
The Interoperability Hype – can we trust it?



ORION HEALTH
WHITE PAPER //
Federica Lanzo,
Orion Health
022024

Introduction



What is the purpose of interoperability and why is it so crucial for the health sector? What's behind the recent increase in momentum?

The traditional healthcare system has had many challenges for decades, ranging from an ever-increasing elderly population, to a shortage of physicians and nurses, health inequities, and escalating costs, to mention a few.

Digital tools have been incorporated into health professionals' daily activities in order to address some of these issues via templates, automated processes, telemedicine and exchange platforms, enabling providers to share tasks with a larger workforce. However, the rapid proliferation and deployment of Health Information Technologies (HITs) has generally outpaced the implementation of training programs, the setup of realistic expectations and the development of interoperability standards, causing a great deal of frustration among providers..

In particular, the amount of clerical burden due to the fallout from a lack of interoperability between electronic health record systems (i.e., documentation redundancy with inefficient workflows) falls heavily on the shoulders of physicians and their staff . These administrative burdens inevitably affect physicians' time spent with their patients and contribute to feelings of general burnout for health professionals worldwide.

Digital tools on their own are not the answer.

The Story of Dr. Z and Lucas Romano: Part 1

Lucas Romano was on vacation out of his home country when he began having trouble breathing. He visited a clinic in the small town where he was staying and had some tests done. The next day, his symptoms worsened. The clinic was closed on the weekend, so he visited a hospital in a bigger city. Dr. Z was almost sure Lucas was exhibiting symptoms of COPD. Lucas informed Doctor Z that he had had

some tests done the day before, but the test results were saved in that clinic's EHR. Dr. Z tried to look up the results, but she couldn't access them. Frustrated, Dr. Z realised she would have to order the tests again and wait an additional day or two for the results to come in before she could proceed with a formal diagnosis. In the meanwhile, she helped address Lucas' symptoms to the best of her abilities.

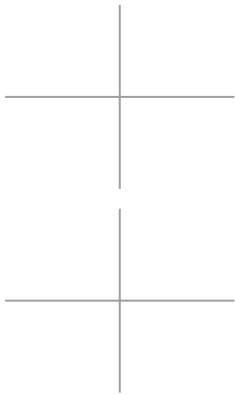
Delays in accessing and gathering different pieces of needed information from a scattered digital clinical record, where a patient's data is siloed across multiple facilities and providers, does not meet the expectations of physicians, much less the patients they serve, in the digital world we live in.

One main issue with achieving interoperability today lies in the abundance of vendors and systems that tend to have "walled gardens" around the data they generate, disregarding what is best for the patient and the negative impact that such closed conduct has on patients' quality of care – referred to as information blocking. Proprietary specifications, lengthy data-sharing processes beset by red tape – often hindered by clauses in contracts

around data sharing – and concerns with regards to patient protection, have been the main causes for many organisations maintaining this siloed, restricted approach to exchanging patient data with each other. To read more about information blocking, please see the American Medical Association's definition in their report here (What is information blocking, 2021).

Interoperability offers a powerful means to alleviate many of these data-sharing issues in modern healthcare, starting with the foundational challenge of data fragmentation. In this white paper, we explore why interoperability is now considered to play a major role in solving the challenges we are currently facing in the global health sector.

What challenges can interoperability help mitigate?



Traditionally, the entities involved in delivering care have not had an easy way to communicate with each other or exchange patient data with external health systems.

Three main challenges have been identified in the quest towards supporting the healthcare journey of a patient nowadays. Interoperability and seamless data-sharing are keys to solving these issues:

- Data fragmentation
- Significant lack of resources
- Higher consumer expectations

Challenge #1: **Data fragmentation**

It is no surprise that lack of communication across the care continuum results in many negative consequences, such as delays when providers or patients try to access data external to their own facility (i.e., through phone calls or faxes); additional costs from repeating procedures such as laboratory tests, which may have been recently performed by another provider in another facility; and a narrowed view of a patient's record, missing the holistic view of a patient due to their data being held across disparate, non-connected systems.

