





# Building Research Support Capacity across Human Health Biobanks during the COVID-19 Pandemic

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**ABSTRACT:** Human health biobanks are forms of research infrastructure that supply biospecimens and associated data to researchers, and therefore juxtapose the activities of clinical care and biomedical research. The discipline of biobanking has existed for over 20 years and is supported by several international professional societies and dedicated academic journals. However, despite both rising research demand for human biospecimens, and the growth of biobanking as an academic discipline, many individual biobanks continue to experience sustainability challenges. This commentary will summarize how the COVID-19 pandemic is creating new challenges and opportunities for both the health biobanking sector and the supporting discipline of biobanking. While the challenges for biobanks may be numerous and acute, there are opportunities for both individual biobanks and the discipline of biobanking to embrace change such that biobanks can continue to support and drive biomedical research. We will therefore describe numerous practical steps that individual biobanks and/or the discipline of biobanking can take to survive and possibly thrive in response to the COVID-19 pandemic.

**KEYWORDS:** biobanking, COVID-19, health biobank, infrastructure, research support, sustainability

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## Introduction

Human biobanks or biorepositories collect and supply human biospecimens and associated data for research,<sup>1,2</sup> and are of key importance to biomarker research, which relies upon the availability of quality human biospecimens for both the discovery and sequential testing of candidate biomarkers.<sup>3</sup> Human health biobanks can therefore be considered a form of glue that connects patient care and biomedical and health research. Indeed, there are numerous parallels between the functions of both adhesive glue and biobanking. As an invisible substance, particularly once set in place, glue is often only fully appreciated when needed but not at hand. While glue also appears to be a simple substance, its composition and function are the result of years of painstaking testing and optimization. There are also different types of glue, as it is well known that different adhesives are required to stably connect different surfaces. Finally, glue needs to maintain its function under pressure and to expand and contract according to changing environmental conditions. Given the many disruptive effects of the COVID-19 pandemic,<sup>4–12</sup> it is not surprising that the resulting changes to the delivery of health care and/or the conduct of research are adding further stresses to the already strained glue of biobanking.

This commentary will focus upon biobanks that provide human biospecimens for research, for several reasons. Firstly,

many individual biobanks are indicated to store and distribute human biospecimens,<sup>13</sup> compared with for example the number of environmental biobanks.<sup>4</sup> This means that more resources are devoted to biobanking human biospecimens than other sample types, and as such, human biobanks merit both particular recognition and scrutiny. Secondly, human biobanks are more likely to be directly and indirectly affected by a human disease pandemic, compared with other biobank types. Finally, as cross-sector effects such as reduced financial support for research, facility access restrictions and social distancing requirements are likely to generically affect most types of biobanks, some of the challenges and opportunities that we will describe may be relevant across the broader biobanking sector.

### *Biobanks compared with other forms of research infrastructure*

Before describing the impacts of the COVID-19 pandemic upon human biobanks and the overall discipline of biobanking, we will first consider the extent to which biobanks resemble or differ from other research infrastructure facilities (Table 1). When compared with small animal houses, microscopy and imaging facilities, and DNA sequencing services, biobanks have several distinguishing features (Table 1).<sup>14,15</sup> While recognizing the growing importance of process



**Table 1.** Comparison of biobanks and other forms of research infrastructure.

INFRASTRUCTURE FEATURES/ACTIVITIES	BIOBANKS	SMALL ANIMAL	MICROSCOPY/IMAGING	DNA SEQUENCING
Specialised infrastructure required?	+ / ++	+++	+++	+++
External material acquisition & distribution?	+++	++	-	-
Direct support of local researchers?	+++	+++	+++	+++
Direct support of distant/national researchers?	++	++	+	+++
Direct support of international researchers?	++	+ / -	+ / -	+
Cost recovery/fee for services?	+ / -	+++	++	+++

-, not applicable/not performed; +, minor and/or infrequent feature/ activity; ++, routine and/or moderately frequent feature/ activity; +++, major and/or frequent feature/activity.

