Information and Intelligence review for the Public Health Agency -

Dr NR

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Introduction

This work was requested by PHA Chief Executive as a result of the information gaps identified by Dr Ruth Hussey's "Rapid, focused external review of the Public Health Agency (PHA) for Northern Ireland's resource requirements to respond to the COVID-19 Pandemic over the next 18 - 24 months". This piece of work directly reflects on this space.

I am grateful to the staff in the Agency who helped me understand their environment better, and I hope this work advocates for a better information environment for all who work in PHA.

As the pandemic has progressed the PHA has had some time to reflect on its practical approach to data and information. It is important to note that the Agency has never been funded to be a collector or user of live data – focusing rather on the consumption and production of intelligence reports. Expectations changed dramatically on foot of the pandemic. Central to the response at critical stages was the need for real time data (numbers of people impacted) as well as an intelligence-led overview of the story behind it.

The Agency has, under sustained scrutiny and pressure, responded better than one would have anticipated. There is now an opportunity to shift to a become a centre of excellence in the ingestion, curation and interrogation of Northern Ireland's health data. This should include live information just as in Covid-19.

Since the creation of PHA, data and analytics leaders within the agency have received little dedicated funding, autonomy or delegated authority. The PHA is heavily dependent on BSO and HSCB for data access and control. Interest in data science was more often seen as an academic focus rather than a core aspect of public health practice. As a result, the Agency has not developed cohesive data systems to empower their teams to detect, predict, respond and mitigate disease outbreaks.

There is a focus of analytics excellence within the surveillance team in PHA which allowed the service to cope during the initial outbreak, but as numbers of Covid 19 cases increased this team came under immense pressure. The learning from our shared experience of building the current Contact Tracing System is that the talent, intellect and drive to work with data is present within the PHA. The challenge is to provide space, training and the technical infrastructure needed to allow that talent to flourish. Perhaps most importantly, the PHA needs to consider a central role in the curation of Northern Ireland citizen data, as it seeks to improve public health.

Health protection and surveillance teams must remain pandemic responsive from this point forward. This will require investment in people, technology and infrastructure. Public health organisations across the world have faced challenges in fully understanding disease outbreak information to make

informed decisions. This is due primarily to the lack of integrated data as a result of data silos, poor data quality, no data access or inadequate data integration capabilities.

Data and analytics is an integral weapon in fighting a disease outbreak. Especially when the outbreak comes as a fast-moving pandemic, decision making needs to be done quickly and correctly, which essentially relies on the data with good quality analytics technologies. Now, and in the future, PHA needs data and analytics leaders to assume responsibilities in building such an integrated information.

At present multiple agencies; Trusts, primary, secondary and social care teams collect data, with little attention to how that data will be subsequently used or analysed for population health purposes. Our current health monitoring systems lack advanced technologies such as event simulation, agent-based modeling and graph analytics to discover insights for outbreak detection, prediction and information dissemination. As a result, we have spent the last year running very fast to establish a rapid method of dealing with Covid 19 whilst keeping an eye on the future, so assets can be reused when applicable.

This paper comes at an important moment. The PHA should be proud of its Covid 19 response - Northern Ireland has successfully built a contact tracing platform that integrates with testing, vaccine and our reporting methodology - as a result we have coped better than many nations. Moving forward PHA must remain pandemic ready, and transfer learning towards the complex public health problems that face Northern Ireland going forward. The dividend for finding solutions rapidly during Covid 19, should be persistent funding, and space to develop a reliably, ever ready information response for public health.

Background

This pandemic has been an overwhelming experience for many of the citizens of Northern Ireland. For those of us working in health it has been particularly difficult. The PHA has been in the spotlight throughout, from the immediate response, through to the implementation and scaling of a population level contact tracing systems.

As an organisation, the PHA has experienced great change over a short time period. The Chief Executive Officer has retired and been replaced with an interim, this has been mirrored by the retirement and replacement of Director of Public Health with an interim Director. Both posts are currently recruiting for permanent appointments. In addition, there have been a number of external rapid reviews, to help understand how the organisation has performed throughout this period of challenge.

This document is not meant as critique of previous practice; rather, it reflects on my experience of working with PHA over the last year, what I have learned from colleagues in PHA, and outlines my suggestions regarding how the information landscape of the PHA can be developed to improve its

efficiency, and perhaps more importantly, the working experience of its employees. Unlike the previous recent reviewers, Bradley and Hussey, I have been working with colleagues in PHA during the pandemic and have experienced directly the circumstances in which they have had to work. The pressure for information has been relentless, and yet the infrastructure and skills needed to deliver such a response has never been fully understood or effectively funded.

In my view, to effectively achieve its goals the PHA must take on greater responsibility in controlling how data and information is assembled, and subsequently disseminated across the wider health service. The Public Health Agency has unique expertise in adding context and intelligence to raw, complex public health data; however, to exercise this prowess, the PHA must engage fully in the wider data agenda and demonstrate its ability to lead and drive change through information. With excellent data stewardship, and insight driven population health delivery, the PHA can achieve greater independence and become the go-to agency when any HSCNI organisation needs information to deliver better care.

This document suggests a rapid process, with brief recommendations, to support the already excellent workforce with an equally accomplished information strategy, infrastructure and training programme.

The normal functions of the Public Health Agency

What the PHA is tasked to was defined during it creation:

"The overall aim of the PHA is to improve the health and social well-being of the population and the quality of care provided, and to protect the population from communicable disease or emergencies or other threats to public health. As well as the provision or securing of services related to those functions, the PHA will commission or undertake programmes of research, health awareness and promotion etc.

