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One for All, All for One? Containing the Promise of Solidarity in Precision Medicine

Abstract

This article addresses the challenges solidarity poses for the development of Precision Medicine (PM). Solidarity is invoked in calls for a new ‘social contract’ for PM, seeking to promote participation in PM by emphasizing reciprocity between contributions to and benefits from this new branch of medicine. In this context, there is a need for further conceptualization with regard to what qualifies as solidarity and how solidarity is performed in Precision Medicine initiatives. We address these conceptual gaps that have important practical implications for PM’s development, most notably for agendas of public engagement and trust. We argue that solidarity does not only represent a value but also takes on infrastructural forms, shaping how PM is practiced in, e.g., health care delivery systems. Next, we empirically probe how solidarity is invoked in PM initiatives in the United States (‘All of Us’-Program) and Europe (the UK 100,000 Genomes Project and the French 2025 Genomics Plan). Based on this analysis, we argue that the infrastructural dimension of solidarity forms a vital precondition to build trust in PM. Echoing the famous motto of *The Three Musketeers*, ‘One for all, all for one’, PM policies cannot just proclaim solidarity for the gathering of data alone (‘One for all’) without caring about delivery of benefits of PM (‘All for one’). We conclude by proposing an empirical research agenda for studying infrastructural formations to secure solidarity in the implementation of PM practices across national contexts.

Key words

Precision Medicine; solidarity; infrastructures; health care systems; trust; EU; US

Introduction

Precision medicine (PM) is widely promoted as a promising way forward for health care and as a domain of economic opportunity. As a novel approach to medicine, PM is supposed to bring advances in the understanding of human biology (in particular genomics and interrelated areas of basic biological functioning) and large-scale data generation and processing (providing insight into lifestyle and environment), which together are expected to improve the overall quality of health care (Dolsten & Soegaard, 2012). At the same time, we are witnessing a ‘race for innovation’ between nations, aimed at developing PM initiatives as a crucial aspect of many state-based economic strategies. Various countries - including the United States, the United Kingdom, France, Germany, and China – have formulated specific national PM strategies to mobilize competitive advantages and highlight expectations regarding scientific, economic, and societal benefits (Marx, 2015).

The frequent promises of PM’s medical and economic benefits have been characterized as a ‘hype’ (Feiler et al., 2017), and indeed the contribution of PM and its associated research domains remain uncertain in light of the, often unspecified, meaning of so-called ‘postgenomic’ science for medical practice (Reardon, 2017). An important promise of PM and the genomic sciences that are constitutive to it remains the advancement of social justice by scientific means, including the idea that genomic technologies provide a solution for health

disparities. PM researchers recognize these challenges, to a degree, by pointing to the challenges facing the so-called ‘translation’ of PM scientific insights to clinics and society (Manolio et al., 2013). While, historically, practices of biomedicine and biobanking have involved the mutual dependency between contributions and benefits, mobilization for PM is particularly challenging due to the massive amount and the type of data (genomics, lifestyle) that is required. Central to the promises of PM is the collection of large amounts of data, which in turn requires ‘the public’ to trust scientists to handle its data. The value of public trust is therefore considered crucial for the implementation of PM (Dzau & Ginsburg, 2016; Chan & Erikainen, 2018).

In response to alleged issues with public trust, PM actors increasingly frame their PM visions in terms of ‘a new social contract’ between citizens and the health care system (Desmond-Hellmann, 2012). This social contract is rooted in a notion of reciprocity between institutions supporting the establishment of PM and citizens. While the former commit to providing improved health care and economic progress to the benefit of all, they do so on the condition that the latter contribute genomic and health data to PM research. Policymakers thus mark PM not only with grand claims on scientific and economic benefits, but also with the formation of a new communal identity (Reardon, 2017). In this context, PM initiatives make reference to social values purportedly accounted for in the new social contract, including the values of patient engagement, inclusion and solidarity (Juengst et al., 2016; Prainsack, 2018).