It is helpful to understand that a big part of the data fragmentation problem is how many EHR companies are out there on the market today. According to a recent Beckers Health IT article, 96 percent of hospitals are running on some kind of Electronic Health

Record, but interoperability between those EHRs is still a struggle (Diaz, 2023). Although there are two major players that dominate more than half of the EHR market – Epic and Cerner – over 500 vendors out there offer some kind of EHR product (Green, 2023). In addition to that, in 2018, the average number of EHR platforms any given hospital was running on at once was sixteen. That's right – sixteen distinct EHR platforms, each with their own proprietary modeling and language, according to statistics HIMSS Analytics pulled from its Logic database analyzing 571,045 providers affiliated with 4,023 hospitals (Sullivan, 2018).

Challenge #2: **Significant lack of resources in the workforce**

For too long, unfortunately, a lack of coordinated focus on healthcare funding and digital tools strategy has led to extremely stretched health systems struggling with an ever-declining number of providers and other healthcare staff. Governments around the world cannot afford to see their national health systems grinding to a halt and are feeling the pressure to maintain high-quality healthcare operations even in the face of a sharply decreasing workforce. In fact, the UK has declared the lack of timely care, especially emergency care, throughout the UK, in part due to staffing shortages, as “a national emergency.” (Emergency Healthcare: A National Emergency, 2023).

Challenge #3: Higher consumer expectations

Alongside these two well-known challenges, modern healthcare is also faced with new expectations from patients, who are now taking the role of consumers. Technology literacy and the abundance of online medical information have shaped patients into engaged users who feel empowered to make informed decisions about their health. This is a positive thing, but it also means patients need access to, and control over, their personal health

data. The proliferation and uptake of health apps is a clear sign of patients' desire to own and manage their own health information. Global citizens then take this further by desiring a portable digital health record to carry with them wherever they are traveling. However, the difficulty accessing healthcare data within the borders of their own country, let alone while traveling abroad, may leave frustrated patients asking themselves, "Why is it that I can easily put data in my fitbit, but I cannot access my own healthcare record?!"

The Story of Dr. Z and Lucas Romano: Part 2

While Lucas was sitting in Dr. Z's office waiting for her to re-order his tests, he remembered that his primary care doctor started him on medication for a different condition two weeks ago. He was still taking it, but he had left it in his hotel room and couldn't remember the name of it. He tried to look up the medication in the PHR app on his phone, but the app was not completely interoperable with his family doctor's EHR, so the information was not there,

either. Dr. Z did not want to take the chance of prescribing something for Lucas' COPD which had a negative drug-drug interaction, so she would have to wait an hour or two for Lucas to get home and call her office with the name of the current medication he was on. It was near the end of the workday at her clinic, though, and so she would not be able to issue a prescription to Lucas until the next morning.

Driving forces for change, and why they are happening now

At Orion Health we believe that in the ideal healthcare world, patients and providers are at the center of the healthcare system, with patients owning their data and authorised providers having as much access to that data as needed to support the best clinical decision-making possible. This is the paradigm shift we should all be aiming for. Admittedly, this is not a simple change of direction: technology, implementations, and expectations must align for this to

successfully take place. For the first time in 30 years that Orion Health has been in the market, we are effectively experiencing the most favorable conditions to drive a real change in a health sector that incredibly needs it.

Below we explore the driving forces that working in orchestration are moving the dial for achieving interoperability.

Driving force #1 – Standards: Building blocks of interoperability

Integration and access for providers and patients through standards

Health IT standards play a crucial role in the ability to share information between healthcare entities. They provide a **common mechanism** – foundational ground rules – for how data should be structured and exchanged. The adoption of standards facilitates the accumulation of an integrated network of data around a patient, including data from a variety of venues, such as hospitals, community settings, health smart devices or other health networks altogether.

The most well-known standard in the healthcare world, and the first one to ever be heavily adopted by Orion Health, is **HL7 version 2 (HL7v2)**. HL7 version 2 represents transactional events in the clinical context where well-structured fields describe specific details around encounters, laboratory testing and problems, to name a few. Traditionally, Patient Administrative Systems (PAS) and Laboratory Information Systems (LIS) in hospitals would generate data using HL7 v2 standards. However, while information conveyed through this standard is very well structured, it does not leave much room for narrative elements.