This aim will be delivered through ***three core functions*** *of the PHA:*

> ***1*** *securing the provision of and developing and providing programmes and initiatives designed to secure the improvement of the health and social well-being of and reduce health inequalities between people in Northern Ireland,*
> ***2*** *protecting the community (or any part of the community) against communicable disease and other dangers to health and social well-being including dangers arising on environmental or public health grounds or arising out of emergencies; and*
> ***3*** *providing professional input to the commissioning of health and social care services which meet established quality standards and which support innovation.*

It is obvious that all of these functions are underpinned by accurate population and healthcare data. It is no longer enough to have some historical data - to retrospectively analyse and to create reports. From now, actionable data is required as and when public health emergencies arise.

A future built on evermore data

Public health has now a vast expanse of information to assimilate and understand if it is to effectively help citizens live better lives. Figure 1 gives a brief example of what potential sources of information should be available for public agencies in the future. Learning to ingest and effectively handle these assets will become the job of public health agencies across the globe.

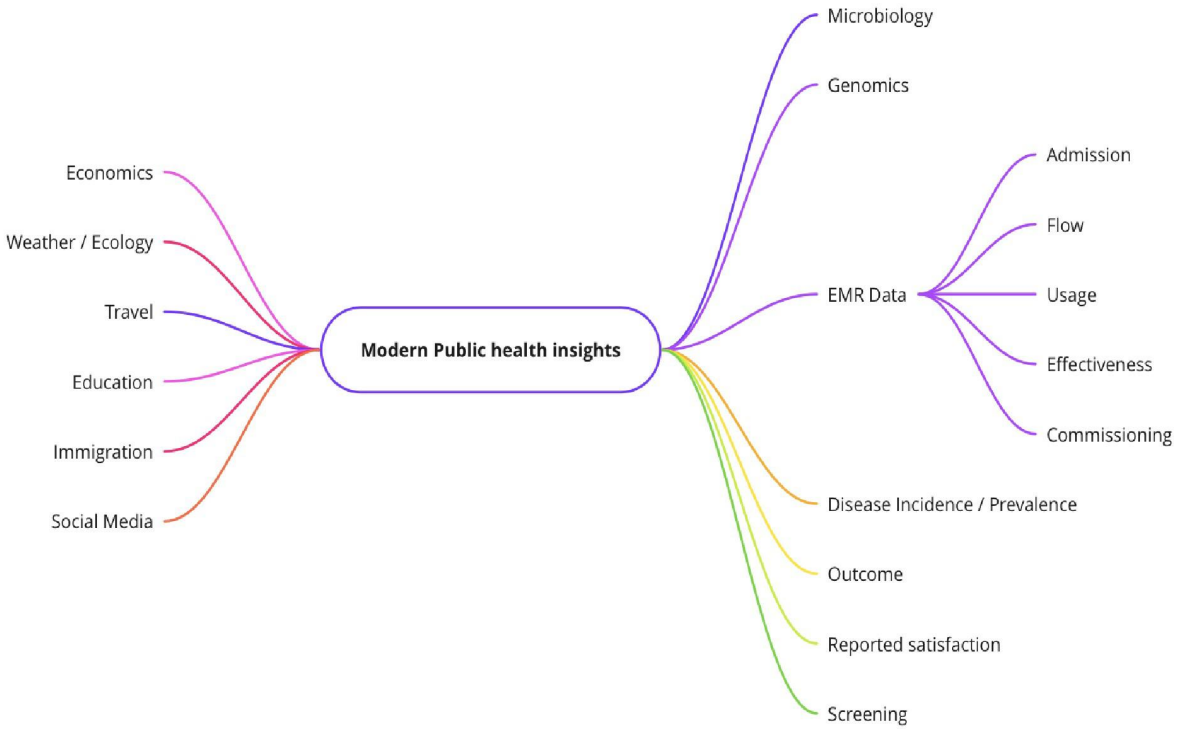


Figure 1 - Delivering health insights requires multiple data sources

The fundamental pillars of what essential Public Health services are, was referred to by Dr Ruth Hussey, in her rapid review of the PHA during Covid 19. She listed them in an appendix and in the image below (Figure 2) I have highlighted 7 areas in particular in which information assets are critical. It is not an exclusive list, other areas also have data dependencies. In her review, she spoke of the PHA needing a clear vision and strategic direction for the use of data and evidence in guiding its function.

I share Dr Hussey's belief that data is a core and critical asset for PHA, and establishing value from it, is one of the PHA's main roles. Importantly, as I will discuss, this data can be stored centrally and used by many functions within PHA without diluting each team's feeling of ownership over it.