Yet the question remains how solidarity is articulated in various PM initiatives. In general, solidarity can be defined as a (shared) commitment to accept the ‘costs’ (in the wide sense of the word) of supporting others with whom people recognize relevant similarities (Prainsack & Buyx, 2017). The costs implied in PM are the contributions individuals make in sharing their data for the

benefit of others. As similar discussions in social studies of insurance suggest, solidarity can be sketched in the terms of ‘one for all, all for one’, as epitomized in the famous motto of *The Three Musketeers*. Adopting from Husted’s analysis of the problem of genetics and insurance (1999), the nineteenth-century novel’s motto encapsulates two crucial dimensions of solidarity: *One for all* implies the need for each musketeer to contribute his share to render their unity viable, stressing the obligations of the individual to *stand together* with others. *All for one* suggests that a musketeer in distress will be wholeheartedly and courageously supported by the other musketeers. Here the importance of *standing by* one in need of help is emphasized, stressing the obligation of support in reverse direction, from the group or collective toward its individual members. If and how both of these dimensions are considered when incorporating aspirations of solidarity in PM initiatives, however, is an open question. We explore that question below, and begin by grounding our analysis in various perspectives on how solidarity may be defined and performed in PM. Next, we explore how solidarity has been articulated in national discourses of PM initiatives in the United States (‘All of Us’-Program) and Europe (the UK’s 100,000 Genomes Project and the French 2025 Genomics Plan). Based on these observations, we suggest that infrastructural formations to secure solidarity form a vital precondition to build trust in PM through the mutual sharing of contributions to and benefits from PM. Echoing the motto of *The Three Musketeers*, PM policies

cannot just proclaim solidarity for the gathering of data alone ('one for all') without showing any concern for the individual benefits of PM ('all for one').

Articulating solidarity in precision medicine

Ethical, Legal and Social Implications (ELSI) scholarship in Precision Medicine (PM) has indicated the need for uptake of social values in PM implementation agendas, including the values of patient engagement, solidarity, and inclusion (Sankar & Parker, 2017). These values are invoked by PM actors as part of a new 'social contract' implying the recognition of citizens that they and everybody else will benefit from medical science if they allow data about their own genome to be collected and shared (Desmond-Hellmann, 2012). Yet various observers have seen this social contract critically, pointing to the uncertain links between research participation and access to benefits (Juengst et al., 2016; Reardon, 2017; Prainsack, 2018; Blassimme et al., 2019). Reardon (2017), for example, raises the question if and how large-scale data collection in genomics will produce societal benefits. In her view, postgenomic research is still in formation, making its benefits unclear and largely a matter of as-yet unsubstantiated promises. Such promises of future benefits can obscure present inequalities, as Benjamin (2014) shows in the context of public investments in stem cell science in California. She argues that investments in speculative innovations imply a marginalization of basic health care in the present.

These observations have profound implications for understanding the challenges for solidarity in the context of PM, despite its promotion as a value in various PM initiatives. Bio-ethical scholarship has discussed solidarity as an analytical lens to explore and redefine the balance between individual rights and collective duties in the context of genomic medicine (Dickinson, 2013; Sabatello & Appelbaum, 2017; Prainsack, 2018). The focus is here on the promise of

solidarity, as a value performed by our fellow-citizens to mobilize recruitment to PM, while critically outlining the role of rhetoric and dogma in the employment of nationalist sentiments for public health in the future (Sabatello & Appelbaum, 2017). This expresses the *stand together* aspect of the Three Musketeers' motto ('One for all'), where the individual has to contribute his/her share to make the unity viable, given that PM can only exist by virtue of the many data.

Recently, scholarship in this field has also indicated the role of healthcare delivery systems in articulating solidarity in PM (Prainsack, 2018; Hoeyer, 2019). The attention shifts here to the infrastructural aspects of solidarity, or how solidarity *matters* as a social value inscribed in, and performed by, diverse institutions, formations and categorizations (Van Hoyweghen & Horstman, 2010; McFall, 2019). Understanding solidarity as infrastructural means that we see it as a (materialized) value that operates 'in the background' (Slota & Bowker 2017: 529) and shapes (or may shape) development of PM in biomedical practice. Solidarity is not only a value performed by our fellow-citizens but is produced in and by specific forms of infrastructures, such as health care delivery systems, notably through the mechanisms of insurance. Scholarship in social studies of insurance demonstrates the role of insurance as a 'normative technology' (Baker & Simon, 2002), actively producing solidarity in linking individual and common interests. Insurance is a 'moral infrastructure' (Hinrichs, 1995) that allows payment responsibility to protect citizens against the risks of illness, accidents

and unemployment. It thus expresses the *stand by* aspect of solidarity, the obligations of the group or collective towards its individual members ('All for one'). This dimension of solidarity has long constituted the organization of health care in the welfare states of Europe. Here, access to care is funded through either mandatory payment of an insurance premium (e.g. France, Germany) or taxation (e.g. UK). Historically, these welfare state models of health care have been shown to provide the basis for public trust (Van Oorschot & Arts, 2005; Horn & Kerasidou, 2020).