When describing specific snapshots in time, enriched with free-text narratives, in fact, the most robust standard to use is the **Consolidated Clinical Document Architecture (CCDA)**, which does allow for these elements. The CCDA standard is the evolution of the Continuity of Care Documents (CCDs) standard. CCDA documents have structured and unstructured parts, where images and narrative-like physician notes are included, split into clinical domains sections. Currently, the CCDA standard is the most commonly used standard for exchanging data in the United States (What is C-CDA?, 2022).

Finally, the most recent of the HL7 family is the **Fast Healthcare Interoperability Resources (FHIR)** specification. It somewhat simplifies the HL7 v2 rules, as its JSON structure is more accessible to developers. It arose from the need to surface the data in a more modern and connected ecosystem, where the recent proliferation of health apps has undergone exponential growth (especially during the COVID-19 pandemic). For example, in 2020, 90,000 health apps appeared on the market, and today, there are 350,000 health apps on the global market (Marvel, 2022). In recent years, FHIR has taken the Health IT world by storm, being recognised, in fact, as the main means of interoperability in the healthcare space and “a landmark step to remove many of the barriers to healthcare data exchange” (ONC Fact Sheet, 2019).

FHIR is a specification aimed at Application Programming Interfaces (APIs) and determines how health data classes, or resources, are modeled structurally and semantically. While

determining the way healthcare entities are represented in terms of attributes and data types in JSON or XML format, FHIR also prescribes what value sets and nomenclatures are preferred.

Orion Health solutions deal, understand and handle all of the above specifications, recognising that organisations and health systems have different requirements, or are simply at a different technological maturity level.

Our focus currently is on the more modern FHIR specification, with its corollary implementations and ability to seamlessly integrate in the healthcare ecosystem.

Nomenclatures

Health standards heavily rely on terminologies and ontologies to be valuable at national and global levels. Depending on international nomenclature, a consistent use of vocabulary that can be unequivocally understood when exchanged is ensured. Coded clinical terms can then be translated into different languages, creating the opportunity for smoother international collaborations and research projects as well.

Typically, local organisations use proprietary codings that fit their specific purposes or billing systems. It is in the interest of the health system to be able to map local terms to well understood codes. Orion Health offers specific services to enable the so-called normalisation, a process in which international standard codes are matched to the original custom terms, in order to allow meaningful sharing of data across separate entities.

Driving force #2 – Government support: Interoperability roadmaps and international collaboration

Standards are indeed the building blocks for interoperability. They technically represent the material and common language through which data exchange is performed. Those involved in the conversation, though, need to be willing to do the talking. Engagement from involved parties such as governments and affected healthcare organisations is essential for sharing clinical data successfully (Bella, 2022). Further, the adoption of standards is complex and expensive; therefore, health organisations have to be in a position to appreciate the value and afford the resources to fully embark on the standards adoption journey.

The COVID pandemic in particular played a critical role in stressing the importance of digital health tools and seamless data sharing. At a time when physical contact was kept to a minimum and clinical records had to be electronically transferred for traditional care as well as for epidemiological studies of the virus, that realisation only grew stronger. It would be unfair to say that governments around the globe had not been planning for digital health services for their citizens, but the shock to the system that the pandemic caused really reinforced the urgency of the matter, motivating governmental healthcare leaders to push forward in defining and planning interoperability roadmaps for health IT vendors and providers.

The ONC Cures Act Final Rule is a good example of a government's effort to put patients at the center of their care by lowering the barriers to data-sharing (ONC's Cures Act

Final Rule, HealthIT.gov). The rule indicates what constitutes information blocking and how it can be avoided by using well-defined interoperability tools (Information Blocking, HealthIT.gov). At its core, the Cures Act rule identifies the HL7 FHIR version 4.0.1 standard as the main mechanism for data access, exchange, and use of clinical data. The Cures Act also identifies some fundamental use cases and related capabilities that must be satisfied by health IT vendors and providers to demonstrate their ability to participate in an interoperable and innovative ecosystem. For instance, they must allow patients to choose an app for their smartphones to access their own health records. Of course, the implementation of such use cases cannot be executed all at once; therefore, a plan with subsequent phases of compliance has been drawn.