automation within large, well-resourced biobanks,<sup>16</sup> small biobanks can be established with access to laboratory personnel, laboratory space, and generic laboratory equipment such as freezers and a networked computer.<sup>15</sup> This low-cost entry point has led clinicians and researchers to frequently collect their own samples and data if their requirements are not, or are perceived to be not easily available elsewhere.<sup>14,15,17</sup> Biobanks also differ through their strong focus upon acquiring, processing, storing and distributing externally-obtained material and data, where these materials are also often limited in quantity and finite in nature.<sup>14</sup> Finally, unlike other forms of research infrastructure which effectively operate on a fee-for-service basis, biobanks have historically shown a more limited capacity to recover costs from their research clients (Table 1).<sup>14,18-21</sup>

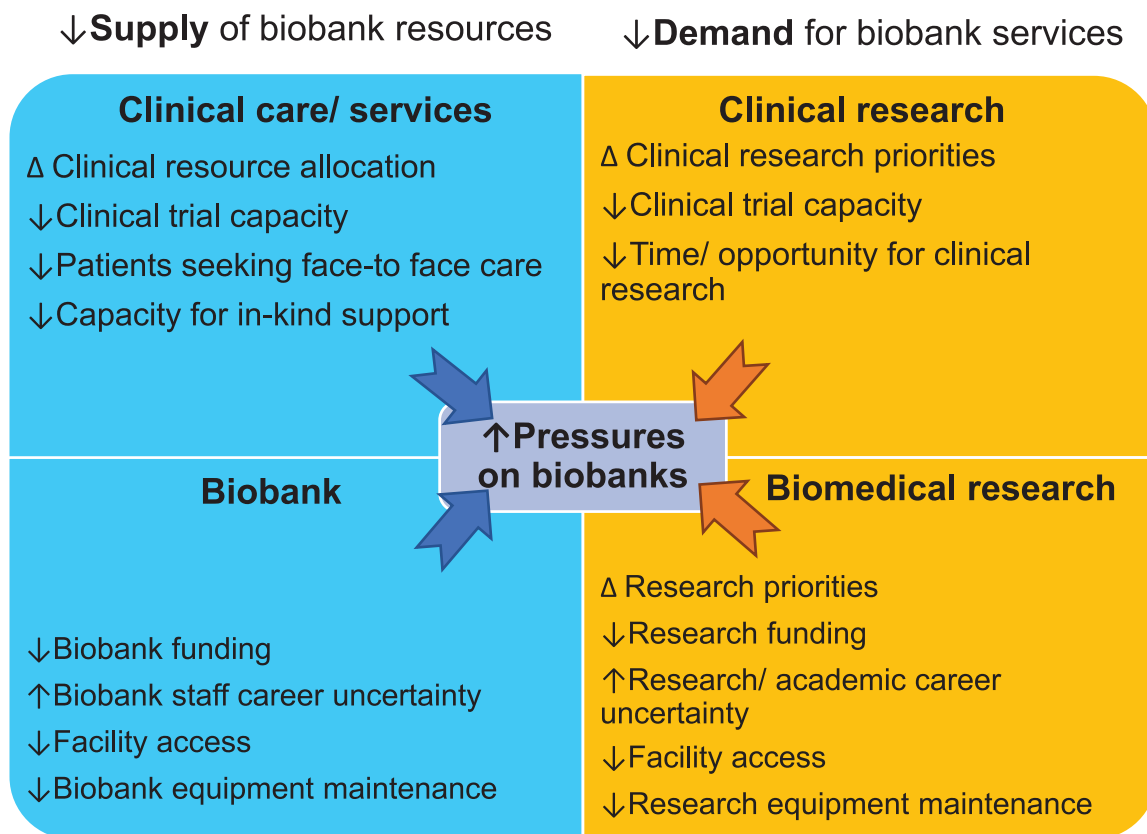
Despite their contributions to biomedical and health research, biobanks have reported sustainability challenges,<sup>2,22</sup> which largely arise from biobank under-utilization relative to their required financial support and/or capacity for cost recovery.<sup>17,18,21,23,24</sup> Biobank under-utilization is likely to be driven by several factors. As described above, it is relatively straightforward to establish a small human biobank,<sup>15</sup> as biospecimens and data can be readily procured through routine health care and/or research studies, and generic, low-cost infrastructure can suffice to store biospecimens and associated data (Table 1). While biobanks are relatively inexpensive to establish, their ongoing reliance upon dedicated staff means that biobanks are expensive to maintain over the years or decades that may be required for biospecimens and data to accrue in both numbers and research value.<sup>1,17,18,25</sup> The resulting human health biobank landscape of many individual biobanks can result in biospecimen duplication and redundancy,<sup>15</sup> poor research visibility of individual biobanks, difficulties in maintaining necessary financial support and best practice standards,<sup>14</sup> and the possible direction of scarce resources toward collections of biospecimens and data that may be not, or no longer, fit for purpose.<sup>26</sup>