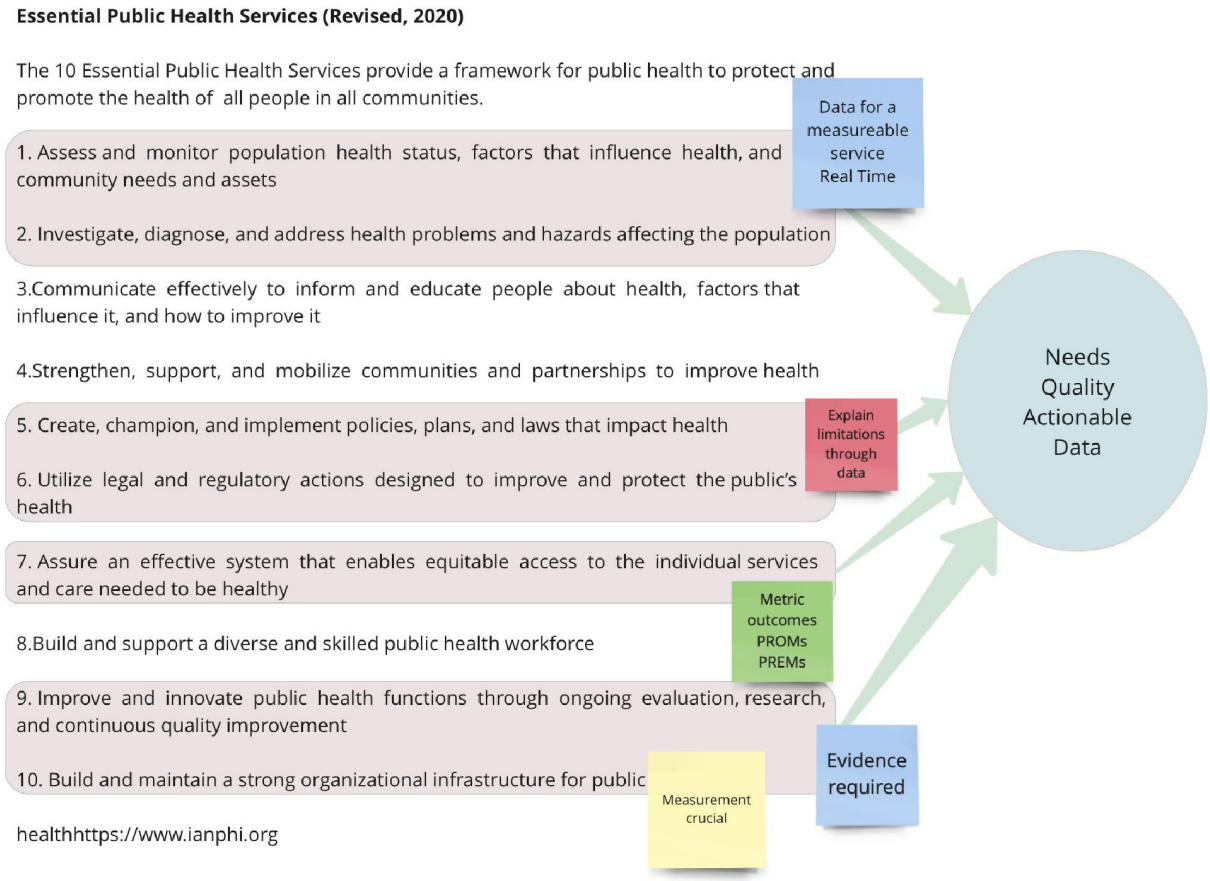


Figure 2. Information requirements for essential Public Health Services.

PHA - Taking a single agency approach to data

It is important not to view the above information dependencies within the current directorates of the PHA as they exist today. The divisions of PHA all contain information dependencies. Primarily, Health Protection and Surveillance, Health Intelligence and Health Wellbeing, Communications, Quality Improvement are all functions that use data; however, they do not currently either directly own, nor have they an ability to specifically dictate how the information they use is collected. In addition, the Directorate of Nursing, Midwifery and Allied Health Professionals base many of their decision on intelligence gained from health care delivery agencies across Northern Ireland.

These subdivisions are a function of how PHA was originally created. For those of us looking in from the outside, we can find these subdivisions difficult to understand. The delivery of better Public Health interventions in Northern Ireland is accelerated by better understanding and knowledge. Data should be, if possible, collected once, shared flexibly and used relentlessly. Within PHA, data is often

duplicated within different divisions to allow teams to try answer their questions within separate teams, this is inefficient and time consuming. Arguably, the corporate function of PHA is to add intelligence to the health data collected through-out our service. In practice, there may be a hierarchy of 'need for data' – with some divisions requiring more immediate and timely data than others, the PHA should seek to serve each division as equally and efficiently as possible.

Generally, sharing data, is a more effective way of gaining value from it – the image below outlines the general benefits. PHA should embrace this approach.