The idea that solidarity is infrastructural loops back to the way it is mobilized in PM initiatives as not just a value that informs the call for participation and promise of benefit but one that centrally depends on adequate health care delivery systems. Below we explore how this dimension – the presence (or absence) of infrastructural formations for securing solidarity - is accounted for, and problematized, in national policy discourses of PM initiatives. As PM involves a work-in-progress and the details of the practices of PM implementation are not yet known, any conclusive appraisal would be premature. However, an exploratory analysis of PM actors' visions on the articulation of solidarity can facilitate the debate on the development of procedures that can maximize PM's translation.

Precision medicine visions of solidarity in the United States and Europe

While PM is established in an increasingly global network of expertise and capital, the focus of this article is on national PM initiatives. Not only do various national governments establish their own, often competing, PM initiatives; the nation-state is (still) predominantly the scale at which decision-making regarding the delivery of health care takes place, at least in the majority of industrialized nations where many PM initiatives are being unfolded. We therefore illustrate

how solidarity is framed in written accounts on PM visions in three specific (national) contexts: the United States, the United Kingdom, and France – the last two being regarded as ‘prime examples’ of PM implementation in Europe (EU Reporter, 2018).

Methods

To probe how solidarity is invoked in PM actors’ and policy discourses across different (national) contexts, we have drawn on various sources of primary and secondary data. First, we performed desk research of national government reports, regulatory documents, science policy reports, and journal articles published by public authorities on PM (2014-2020). We accessed documents through official government websites in the US, the EU, the UK, and France, and retrieved materials through a PubMed search on ‘Precision Medicines Initiatives’ (which yielded 27 results in title/abstract, out of 204 overall), ‘Precision Medicine’ and ‘ELSI’ (which yielded 12 results in title/abstract, out of 13 overall), and ‘Precision Medicine’ and ‘ethics’ (which yielded 361 results in title/abstract, out of 464 overall). Secondly, we drew on archival research and textual analysis of public statements in national and international newspapers, social media (websites, blogs, newsletters, Twitter), and popular scientific reports released by national PM initiatives. In this way, we considered a total of 78

sources to study how solidarity is invoked, which we analyzed by means of critical discourse analysis methodologies (Wodak & Meyer, 2009).

United States ‘All of Us’– the promise of solidarity

On January 20, 2015, then US president, Barack Obama, announced the Precision Medicine Initiative® (PMI) in his State of the Union address. As part of the PMI, the National Institutes of Health (NIH) is ‘leading the effort to build a national, large-scale research enterprise with one million or more volunteers to extend precision medicine to all diseases’ (White House, 2015). The PMI supports research at the intersection of lifestyle, the environment and genetics to create precision medicine as ‘Health care tailored to *You*’. The benefit of federal investments in PM for the individual was thereby put center-stage. An important prerequisite for achieving these individual benefits was the participation of large numbers of patients and healthy individuals. To seek this widespread participation, the PMI invoked important social values related to patient empowerment, data-sharing and solidarity (Sabatello & Appelbaum, 2017). As Obama recalled, ‘the PMI is about empowering patients to use their data for the common good’ (cited in: Stone, 2016). Seeking widespread participation, PMI actors increasingly acknowledged that in order to recruit more broadly from the population, the PMI needed ‘to build the trust of the American folks’ (Collins, cited in: Cunningham, 2018).

In 2016, to drive home the message that the aim of PM was to produce comprehensive public health benefits for the US population, Obama renamed the PMI as ‘All of Us. The future of health begins with you’ (National Institutes of Health, 2018). This alignment of individual and collective benefit made the underlying value of solidarity more explicit. PM involves health care that begins with *you*, and that benefits ‘all of us’. ‘That’s how we will overcome the

challenges we face: by unleashing the power *of* all of us *for* all of us. Not just for those of us who are fortunate, but for everybody’ (Obama, 2016). Reflecting back at the messaging makeover, the director of the PMI/All of Us, Francis Collins, recalled that he wanted an ‘inclusive-sounding name’ because one of the PMI’s key goals was ‘a diverse range of participants’. The program’s renaming was thus meant to overcome important barriers to participation. In order to build trust in the initiative, ‘All of Us’ articulated a set of core values, including ‘openness, diversity, patient engagement, inclusion, and privacy safeguards’. As the website puts it: ‘The name change reflects these values. We will invite people from all across the US to raise their hands to be one of a million or more participants who will contribute their health information’ (National Institutes of Health, 2016). The renaming articulated the new social contract for PM in the US, which was now expressed as ‘a truly inclusive effort’: ‘We are calling every person in every community in America to give, for ourselves, for our communities and for our future’ (National Institutes of Health, 2018).