### *Impact of the COVID-19 pandemic on clinical care, biomedical and health research and biobanking*

Since March 2020, the COVID-19 pandemic has exerted profound effects on human health and national economies that are likely to continue for many years.<sup>4-11</sup> While recognizing that researchers and by extension biobankers may have experienced less serious hardship than other affected professionals,<sup>7</sup> the COVID-19 pandemic is nonetheless exerting particular pressures on biobanks, due to the position of biobanking at the nexus between clinical care and research (Figure 1). Pressures on biobanking can therefore be indirect through changes in the provision of health care and/or support for research, as well as direct by constraining biobank operations or funding.<sup>4</sup> These pressures can reduce the supply of necessary biobanking resources, the research demand for biobanking services and/or the direct financial support that is available to biobanks (Figure 1).

In many countries, health care resources have been rapidly reorganized to support COVID-19 diagnostic screening and testing, the clinical care of rising numbers of COVID-19 patients,<sup>4,8,9</sup> and increasingly, the mass roll-out of COVID-19 vaccination programs. There have been rapid and marked transitions away from face-to-face health care provision to telehealth consultations, restrictions upon elective surgery, and patients electing to delay or cancel appointments.<sup>8,9</sup> With the possible exception of COVID-19 research and clinical trials, fewer face-to-face interactions between patients and clinical staff have reduced opportunities for traditional patient consenting and biospecimen collection (Figure 1).<sup>4</sup> Reassignment of clinical staff to other duties may have also reduced some previous opportunities for clinicians to engage in research, which may affect both the supply of in-kind support for biobanks, as well as clinical research demand for biobank services (Figure 1).

The COVID-19 pandemic has also seriously affected many aspects of biomedical research (Figure 1).<sup>5-11</sup> Again with the possible exception of COVID-19 research,<sup>6</sup> government