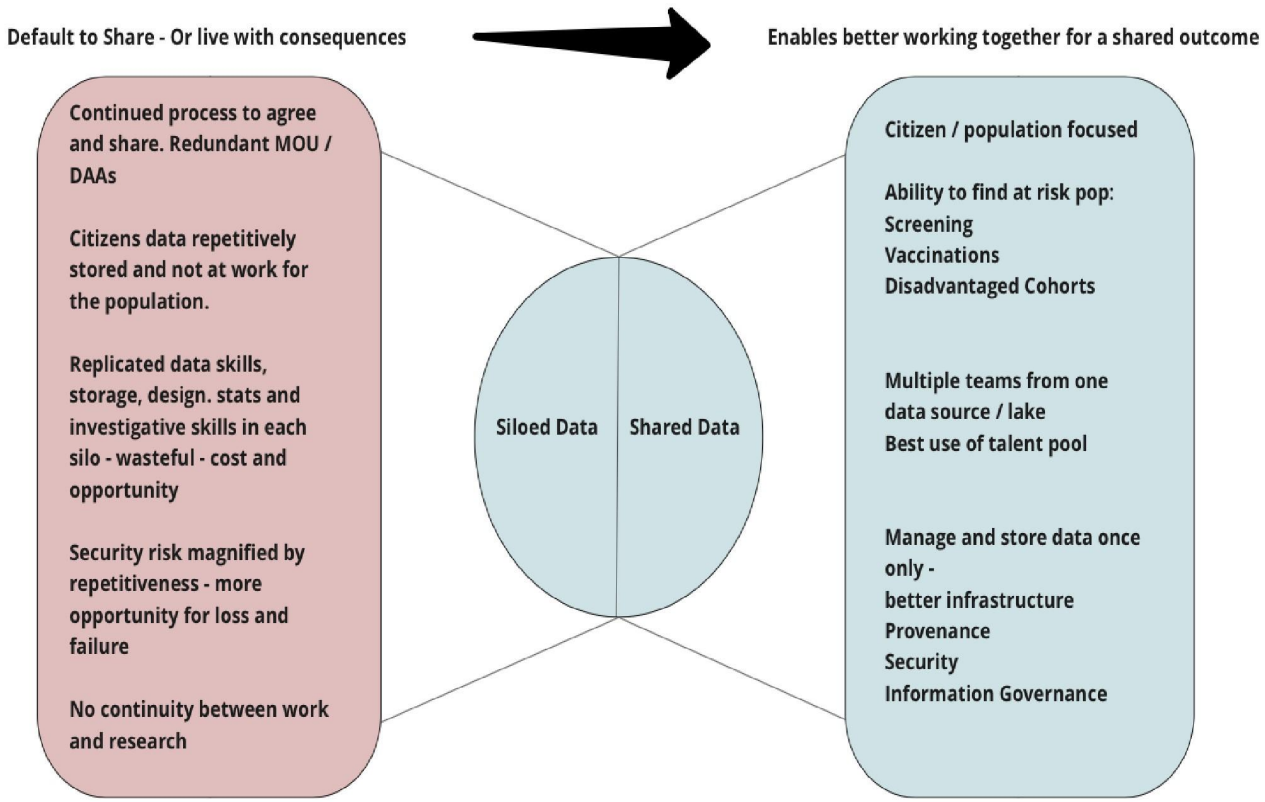


Figure 3. Benefits of data sharing

To achieve the three core functions of the PHA, the agency should seek to be more involved in driving the strategy regarding collection and use of information for Northern Ireland. The agency should not only be a "receiving agency" of data; rather it should ambitiously set the information agenda for health delivery. The collective expertise within PHA needs data to do their job properly - I therefore believe that a fundamental part of the PHA role is to ensure Northern Ireland has the best population information possible. In short, PHA should consider becoming the "delivery agency" of interpreted health data to everyone else.

Data without context is often meaningless - the, given its collective expertise, should become the default provider of intelligence to raw health data. This does not mean that the PHA needs to be a highly technical organisation - BSO and DHCNI can provide support in this regard – the PHA does however, need to be central in conversations about collection, curation and analysis of data used to derive population level insight.

Key point.

As currently configured PHA is largely a consumer of data produced by others. These critical public health functions are often dependent on other agencies providing clean, usable data. The PHA does not lead in the strategy systematic collection, management, storage or co-ordination of data relevant to delivery of Public Health in Northern Ireland. This needs to change for the PHA to become "the" information resource in health. As data use accelerates in healthcare, a failure of PHA to actively participate in managing this resource, could allow it to be effectively ignored by delivery partners.

What PHA achieved (and adapted to achieve) with technology and data during Covid

It is important to recap on what PHA has built in partnership with DHCNI, Kainos and Strategic Investment Board (SIB) during Covid 19, as it provides direction for potential next steps in advancing the PHA's intelligence capabilities.

At the beginning of the pandemic the PHA response attempted to scale to deal with thousands of cases. The manual importing and contact tracing system was unable to scale despite best efforts of public health staff.

PHA needed to respond and sought help from allied agencies. The modelling of virus spread, reproductive rate calculation was achieved through a combination of PHA and expert internal input from SIB. The dashboarding requirement was problematic. This reflected the inability get information from the frontline back into a usable form. The legacy PAS systems do not automatically update and are manually controlled. The DoH led on this and utilised IAD and EY to build the solution. The missing piece was the work behind the scenes by PHA, PMSI, HSCB, Trust and clinical colleagues in the - Resource Modelling Group – who worked tirelessly to link these disparate systems and to ensure what was dash-boarded was accurate.

DHCNI was tasked with helping PHA facilitate the technology response. This journey led us through iterative developments with EpiInfo, which were discounted ultimately, to finally contracting with Kainos and SIB, led by DHCNI, to build from scratch a contract tracing system built on a Microsoft Technology stack.

Within other divisions of PHA, the information requirement was equally acute. The Director of Nursing, Midwifery and Allied Health was modelling Personal Protective Equipment (PPE), staffing for ICU, oxygen delivery and escalation contingency. These roles were supported by SIB, and agency staff as the skillsets and data resources were not available in PHA.

Post-Covid 19, every Public Heath Delivery body should be underpinned by competency in technology (either self-controlled or commissioned), data science, academia, agile project management and behavioural science expertise. To create a working environment for modern delivery of this way of working requires a view of future horizons and less reliance on what was in place in Northern Ireland previously.

It was evident PHA has no easy mechanism to systematically curate datasets, mange content control or searchable archiving. Data was not available to hand when needed and questions were difficult to answer. This placed considerable stress on individuals. There was no resource to handle live, massive population datasets actively - this is the direction of population health today, and inevitably the PHA must move to a place where this is normal practice.

As we developed the contact tracing we realised the analytics platform we had developed had a much wider utility. We have now extended this to include the Vaccine Management System and the analytics infrastructure for the Covid 19 response. This entire platform is described in the appendix at the end of this document. This is a detailed architectural drawing of what the final solution will look like (it is currently in iteration and a few stages behind this). I have deliberately included this to reinforce the complexity of collating public health data in 2021.

We have recently renamed this Microsoft Azure environment the **"Public Health Intelligence Platform" PHIP,** to reflect its wider application. The system has been developed using agile methodologies, in partnership with PHA. It will, at the end of the pandemic remain a PHA asset and the logical approach would be to use it as a kernel upon which to build. Many within PHA will have little knowledge of the actual technology and that's totally understandable. This is a commercial state-of-art analytics platform that is rare in healthcare today, it will however rapidly become normal practice.