Yet, in transforming ‘All of Us’ from a research project to a population-wide health program, not only the recruitment of participants forms a challenge. Elements of the infrastructure of health care systems in the US are also characterized as potential obstacles. In a White Paper, ‘Transforming Healthcare with Next-Generation Genome Sequencing’, industry partners announced that the ‘US health care provision structure is not optimal in place to streamline WGS

[whole genome sequencing]’ (Intel & Illumina, 2016). This White Paper identified the following paradox: there is a lack of insurance funding for genome sequencing in the absence of clear evidence of the benefit of testing, while, conversely, there is the inability to provide evidence that sequencing would be an adequate ‘standard of care’ because clinicians are reluctant to offer this type of testing if it is not paid by insurers. Calling this a ‘vicious circle’, the paper’s authors observe that both clinicians and payers are reluctant because the US health care system is not adequately positioned to facilitate the ‘circulation of data’ for PM. This problem of the mismatch between the progress of PM and its payment, also called ‘the reimbursement sandwich’ (Chaihorsky, 2019) was also identified by other US health care actors, including the American Medical Association (Robeznieks, 2017).

The Intel & Illumina White Paper further points to a lack of participation among citizens who are reluctant to undergo WGS testing due to concerns about affordability in light of unequal access to health care: ‘Because payers are not covering the costs of NGS [next generation sequencing] testing, precision medicine is often available only to individuals who can pay the costs themselves, or who live near major urban medical centers that cover the costs as part of research initiatives’ (Intel & Illumina, 2016). Many of these high-value diagnostic tests or PM services are not covered by health insurance companies in the US (Phillips et al., 2017; Markens, 2017). But even if these tests would be reimbursed, in many cases the extensive and expensive follow-up is not covered (Timmermans & Buchbinder, 2012). Questions of access and affordability are thus articulated as critical with regard to how health care delivery in the US may shape Precision Medicine and are considered to form an important barrier for participation in PM. The ‘All of Us’ Research Program has its core social values of openness and inclusion to build public trust to encourage participants to enroll.

The promise of shared benefits thereby serves to stimulate PM research but does not guarantee access to these benefits due to the particular set-up of the US healthcare system. This results in important trust issues that purportedly make US stakeholders (clinicians, payers, patients) reluctant to enroll. The promise of solidarity, which is implicitly mobilized in the ‘All of Us’ visions, may thereby not become reality due to the absence of an adequate health care system.

Precision medicine initiatives in Europe

‘If the US can pull off a project of such magnitude with its 300 million citizens then, surely, the EU can achieve the same with 500 million across 28 member states.’ (Horgan, cited in: Petrone, 2016)

As this quote from the European Alliance for Personalised Medicine (EAPME) demonstrates, Europe is actively positioning itself in relation to PM initiatives in the US, suggesting it has certain competitive advantages. Not long after the US PM initiative, the Million European Genomes Alliance (MEGA) was launched as a response (Horgan et al., 2017). In fact, the Luxembourg EU presidency made personalized medicine a priority area (see, for example, Council of the European Union, 2015; European Commission, 2014), and in May 2018, at the European Commission’s Digital Day held in conjunction with the Bulgarian EU Presidency, 15 EU member states signed a Joint Declaration to collaborate on a groundbreaking one-million genomes project (European Commission, 2018).

Policymakers in the European Union have been equally explicit about the need for citizens to contribute time, data, and effort to personalized medicine. In line with ‘All of Us’ in the United States, PM in Europe seeks wide participation by individuals and does so by importing social values, such as patient engagement, data sharing and solidarity. These values are reflected once more in the (re-)naming of European PM visions: initially, a shift was announced from a ‘Health for All’ to an ‘All for Health’ approach (EGE, 2015), mobilizing citizen participation and empowerment for PM. In 2016, the EC Commissioner for Research, Science and Innovation, Carlos Moedas, presented the slogan ‘Better Health for All, One Person at a Time’ (Moedas, 2016), re-emphasizing that the benefits for PM are there ‘for all’, consistent with the ‘All for Health’ agenda of the European Union. The alignment of the individual’s contribution (‘All for Health’) with the community’s benefit (‘Health for All’) is thereby deployed as an important operator of solidarity.