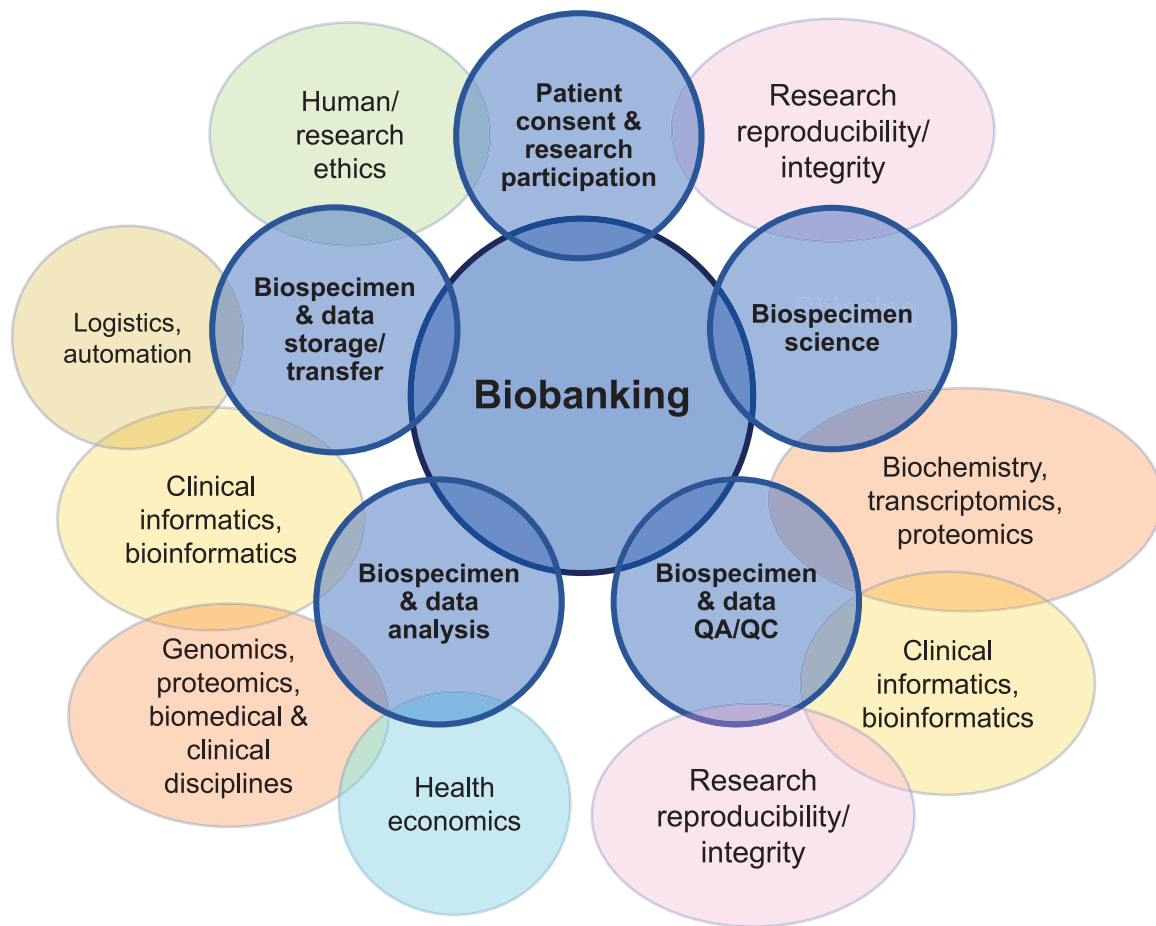
**Figure 1.** Diagrammatic summary of the direct and indirect pressures that are being exerted on human health biobanking by the COVID-19 pandemic. Blue panels (at left) include factors that may reduce the supply of biobank resources, whereas orange panels (at right) include factors that may reduce the demand for biobank services. The triangle symbol represents changed activities, whereas downward arrows indicated reduced activities.

research budgets are likely to reduce in real terms due to widespread economic downturns, adding to the effects of years of largely stagnant research budgets in many countries. Some University budgets have been impacted by fewer international student enrolments, leading to academic job losses and adverse effects on academic and research careers (Figure 1). The philanthropic support of research has also been affected, through a reduced capacity to raise funds through social events, increased competition within the on-line fundraising environment, and reduced community capacity to donate (Figure 1).<sup>10</sup> Reduced funding could lead researchers to abandon biospecimen-driven projects and/or increasingly seek the most affordable biospecimens and data, as opposed to quality biospecimens from professional biobanks.<sup>14</sup> At an operational level, social distancing requirements have reduced access to both research laboratories and infrastructure facilities such as biobanks,<sup>4,6,7,27</sup> and in geographically isolated countries, travel restrictions are preventing specialist engineers from servicing or repairing essential research and biobank equipment (Figure 1). In summary, reduced biomedical and health research funding and capacity is likely to reduce research demand for non-COVID-19 biospecimens and data (Figure 1), further reducing the capacity of biobanks to recover their operating costs through research support and/or service provision,<sup>18–21</sup> and placing further pressures on biobank sustainability.

We recognize that the combined challenges of the COVID-19 pandemic risk painting a bleak picture of the future of human biobanks and their research clients, as has been further described elsewhere.<sup>4,12</sup> However, as has been argued for other dimensions of society,<sup>5</sup> the COVID-19 pandemic is likely to force changes that may have been due within the discipline of biobanking for many years and which are now simply unavoidable. At the same time, new opportunities created by the COVID-19 pandemic within both the clinical and research sectors<sup>5,9,11</sup> can be actively embraced by individual biobanks and the overall discipline of biobanking. In addition to new opportunities for biobanks,<sup>4,12</sup> more systemic changes may allow biobanks to achieve closer relationships with their end-user research disciplines and clients and help to fulfill their mandate of supporting biomedical and health research.