The platform, as designed in the appendix, allows the secure ingestion, matching, analysis and display of healthcare data from effectively any source. It can manage this in real time - as in Covid 19 - or in retrospect. Data does not need to leave the platform - all analysis and reporting (dashboards) are built within a secure and protected environment. All software for analysis is accessible from any computer with internet access and security clearance. In short, this is as advanced as any analytics platform in existence within healthcare anywhere in the United Kingdom.

What will this actually mean for PHA in practice?

The technical aspects of how we have created the PHIP platform are important, and for some within PHA, this may become an active part of their role. For most employees all they want is way to access data in a simple and predictable way. The essence is outlined in Figure 4 – a single methodology for requesting, accessing and presenting information. Although requiring investment, the outcome is more efficient, safer, more controlled access to greater data sources. The proposal suggests a single team within PHA to support information requests within the agency – supported by the correct group of skilled individuals.

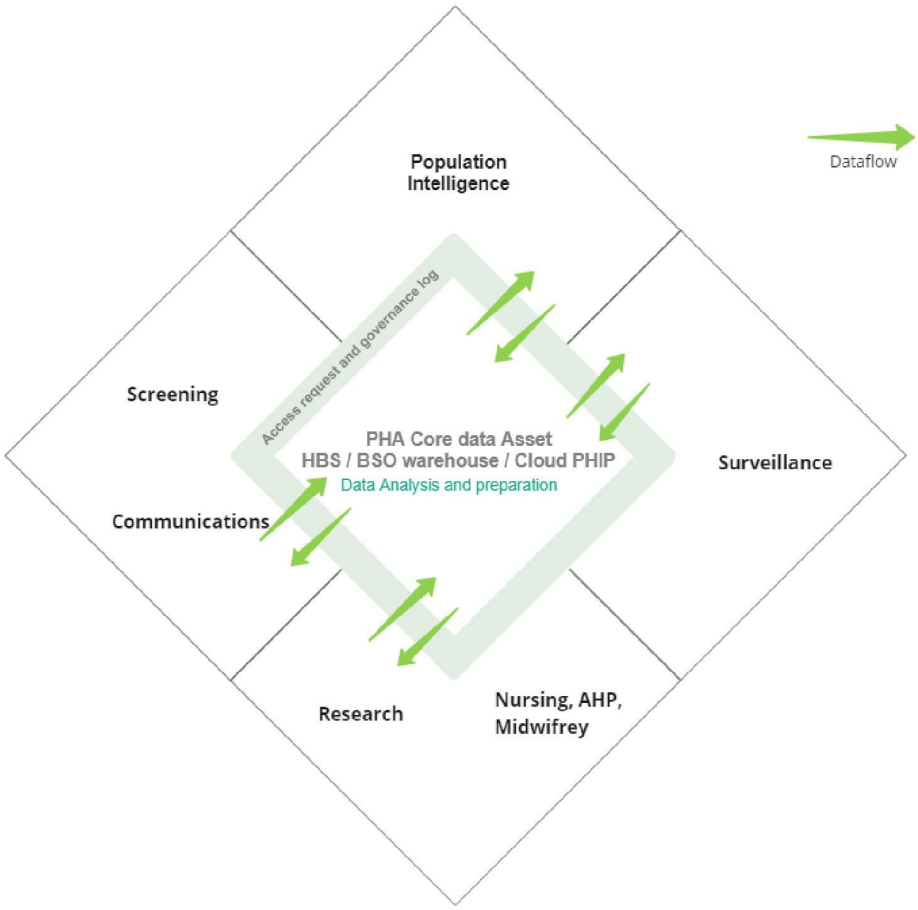


Figure 4. A single information asset for PHA which serves many directorates

Future proofing PHA information assets – Horizon scanning

Encompass (using Epic software) is the largest, hardest and most impactful of all the delivery programmes across all of the portfolios in NI. It is both a Digitisation (completing the journey towards a paper-less secondary care sector in Northern Ireland) and a Digital Transformation (enabling standardisation of secondary care pathways, and supporting greater integration across acute Hospital Care, Social Care, Mental Health Services and Community Services). Perhaps most importantly; it provides safe and protected individual data on the effectiveness of the care we provide. Encompass programme is a critical part of the Digital Future of Health and Social Care, it has the potential to make so much possible in secondary care, mental and social services. The summary image below provides the goals of the programme. It is inconceivable that PHA would not be actively involved in leveraging the population benefits of this programme to delivery better advice and guidance.