This emphasis on solidarity in PM visions is not a coincidence in the European political context. In stark contrast with the novel and mostly implicit reference to solidarity in the American ‘All of Us’, solidarity is one of the ‘supreme political values of the European Union’, as European Commissioner Carlos Moedas recalls (Horizon 2020 Projects, 2016). The principle of solidarity is enshrined in important European regulation, including the EU Treaty, the Charter of Fundamental Rights of the European Union, the Lisbon Agenda, and the European Pillar of Social Rights (Van Hoyweghen et al., 2020). The value of solidarity in the EU is aligned with the political logic of the universalist welfare state, where science and the state work hand-in-hand to develop policies for the public good through the redistribution of benefits. While the European Union has developed its PM vision, PM implementation largely remains within the remit of individual EU member states, in line with the EU subsidiarity principle and the

(historically) national competencies in health care. What is common across these national PM initiatives in Europe is that they, in contrast to the US, explicitly mobilize their universal health care coverage systems as a critical precondition for successful development of PM. To examine what is at stake here, the next section will investigate two of these recent initiatives in countries at the forefront of PM in the European context: the 100,000 genomes project in the UK and the Genomics Medicine 2025 Plan in France.

100,000 Genomes Project– a ‘transformative actor’ for the National Health Service

The UK’s 100,000 Genomes project was launched in 2012 with the aim of sequencing 100,000 genomes from UK National Health Service (NHS) patients. The project is led by an NHS-owned company, Genomics England, and involves the formation of 13 Genomics Medicine Centres (GMCs) to enable the NHS to act as a ‘natural local customer’ (Monitor Deloitte, 2015). Genomics England actors explicitly state that the embedding of the 100K project within the National Health Service (NHS) will help to deliver the promises of PM. As board member John Bell expressed:

‘The NHS already holds extensive clinical information on individuals, and pairing this with detailed genomic data will enable powerful insights into the links between medicine and genetics (...) The state-funded,

centralized UK health-care system is ideal for such population-based approaches in genomic medicine' (Bell, cited in: Marx, 2015).

At the same time, the 100,000 genomes project is considered an ultimate vector to spur innovation in the NHS system with the potential to fundamentally change the way the NHS is run. The NHS is thereby positioned as a unique selling point for the functionality of PM where the 100K genomes project offers the UK both potential health benefits and projected economic returns. The promotion of PM through the established structure of the NHS thereby builds on a deeply engrained sense of national pride attributed to the health service (which often surfaces in public controversies, for example as a focal point in campaigns preceding the Brexit referendum), while simultaneously mobilizing the trope that the NHS is perennially in need of improvement to argue for the benefits PM may bring.

However, since its official start in 2012, the UK genomes project has encountered serious challenges to its implementation. Among the issues raised were the alignment of the new PM project with the (existing) NHS infrastructure (e.g., with molecular pathology diagnostic classifications, Karkow, 2017) and logistical hurdles resulting from the dispersed character of the regional genomic laboratories (Samuel & Forsides, 2017). Most notably, ethical controversy has arisen concerning issues of privacy and data protection, seriously affecting public trust in the 100,000 Genomes Project (Powles & Hodson, 2017). These challenges have resulted in considerable delays for the UK genomes project.

Genomics Medicine 2025— a 'French touch' to precision medicine

In France, the Genomic Medicine Plan 2025 was launched in 2016 with the goal of sequencing 235,000 genomes annually. Even more so than in the UK, where the NHS is seen to facilitate the establishment of PM, PM is explicitly considered

in the French Plan to be part of universal health care coverage, framed in terms of solidarity. In the Plan, the specifics of the French health care system are explicitly portrayed as a success factor, accentuating the particular ‘French touch’ of PM implementation (Aviesan, 2016).