#### *Rethinking the discipline of biobanking*

The discipline of biobanking includes the elements of the biospecimen lifecycle,<sup>28</sup> ranging from patient consent, the collection of biospecimens and data, biospecimen and data quality assurance and quality control analyses, biospecimen and data storage, and subsequent utilization or transfer/release for research, informed by knowledge of relevant pre-analytical variables through biospecimen science (Figure 2). These individual



**Figure 2.** Diagrammatic representation of the different elements of biobanking (shown as dark blue circles), and how these elements overlap with other research disciplines (shown as different colored circles or ovals). Where research disciplines overlap with more than two different elements of biobanking, these research disciplines are shown twice. Due to formatting limitations, not all possible discipline overlaps are shown.

**Table 2.** Overview of international biobanking conferences and journals, listed in alphabetical order, with their supporting biobanking organization(s) and/or academic publisher.

CONFERENCE/JOURNAL	NAME	BIOBANKING ORGANIZATION(S)/PUBLISHER
Conference	Europe Biobank Week	ESBB, BBMRI-ERIC
	Global Biobank Week	ESBB, BBMRI-ERIC, ISBER
	International Biobanking Conference	ESBB, BBMRI-ERIC, ISBER, Qatar Biobank
	ISBER Annual Meeting	ISBER
Journal	Biobanking and Biopreservation	ISBER/Mary Ann Liebert Inc.
	Cell and Tissue Banking	Springer
	Journal of Biorepository Science for Applied Medicine <sup>a</sup>	Dove Press
	Open Journal of Bioresources	Ubiquity Press

Abbreviations: BBMRI-ERIC, Biobanking and Biomolecular Resources Research Infrastructure-European Research Infrastructure Consortium; ESBB, European, Middle Eastern & African society for Biopreservation and Biobanking; ISBER, International Society for Biological and Environmental Repositories.

<sup>a</sup>The Journal of Biorepository Science for Applied Medicine ceased publishing new articles in 2018.

elements of biobanking also intersect with many different research fields, such that biobanking represents a broad and multi-disciplinary activity (Figure 2).

As a recognized discipline, biobanking is supported by several professional societies operating at an international scale

(Table 2). These professional societies organize regular international biobanking conferences and either directly or indirectly support different biobanking journals (Table 2). Biobanking conferences and journals serve to promote the career development of biobanking professionals and provide



opportunities for biobankers to discuss issues of importance and to network within the field. The discipline of biobanking undoubtedly requires a degree of inward focus to carry out the many aspects of biobanking to high standards (Figure 2). Nonetheless, any disproportionate focus upon internal biobanking activities at conferences or within journals is somewhat at odds with the multi-disciplinary nature of biobanking (Figure 2), which must also be outwards-facing toward research end-users to achieve its mandate of supporting biomedical and health research.<sup>2,15,29</sup> Indeed, our analyses indicate that the biobanking literature may have focused more on biobank “inputs,” or the resources and activities that enable biobanking, than the outputs that biobanks produce through their support of research.<sup>2</sup> As we will describe, the COVID-19 pandemic provides an opportunity for the discipline of biobanking to recalibrate this focus to more effectively engage with researchers and research communities.

*Conference attendance and organization.* The COVID-19 pandemic has necessitated a rapid and sustained switch from in-person conferences to virtual or online events,<sup>5,10,11</sup> with international biobanking meetings being similarly affected in 2020 and 2021. As is the case for most research disciplines, virtual conferences present both advantages and disadvantages for the biobanking community. Advantages of virtual conferences include reduced registration and other costs, as well as improved accessibility and environmental sustainability.<sup>5</sup> Virtual conferences can also represent a more efficient use of time, as the need for travel is removed, and attendees can more easily access the content that they need, either by moving between different online sessions and/or revisiting conference recordings in their own time. These aspects of virtual conferences represent particular advantages for biobanks, where in-person conference attendance can compete with the need to maintain on-site operations, notably where biobanks employ few dedicated staff members.<sup>1</sup> Lower-cost and time-efficient virtual meetings should not only render biobanking conferences more accessible to biobank staff but should also provide more opportunities for biobankers to attend research conferences. Attending research conferences can allow biobanks to remain at the forefront of research and technical developments that may dictate future biospecimen and data requirements. With reduced face-to-face interactions between biobanks and researchers due to social distancing requirements and/or facility closures, online research conferences also provide opportunities to renew contacts with previous research clients, and to establish new contacts that can further develop through follow-up virtual meetings.<sup>11</sup>