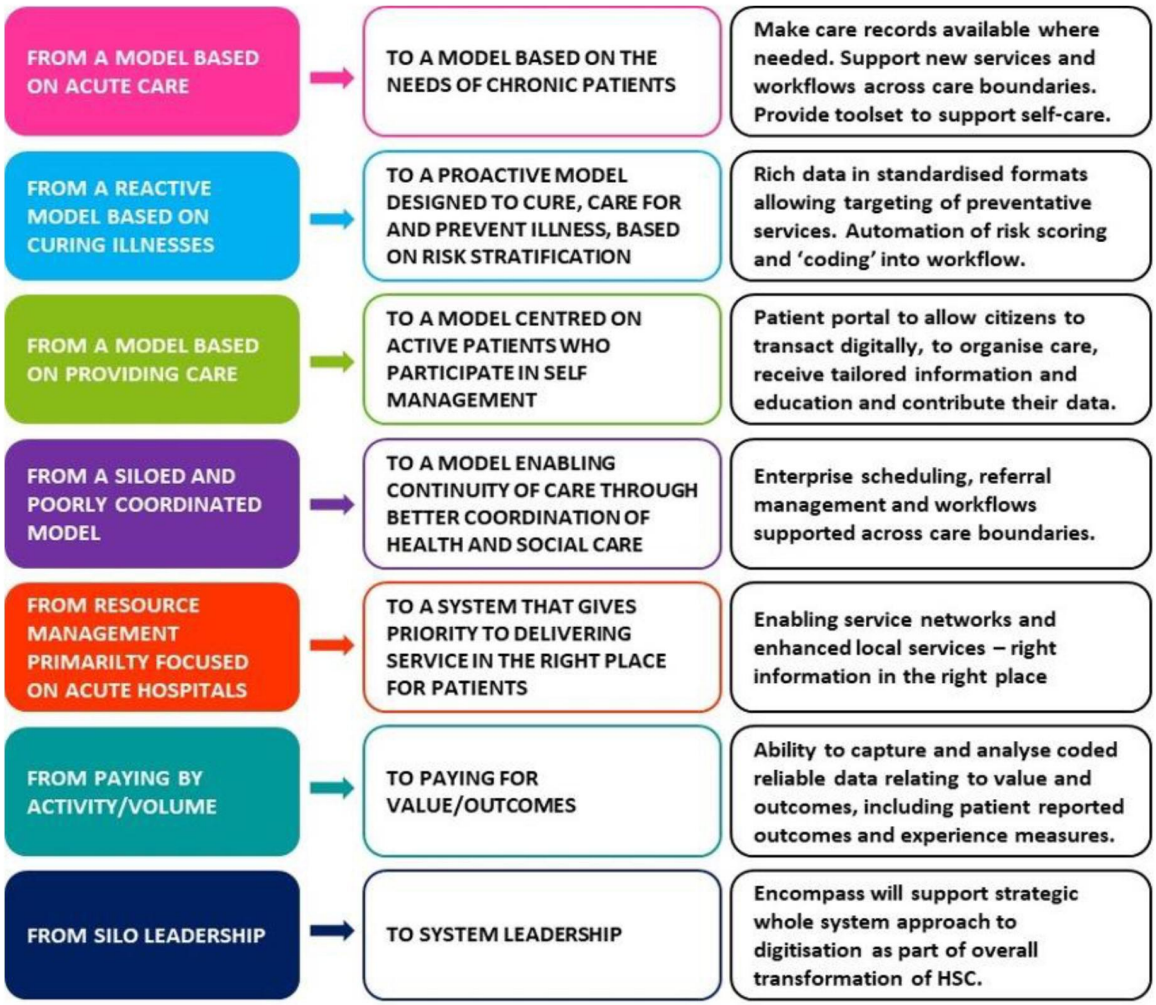


Figure 5 Transformation envisaged by encompass through technology

Making use of research proactively in Public Health delivery

The Northern Ireland response to Covid 19 has included a research response. There is a limited amount of effective public health research conducted between PHA and the two local Universities. PHA has one joint-clinical academic appointee who has establish greater links with the BSO Honest Broker Service and with other colleagues has encouraged wider use of the information assets that exist within the local data warehouse.

Health Data Research UK (HDRUK) approached Prof Ian Young, the PHA R&D Office, and requested Northern Ireland be involved in a range of Covid studies. As part of this response money has been allocated to the R&D Office in PHA (750K) to prepare for relevant studies for Northern Ireland to be commissioned. PHA act as the sponsor for research governed by normal HBS research processes.

To allow inclusion of a wider scope of work, and to help drive through changes to the Northern Ireland secondary use legislation for data sharing, we have created a temporary organisation called 'The Northern Ireland Trusted research Environment – NITRE' to manage this process. It is programme managed by staff from DHCNI, ARDC, BSO, NIRSA, PHA and includes representation from a view range of stakeholders, including Information Commissioners Office and Northern Ireland citizens.

The NITRE Board is charged with delivering the needs of HDRUK and with improving the access, governance and use of data by wider Northern Ireland researchers. It is, like the PHIP platform, a potential PHA resource, and in due course will revert to business as usual within the wider Northern Ireland environment. NITRE should logically sit as a part of PHA, under the guidance of the (suggested) Director of Research and R&D Office Director and become a gateway for PHA to co-ordinate and become actively involved in relevant public health research that benefits citizens. It could become the home for the scientific advisory council suggested by Dr Hussey, and act as an internal resource to guide and direct service related research and training for PHA staff.

On a wider Northern Ireland agenda, DHCNI have been developing a broader information strategy for Northern Ireland. The Health Data Strategy is under internal review. This has required revision as many of the plans I outlined in the original draft have been accelerated and delivered as part of the Covid 19 response. HSCNI has now delivered cloud hosted Apps, created a cloud data lake (PHIP) and used agile methodologies for citizen facing applications. The idea of an **Information Institute** for Northern Ireland health is a central part of the Health Data Strategy, PHA is envisaged as an integral and central part of that institute. The appointment of a CIO and reassessment of PHA vision for information will dictate the level of PHA engagement in this innovation.

