with metastatic colorectal cancer who underwent molecular testing for treatment decision-making.

Participants were asked their experience of PM and the impact on their treatment journey. Participants targeted therapy as a first treatment option rather than the chemotherapy, saying the surgeon gaining knowledge of the tumor and the impact on treatment decision-making. Participants reported genetic testing, even when all previous treatments had failed, she felt beyond the treatment and felt that the treatment was "a lottery." Participants felt that the treatment was "a lottery." Participants felt that the treatment was "a lottery." Participants