While virtual meetings present advantages of efficiency and cost, reduced opportunities for face-to-face meetings may negatively affect biobank engagement with research clients. Loss of opportunities to meet in-person could particularly impact the development of trusting relationships with biobanks that researchers clearly value.<sup>30</sup> Virtual meetings are also yet to provide the same opportunities for chance

or unexpected meetings that represent a valued aspect of attending in-person conferences<sup>11,31</sup> and working within research facilities.<sup>32</sup> As virtual meetings are likely to continue beyond the duration of the COVID-19 pandemic, the biobanking community will need to consider how to best leverage virtual meetings to build and maintain productive relationships with their research clients, and balance face-to-face and virtual meetings in the longer term.

The widespread adoption of lower cost, on-line conferences also provides opportunities for biobanking conferences to be more outward-focused toward other research communities. As on-line conference organization becomes more accessible, biobanking conferences could actively seek partnerships with conferences that support biobank research clients. The many intersections between different research disciplines and biobanking (Figure 2) all represent opportunities for shared conference organization and/or shared conference sessions within larger meetings. Shared conference sessions within meetings of biospecimen end-users could focus on topics of broad interest, such as how to locate and then apply for biospecimens from biobanks. While these processes may seem obvious to biobankers, they are likely to challenge many researchers,<sup>30</sup> particularly those with no prior experience of working with biobanks. We have previously proposed that cancer research conferences could include sessions that describe the impact of biospecimen quality upon research quality and reproducibility, in shared conference sessions involving both cancer researchers and biobankers.<sup>33</sup> The COVID-19 pandemic similarly presents opportunities for biobanking organizations to seek partnerships with COVID-19 researchers, where shared conferences or conference sessions could present new opportunities for biobanks to directly engage with and support COVID-19 research.

*Opportunities for cross-disciplinary publishing in biobanking.* Dedicated biobanking journals provide important venues where biobanking professionals and researchers can discuss issues of importance and develop and communicate new ideas (Table 2). At the same time, established research disciplines benefit from being represented across journals that focus upon other research topics, to both raise awareness of the discipline and expand journal citation patterns.<sup>34</sup> The many points of intersection between biobanking and other research disciplines (Figure 2) provide opportunities to publish biobanking papers across a range of journals, such as those serving disease-specific disciplines or the experimental techniques that are employed for the analysis of biospecimens and/or data. As possible examples, specialty journals may value manuscripts that describe how biobanking can better support the specific biospecimen and data requirements of their research disciplines. Similarly, journals that focus upon experimental techniques are likely to value evidence-based descriptions of biospecimen and data requirements that enable robust research results.<sup>35</sup> The COVID-19 pandemic provides many similar opportunities to

**Table 3.** Comparison of the benefits of participation in local or precinct-based biobank networks versus remote research-focused biobank networks.

BENEFITS	LOCAL OR PRECINCT-BASED NETWORK	REMOTE RESEARCH-FOCUSED NETWORK
Equipment & reagent sharing	Equipment sharing/consolidation including back-up facilities	Shared database platform
	Bulk consumables/reagent ordering	Harmonized database information fields
	Shared database platform	Shared quality management system
	Harmonized database information fields	
	Shared quality management system	
Staff sharing	On-site and remote functions	Remote functions
Staff development & training	On-site (where permitted) & online training	Online training
Information sharing	Across research precinct	Between research sites/institutions
Biobank support of grant applications	Local equipment & infrastructure grant applications	Network-based infrastructure & research project applications

reach new audiences through journals that have not previously considered the topic of biobanking.

*Increased focus on biobanking research priorities.* Biobanks have long claimed to represent essential research support services, yet these claims have not always been matched by empirical evidence.<sup>2</sup> In light of shrinking budgets for both research and infrastructure support, biobanks will increasingly need to base their funding applications upon evidence of how biobanks support research and the types of research outputs and outcomes that are enabled by biobanks. Biobank conferences and journals could highlight the importance of gathering such evidence by prioritizing conference sessions and/or special journal issues that focus upon research priorities for the field. These priorities could include research that informs the organizational dynamics of biobanks, such as how biospecimens and data are employed in research, and by whom.<sup>23,26</sup> Research is also required to delineate the types of research outputs that are supported by biobanks,<sup>2</sup> how biobank-supported research outputs compare with those supported by other forms of research infrastructure, and how individual biobanks continue to successfully respond to the effects of the COVID-19 pandemic (Figure 1).<sup>4</sup> While recognizing that professional biobanking organizations are also experiencing financial hardship in response to the COVID-19 pandemic, low-cost approaches such as invited conference talks accompanied by free conference registration could be considered to encourage student and early career researcher contributions toward priority research areas in biobanking.