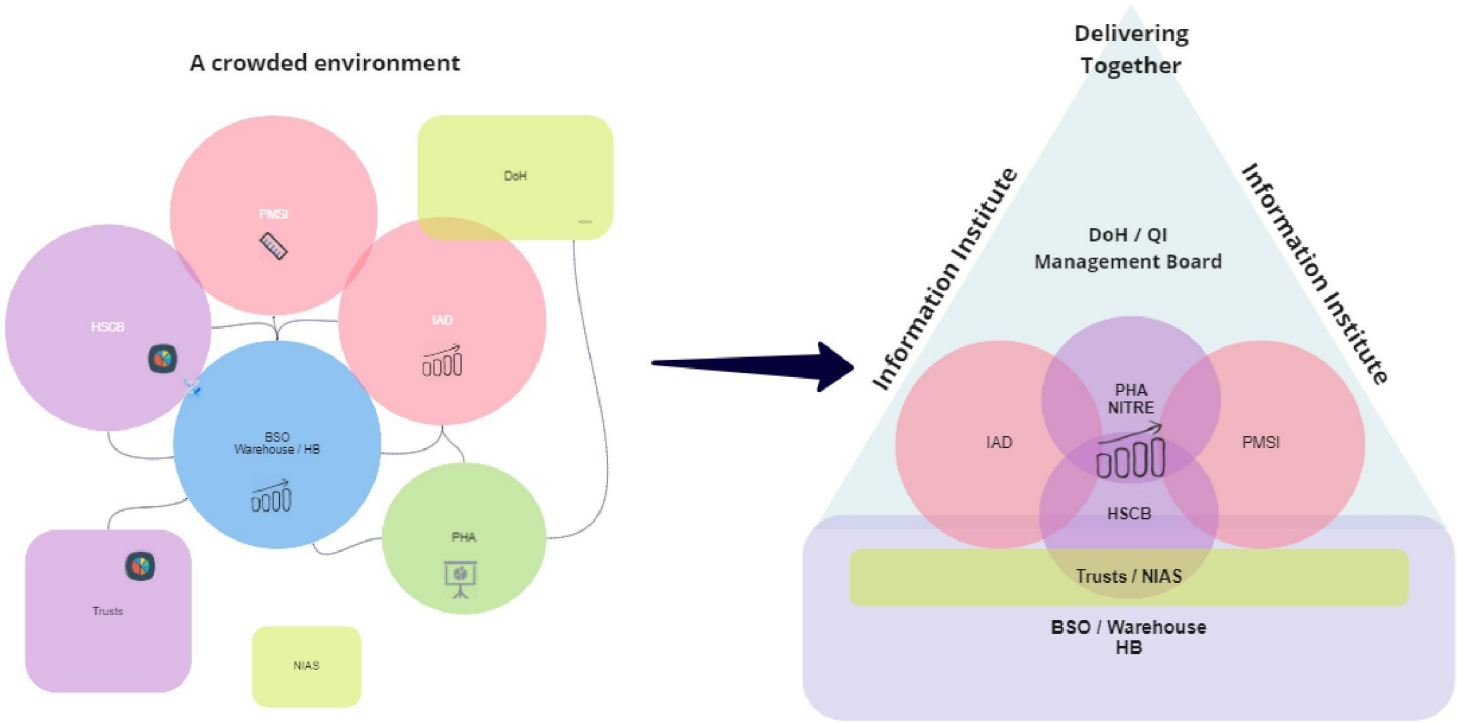


Figure 6. A potentially more coordinated information institute for Northern Ireland

Recommendations:

1. I am in complete agreement with Dr Hussey's recommendation regarding the PHA needing a strong vision and strategy aligned to its functions and goals. I strongly believe data should be at the center of this. The PHA should, at board level, make a decision regarding its future overall role and ambition in the National healthcare information landscape. It must decide if it wants to be a "recipient of healthcare information" from multiple other agencies. Or, if it has ambitions to become, in partnership with BSO and DHCNI, the welcoming host, controller and deliverer of population level insight to the service. I would support the second option, fully recognising the additional work and responsibility this would bring to the PHA.

2. The PHA should appoint a Chief Information Officer (CIO) as soon as possible. As the process of recruitment takes place the PHA should create a temporary "The Office of the CIO" to begin the work to embed improvements made during Covid and simultaneously plan transition from current position to a future state. This team existed as a combination of DHCNI, PHA, Kainos and SIB, and this agreement could be persisted until a CIO is in place. The CIO should be a board level appointment in keeping with National recommendations to introduce expertise in Digital Transformation to wider NHS organisations.

   The CIO priorities should be

   - Develop an immediate short-term plan for Covid 19 information assets. As a Senior PHA team member, co-develop a longer-term strategy for PHA, regarding its use of healthcare data to derive population intelligence.
   - Ensure pandemic responsiveness is resilient and ever ready for future outbreaks.
   - Ensure the **PHIP** analytics platform has recurrent, secured funding and is flexed to bring greater benefit beyond its current use. Create a long-term interface with BSO data warehouse and working methodology that is complementary and strategic.
   - Perform an urgent information asset review of PHA. To include review of human and technological analytics capabilities, and to develop a target information architecture suitable for the PHA.
   - Design and develop a training programme, in people and technology, for PHA staff - establishing a level of informatics competency that will underpin future delivery.
   - Firmly establish data access and control agreements within HSCNI family. This should be a framework agreement that establishes the primacy of Public Health data within PHA for delivery of better care for Northern Ireland. The CIO should work in unison with "The Office of the CDIO" in DoH to ensure benefits of secondary use legislation passage are rapidly implemented for Northern Ireland citizens. This will require greater cooperation between PHA and BSO with acknowledged requirements in the longer term for greater access to population data (from all aspects of care) to deliver better Public Health. An indicative timeline is included in appendix 2.