Even the National Health Service (NHS) in the United Kingdom has focused its attention on a national strategy and plan for interoperability to allow for a much-needed digital health transformation to take place in the UK (Digital Primary Care, 2023). The NHS Long Term Plan is, in fact, set out to "Mandate and rigorously enforce technology standards ... to ensure data is interoperable and accessible" (Online Version of the NHS Long Term Plan). The roadmap for standards to be used and compliance to those standards is publicly available online, and it includes the adoption of FHIR specifications, clinical terminologies and the UK's national shared care record (Joining up and sharing ... , NHS England).



Finally, the New Zealand Ministry of Health and Digital (now called Te Whatu Ora) has funded a five-year-long program called Hira in order to connect people's health and wellbeing information. Mirroring the work of standards organisations like the International Organisation for Standardisation (ISO), the Systemised Nomenclature of Medicine (SNOMED), and HL7, and liaising with international collaborations, the program is articulated in three main branches of work, where digital toolings, standards and protocols are analyzed and adopted to develop accessible and discoverable digital health services for the population of New Zealand (Hira, Te Whatu Ora).

It is clear that many developed countries are expanding their digital enablement in healthcare, and they are not doing it in isolation. Similarities in approaches and toolings are the result of a growing international collaboration. Digital partnership, workshops and hackathons around the world are becoming a fundamental

vehicle for standards evolution and adoption. These would typically involve technology vendors too, like Orion Health. Counting on our international experience, we can in fact assess regional approaches and recommend changes to guidelines wherever useful.

Countries involved in international collaboration can learn from other parties' experiences and apply what is relevant to their local interoperability issues. The Global Digital Health Partnership (GDHP) has been particularly focusing on progressing the interoperability effort at a global scale for the advancement of health and healthcare (Interoperability, GDHP). For example, the GDHP states in its vision that the organisation "facilitates international best practices in the use of data and technology to advance health and care, provides opportunities for policy co-production and knowledge transfer, and facilitates horizon scanning to more accurately forecast emerging trends" (GDHP Vision, GDHP).

Driving force #3 – Modern use cases and expectations: Patient engagement and expectations



One final key element to interoperable ecosystem growth can be found in the rise of expectations in the digital health space.

The flood of smartphones and wearable devices has definitely contributed to the explosion of healthcare data that we have available today (Wiederrecht, Darwish, & Callaway). The combination of technology advancements, along with the worldwide population's growing interest in their own well-being, has created an environment where both big vendors and independent developers are able to build very helpful applications and contribute to the growing number of health apps on the market. The adoption of standards like FHIR have created a level playing field where the barrier to participate in the healthcare app market has been lowered significantly (Smart App Gallery).

Earbuds that monitor body temperature, microphones that track a person's sleep cycles, or exercise apps that suggest the best walking track are everyday items that produce a large volume of detailed data. An engaged user will analyze those trends and act upon them accordingly or even share them with their practitioner (Kang & Exworthy, 2022). The current app ecosystem is very competitive – patients are quite demanding and might quickly switch to another app if the current one is not meeting their needs. In transitioning to another vendor's app, they expect to compare their previous data to data in the new app; after all, the user owns their own data.

The desire to track daily health metrics and understand how they impact health conditions exposes a gap in current electronic medical records as we know it – patients do not have access to the data that has been generated about them in a clinical setting. The ability for an individual to view their clinical records and make informed decisions about their health is crucial to modern patients. To illustrate this by comparison, we need look no farther than the example of a meal-planning app which can guide a patient towards making healthy eating choices and subsequently reduce their overall blood sugar levels. By having direct visibility on their glucose test results compared to their efforts, patients feel more empowered and motivated to maintain a good diet.

Historically, health organisations have kept patient data locked in their own systems in the name of privacy and security. However, nowadays, technology in many other industries has been able to evolve and develop safe mechanisms to protect users and their sensitive data. A prime example of this would be the technology currently found in the banking and finance world, where clients can trust their information and transactions to be secure when operating through financial and banking mobile apps. The main enabler in this context is the development of shared standards around authentication and authorisation, such as OpenID Connect and OAuth 2.0 – which are actually perfectly suited for health data exchange as well.