#### *More efficient and sustainable biobank operations*

Biobanks have historically suffered from under-utilization, leading to sample and resource waste.<sup>17,21,23,24,26</sup> The increased pressure upon research and operational budgets mean that biobank under-utilization is unlikely to continue to be

tolerated as it may have been in the past. At the same time, an unexpected consequence of the COVID-19 pandemic has been the opportunity to revisit long-held practices and assumptions.<sup>5-7</sup> In a similar fashion, there are many aspects of biobank operations that can be revisited and improved in response to the COVID-19 pandemic.<sup>12</sup>

*Improved committee support and participation.* Biobanks need timely access to quality information and advice to anticipate and respond to changes across the research ecosystem (Figure 1). In addition to gaining information through the literature and/or conferences, biobanks can access critical information through committees that either directly or indirectly support the activity of biobanking. While recognizing that committee involvement needs to be balanced with other activities, the rapid adoption of virtual conferencing provides an opportunity for biobanks to rethink their engagement with both research and infrastructure communities through productive committee participation.

Biobank scientific advisory committees are typically comprised of experts spanning the research interests and activities of the biobank, and may also include human research ethics, governance, institutional and funding body representatives. Scientific advisory committees can advise regarding changing research priorities as well as new research directions and analysis techniques that can guide biobank planning, and committee members can advertise the biobank within their networks. At the same time, scientific advisory committees can be challenging to establish and sustain, with members likely to be senior experts with competing demands that may have been further exacerbated by pandemic responses. This provides an opportunity for biobanks to revisit the composition of their supporting committees, particularly if the biobank's research focus has also shifted, or if advisory committee members have been seconded to other roles.

Biobanks can also benefit from being represented on planning or oversight committees that make recommendations

and/or decisions about research and research infrastructure support. Research committees typically operate at local or regional levels, with local or precinct-based committees being best placed to inform biobanks of changes to local research capacity and direction. Biobank representation can be facilitated where senior biobank staff are active researchers but can also occur through scientific advisory committee members and/or honorary research appointments within the biobank. Indeed, biobank representation on research planning committees can have mutual benefits. For example, in the case of COVID-19 research projects, early engagement with local biobanks can ensure that biospecimens of the necessary quantity and quality can be sourced from the project outset, allowing local biobanks to adjust their operations in real time, and increasing biobanking efficiency and use. Rapid building of local research capacity through local biobank support can also provide pilot data to support research grant applications and institutional business cases for further capability expansion and can thus drive local productivity while more distant collaborations are being established. In summary, active biobank representation on research planning or funding committees can benefit biobanks, researchers, institutions and funding bodies, by increasing the value of existing biobanking investments and preventing unnecessary biobank duplication and resource waste.

*Biobank networking and infrastructure collaborations.* Biobanks can also share ideas, resources and approaches to problem solving by collaborating with other biobanks through partnerships and networks (Table 3).<sup>15,19,36–38</sup> Biobank networks can be research precinct-based and/or built around a shared research focus,<sup>39,40</sup> with these different network types offering shared but also distinct advantages (Table 3). Local or precinct-based networks can raise the profiles of local biobanks and enable local consolidation of capacity and/or operations sharing, such as common enrolment platforms for consenting and biospecimen and data collection.<sup>26,39</sup> Local networks can also extend beyond biobanks to consider how staff, equipment, emergency supplies and quality management systems could be shared between biobanks and/or other local research infrastructure (Table 3).<sup>4</sup> Research-driven biobank networks or partnerships can provide specimen cohorts of increased numbers (Table 3),<sup>38,39,41</sup> although process harmonization is required to ensure comparable sample quality and data annotation, and uniform research application processes that are as simple as possible for researchers.<sup>30</sup> Biobank networks or partnerships can also achieve efficiencies through being supported by single scientific advisory committees, which can accelerate process harmonization across the network, while extending the time and expertise of advisory committee members to multiple biobanks with shared purposes and/or ambitions.