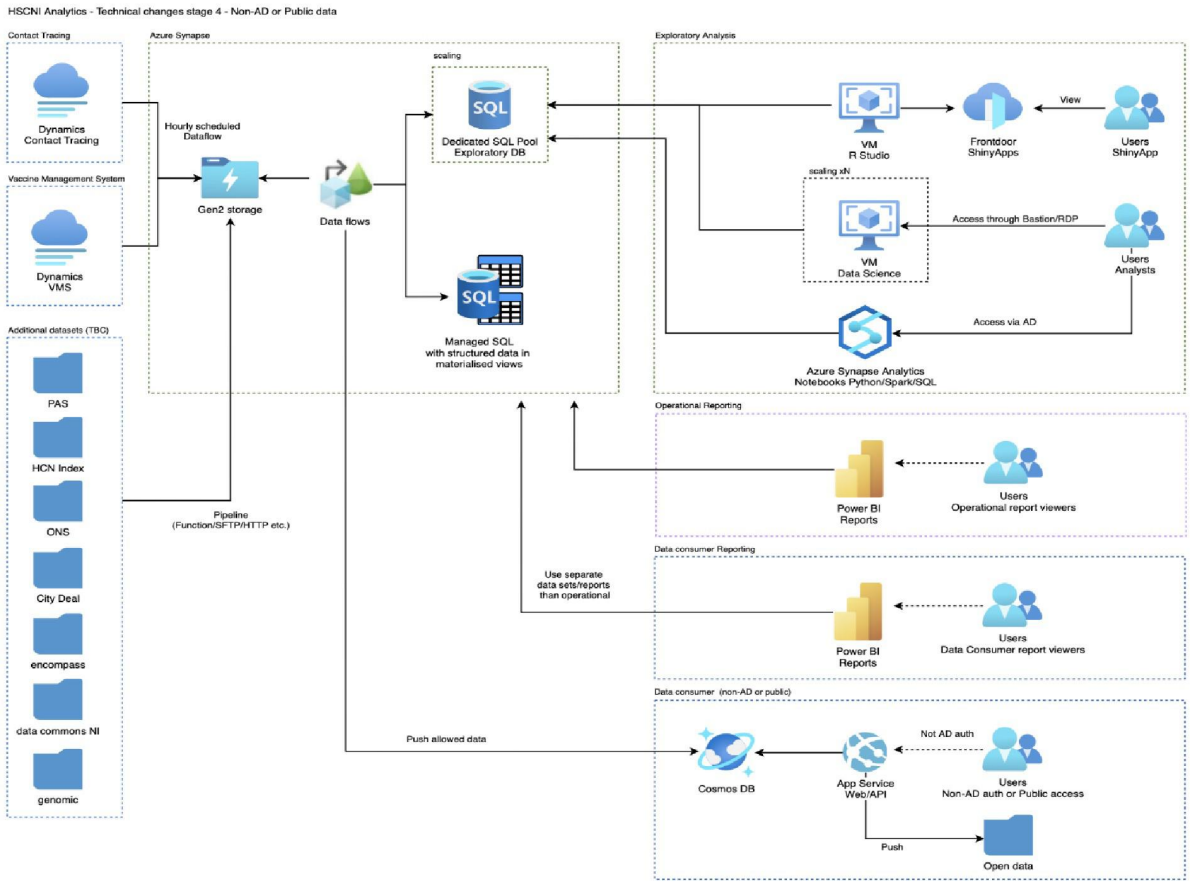
3. The CIO should be complemented, by the appointment of a Director of Research and Epidemiology (DRE), to oversee the specific use of research data within the PHA. This DRE should work closely with CIO and DPH and will be responsible for cementing PHA's relationships with data repositories in BSO, Universities and leveraging the recent HRDUK investment in the R&D Office and future City Deals. The DRE will be charged with developing a Scientific Advisory Board within PHA, which will act to advise and support PHA when novel challenges arise. The DRE will insure insights gained in research will be rapidly translated into practice.

4. The PHA should establish direct links into the encompass programme and wider DHCNI team. Either through joint appointments or combined work programmes. The encompass programme will provide a wealth of public health information regarding; population health, commissioning and care delivery. Working closely with DHCNI, the PHA must identify a non-duplicative approach to managing the intelligence that can be derived from this programme, and wider information strategy work, for the citizens of NI.

5. The PHA should create a single information and analytics resource within the agency. These units are often referred to as the "Analytics Function" within similar government organisations. All information requests should be routed through this function regardless of directorate structure, or origin of request. Based on efficiency of effort, infrastructure, skills and training, there is no requirement for silos of informatics skills within PHA. This journey towards an information function within PHA will take some time and should be done deliberately and slowly taking current staff opinions seriously and iteratively targeting the best operating model for PHA, recognising this is as much about culture as technology.

6. A long term planning discussion should begin between senior staff in PHA with IAD, PMSI, NIRSA and the Department of Health regarding the reporting of healthcare information in Northern Ireland. There is duplication of effort throughout HSCNI data reporting. This was evident during Covid 19. The inaccuracies and interpretation of data should be discussed, and the inherent problems and margins for error should be transparently embraced. There is no right answer. My opinion is that PHA should act as an interpreter for all "noisy data" for Northern Ireland - providing insight and intelligent commentary on the data we produce - rather than every agency providing their own siloed interpretation. It is for senior PHA team to decide if this is in keeping with the agency's wider aspirations.

Appendix 1.



PHIP - Public Health Intelligence Platform – proposed

Data ingest sits on left side of diagram. Synapse is the storage / matching platform. Analysis and presentation right hand side. Included is anonymous export and dashboarding. Moreover, the PHIP platform can create agile and efficient ingestion methods which allow citizen facing services to be stood-up rapidly and be efficiently created for specific problems. Future investigation for flexible use could include screening, wider vaccination programmes, patient related outcome and experience measures.

Appendix 2.

Potential timeline for CIO activities