The Plan explains its competitive advantage as the integration of genomics medicine into the general health care system to pave the way for the implementation of PM ‘to the benefit of as many people as possible’ (Aviesan, 2016). This guiding role for France is also stipulated in the Plan’s ethical dimension: ‘In this field too France has to construct a new model—here too France will innovate’ (Aviesan, 2016). In his inaugural speech on the Genomic Medicine Plan, the French Prime-Minister at the time, Edouard Philippe described this ethical dimension in terms of a social contract: ‘If we do not exercise all the necessary ethical rigor in our collective undertaking, we would risk a rupture in the democratic pact between science and society’ (Philippe, 2017) [author’s translation].

The notion of a ‘democratic pact between science and society’ is in line with the value of solidarity as enshrined in the French health care delivery system. The value of solidarity is thus fundamentally linked to the way health care policy is materialized in France. If this renders the idea of delivering PM via existing health care systems functionally appropriate (since it is a straightforward way of making sure new forms of treatment are available to patients), it also offers a way

of dealing with accessibility in terms of social values that are presented as quintessentially ‘French’. In the French initiative, the functionality of incorporating PM into existing forms of health care delivery is thus intricately bound up with the social meaning attributed to the health care system and, particularly, with the way in which it ensures broad access to the population.

Competing for solidarity in the precision medicine nation race

The arguments put forward, whereby each national health care system supposedly has a unique ability to incorporate PM, seem to result in competition *between* nation-states framed in terms of solidarity. This became visible in a UK report published a couple of months after the French Plan, entitled *Generation Genomes*. The UK report was deliberately positioned in relation to the ‘French touch’: ‘Other countries, like France, have started a centralised national genomic plan and associated delivery structure. (...) a concerted UK effort is required (...)’ (Generation Genome, 2017). To maintain their leading position, the report recommends - echoing the French Plan - a nationalization of UK genomic medicine through up-scaling, standardization and centralization of genomic laboratories and services, as the next step towards the new NHS Genomic Medicine Service.

Most notably, the notion of ‘social contract’ now also takes center-stage in the PM set-up in the UK, which signifies a broader mobilization of social values to argue for the publicly responsible nature of the project. The idea of ‘a new social contract’ for PM is introduced as an important condition for public trust, emphasizing the value of solidarity, which is considered to the functional benefit of PM:

‘The basis for greater trust and confidence created by such a social contract could encourage the growth of ‘genomic citizenship’ or genetic

altruism and solidarity (...) Genomics offers benefits and responsibilities (...) that cannot be realized by keeping the secrets revealed from one genome separate from others' (Generation Genome, 2017).

Besides the notion of 'genomic altruism', the UK Report also mentions the notion of 'mutuality' - as 'the optimum way to use genomic information to improve services for mutual gain' (Generation Genome, 2017). Here, trust is based on the idea that people are part of an *enduring* arrangement where benefits and obligations of PM are mutualized. As the UK report stresses: 'It will not be reasonable to expect people to accept the new social contract unless the health service accepts responsibilities for ensuring that the benefits will be available to all.'

Importantly, what we see here is not merely an appeal to the promise of solidarity for the sharing of data in PM but an emphasis on systems of universal health care coverage as systems where mutual gain is to be achieved. As Montgomery (2017) notices, the new social contract for PM in the UK is in this sense a re-framing of the implicit social contract that underpins UK health services. This is expressed in the Beveridge founding principles of the NHS to democratize services ensuring 'excellent care for all' as expressed in the NHS Constitution (Department of Health & Social Care, 2015). The value of solidarity is underwritten here by the institutional arrangement of the NHS, offering

universal health care to all UK citizens. Similar now to the French PM vision, the functionality of incorporating PM into the UK's health care delivery system is intricately bound up with the social meaning attributed to the NHS and, particularly, the way in which it ensures broad access to the population.

Discussion and Conclusion

In this article we foregrounded the infrastructural dimension of solidarity in the development of Precision Medicine (PM). We compared how PM actors articulate the value of solidarity in promoting PM in the United States and Europe, France and the United Kingdom in particular. Based on this analysis, we showed how both US and European PM actors invoke the value of solidarity in promoting widespread participation in PM as valuable to 'all of us' through an affective discourse that encourages individuals to contribute to PM through appeals not only to patient empowerment but also to data-sharing and inclusiveness. These values were imprinted in the (re-)naming of the US and European PM initiatives: the rebranding of 'PMI' into 'All of Us' in the US, and the shift from an 'All for Health' to a 'Better Health for All, One Person at a Time' in the EU. At the same time, we saw important differences in the way solidarity was 'infrastructural' in shaping efforts to develop PM in the US and Europe. In the United States, widespread participation in PM, although promoted through an appeal to data-sharing as valuable to 'all of us', was considered to be significantly hindered by the absence of health care systems that would make benefits widely accessible. This state of affairs contrasts with the European Union's claims on PM, which have assertively linked the social contract for PM to universal health care coverage. Yet such a social contract remains in the hands of EU member states, since health care largely remains a domain subject to subsidiarity. Thus, we saw illustrative differences between the UK, where the