*Improved individual biobank operations.* Pauses in research activity in response to the COVID-19 pandemic can provide

researchers with the opportunity to both complete outstanding projects and formulate new ambitions and goals.<sup>7</sup> Research-slow periods similarly provide biobanks with the opportunity to review, update and improve internal processes.<sup>12</sup> For example, biobanks can seek to streamline and improve their biospecimen and data access policies,<sup>21</sup> in recognition of the critical importance of efficient, timely biospecimen access to both research and industry clients.<sup>30,42</sup> Limitations on prospective collection capacity may also provide biobanks with time to activate specific marketing strategies to distribute existing sample collections,<sup>21</sup> to cull biospecimens that are unlikely to be in demand in the (post-) COVID-19 research environment,<sup>12</sup> and/or to adopt permission to contact<sup>43</sup> or so-called “walking biobank” models<sup>24</sup> supported by e-consent.

### *Biobank staff development and support*

Biobank closure can be an inevitable aspect of biobanking,<sup>25</sup> and often takes place when biobank activity does not address research priorities and/or capture the trust and engagement of research communities.<sup>17,18,44,45</sup> With the additional direct and indirect pressures that are being imposed on biobanking (Figure 1), it is likely that biobank downsizing and/or closures will accelerate during and after the COVID-19 pandemic.<sup>12</sup> Given the documented effects of biobank downsizing and closure upon biobank staff,<sup>44</sup> it is important to pre-emptively consider how the careers and future employability of biobank staff can be enhanced, to both reduce the requirement for and impacts of biobank downsizing or closure.

Biobank workforce development should aim to improve biobank operations and research support while also considering the future career aspirations of individual staff. One consequence of biobank downsizing can be the requirement for remaining team members to take on multiple roles.<sup>44</sup> While this may be challenging in the short term, cross-training can build in operational redundancies, preventing or slowing any loss of corporate knowledge during downsizing, while allowing skill acquisition and development that may make staff more employable if the biobank needs to further downsize or close. Retraining staff to take on new biobanking responsibilities can be supported by formal training, which is increasingly available online.<sup>46,47</sup> Activities that increase biobank capacity to support research, such as attending and presenting at research conferences, also represent career development opportunities for biobank staff, particularly those who may be seeking to move to research-dedicated positions. Managers can support their staff by advocating for authorship and/or acknowledgement on biobank-supported research publications, while recognizing that authorship demands can also deter researchers from using biobanks.<sup>48</sup> The creation of authorship identifiers that can be digitally linked to multiple individuals can maximize authorship opportunities for biobanks or biobank networks,<sup>40</sup> and may be more acceptable to research teams. Managers can also support the development of transferable skills in biobank staff



in core areas such as communication, financial management and process improvement, which remain in demand across all industries.<sup>49</sup>

### Summary and Future Directions

Although impacts of the ongoing COVID-19 pandemic continue to challenge biobank operations and support of research, the pandemic also represents an opportunity to pause and recognize the need to do things differently, and to consider the type of research-enabled future that we collectively wish to create.<sup>5</sup> To fully support research, biobanks need to function as active and equal partners in research, yet the discipline's historically inward focus to develop a separate professional identity may have unwittingly contributed to biobank underutilization.<sup>2</sup> Biobanks can capitalize on many responses to the COVID-19 pandemic, notably the development of low cost and increasingly effective virtual communications<sup>11</sup> and an accelerated and overarching willingness to embrace change,<sup>4-7,12</sup> to more broadly and effectively interact with research disciplines, operations and teams. Biobanks can use these approaches to proactively seek timely advice from different sources such that biobanks are best positioned to adjust and improve their operations in real time. Better integration with research communities and the many research disciplines whose activities intersect with biobanking will also allow biobanks to contribute more effectively to research, including inter-disciplinary research projects that can accelerate discovery.<sup>50</sup> In summary, by recognizing and responding to the many challenges of the COVID-19 pandemic, the glue of biobanking that has long served to connect patient care with research can become stronger, more resilient, and a more effective partner in biomedical and health research.

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JAB conceived of and drafted the manuscript; JAB, JEC, CC, KP, SB and PHW revised and edited the manuscript.

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