National Health Service (NHS) was initially referenced as functionally enabling PM, and France, where we saw a strong emphasis on population-wide health care delivery as a central element for PM – an emphasis on mutualization of contributions and benefits that was later also adopted in the UK in order to stimulate developments in the UK 100K genomics project.

Despite ‘All of Us’ proponents’ promise of solidarity as shared benefit for ‘all of us’, in the American PMI there are no guarantees that participants will actually benefit from enrollment in PM due to the specific US health care delivery system. Unlike in European countries, where public health care systems are built on welfare state models, the US health care system is structured by a private and employment-based health insurance model, often failing to provide stable and consistent health insurance coverage. The US health care delivery system as such is not aligned with the new social contract for PM and the core social values of ‘All of Us’ in the United States. In Europe, PM initiatives purportedly stage their welfare states’ universal health care systems as a condition for success of PM. The PM initiatives’ evocation of French and British health care delivery is indicative of how an older social contract, based on a model of trust in the welfare state through an insurance ‘contract of solidarity’ (Ewald, 1986), continues to be leveraged in support of the anticipated new knowledge infrastructures of PM.

Noteworthy in the various articulations of solidarity rooted in a new social contract model for PM is thus the central role of health care delivery systems, which were alternately perceived as obstacles, facilitators or preconditions for the successful development of PM. Considering the various ways in which these systems are mobilized in the interest of developing PM – and how a lack of attention to infrastructural dimensions of health care delivery was considered to imperil some of the PM initiatives – we argue that infrastructural practices for securing solidarity should be considered vital for the implementation of PM. For the value of solidarity to structure PM initiatives, it requires adequate systems of delivery of the benefits of PM to guarantee that those who deliver data (‘One for all’) will also benefit (‘All for one’). Reflecting back on The Three Musketeers’ motto, PM policies cannot just proclaim solidarity for the gathering of data alone without caring about delivery of benefits. Without guaranteeing access to PM benefits, the PM social contract requests from participants something closer to pure altruism: sharing their data without a plan to ensure that they and their families enjoy the benefits arising from PM. We argue that the two sides of solidarity – ‘one for all’ and ‘all for one’ – need to be practiced in tandem to foster public trust in Precision Medicine.

As a central question for the various national PM initiatives, we may thus wonder whether solidarity will become the litmus test for PM implementation. The argument we develop in this article is based on an exploratory analysis of PM visions – whether and how it accounts for the reality of PM in practice needs to be further investigated. Accordingly, we propose a comparative empirical research agenda to study the concrete ways in which solidarity serves to structure practices of PM across specific (national) contexts, for example through health

care delivery systems. Elements of this research agenda have so far been elaborated in studies attending to the distributive practices for genomic and personalized medicine in distinct national health care systems (Aarden et al., 2009, 2010). Several of these studies consider Scandinavian countries, which have long-standing traditions of public health care delivery and population-scale data collection that governments seek to make productive for the purpose of data-centered health research and PM (Hoeyer, 2019; Cool, 2016). Such studies point out how PM initiatives contribute to changing relations between the state, citizens and the private sector, and are often speculative with regard to the implications of PM – observations similar to the ones our analysis of policy visions alludes to. Moreover, Gjødsbøl and colleagues (2019) point out that the promises and imaginations surrounding PM often do not align with how clinicians tend to approach genetic dimensions of disease. Studies of health care delivery practices in the era of postgenomics (Reardon, 2017) thus challenge some of the most far-reaching promises expressed in policy visions, showing how aspects of the ‘all for one’ dimension of solidarity are critical to making the ‘one for all’ work. In other words, the relation between states, citizens and other actors matters not only to the delivery of PM benefits, but also to producing such benefits to begin with. As PM initiatives represent a ‘constitutional moment’ (Jasanoff, 2003) in the understanding of the relationship between citizens and states, we should not stop to monitor the proper conditions for the genomic citizenship of PM and whether

they meet the promise of solidarity associated with ‘All for Health’ or ‘All of Us’.

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