Interoperability standards around APIs and secure access respond to and satisfy the needs of the modern patient in a very precise manner, which enables them to be engaged in their care and make informed decisions that will keep them away from the doctor's office, or, if they need medical care, be directed to the best health care service for them.

This is the core pillar of the ONC Cures Act, which intends to put the patient in charge of their care as much as possible. They prescribe, in fact, that individuals be able to use any smartphone app of their choice to access their own record. However, this is possible only if a predefined standard for interoperability is chosen. As it appears in many national digital roadmaps, the Cures Act recognises FHIR as the API specification to follow, while the related SMART App Launch use cases, published by HL7 International – FHIR Infrastructure WG, are to be adhered to in order to provide safe access to health systems' data (HL7 SMART App Launch, Overview). If all health organisations can expose clinical records following the same standards in this kind of manner, then patients would not be limited with their choices and would have the freedom to choose the app that best suits them.

The Story of Dr. Z and Lucas Romano: Part 2

Let's revisit the story of Dr. Z and Lucas Romano – but this time, with fully interoperable health care systems sharing Lucas' patient data with each other.

Lucas Romano was traveling out of his home country when he started having difficulty breathing. After he had tests done at a clinic in a small town and his symptoms worsened, he visited a hospital the next day, where his doctor, Dr. Z, was almost sure Lucas was exhibiting symptoms of COPD. Dr. Z was able to quickly look up the results of Lucas' tests the clinic conducted the day before via a shared health information exchange portal that her hospital shared with the smaller clinic. This was especially important because the clinic was closed on weekends and so she would not have been able to call or fax them for the test results. From the tests, Dr. Z was able to formally diagnose Lucas with COPD while in her office, based on the results of the test.

As he was being seen in Dr. Z's office, Lucas remembered that his primary care doctor started him on a medication for another condition two weeks ago, which he was still taking, but he left it in his hotel room and couldn't remember the name of it. In a few seconds, though, he was able to easily look up the medication through the PHR app on his phone – which was completely interoperable with his doctor's EHR – and tell Dr. Z what the medication was.

Dr. Z discovered that there might be a mild drug-drug reaction with the medication she was about to prescribe to Lucas for his COPD, so instead, she prescribed him an alternate medication, which he was able to pick up from the hospital pharmacy that day to begin his treatment.

Lucas' breathing improved over the next few days and he was able to return from his trip overseas without further incident.



It is the right time to embrace interoperability.

The advantages to patients, healthcare organisations and society in general are clear, and can be realised through the support and collaboration of government and health agencies.

Conclusion

Interoperability is fundamental to solving many of the existing pains that our healthcare system is experiencing. Thanks to the ability to exchange data using widely accepted and agreed-upon standards, providers can take advantage of a meaningful longitudinal patient record made up of data seamlessly gathered from disparate sources, that offers a holistic view of a patient at the point of care, improving clinical decision-making and care outcomes.

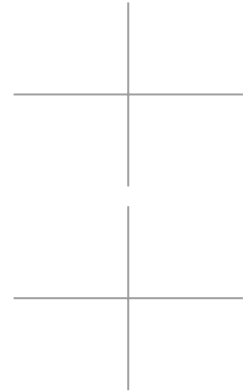
Interoperability also represents the means to transform the way healthcare is designed, by positioning the patient at the center, in a more balanced relationship with the patients' health professionals. Thanks to the opportunity to observe the evolution of their own clinical records, individuals can feel more engaged and responsible for their own care, and empowered to make more informed personal decisions for their wellbeing.

A healthy population that avoids unnecessary hospital visits is the goal of many governments around the world, and interoperable digital technology is one of the stepping stones in helping achieve it, thereby reducing that burden on the health care sector.

It is the right time to embrace interoperability. The advantages to patients, healthcare organisations and society in general are clear, and can be realised through the support and collaboration of government and health agencies. The direction of our new global health care system is architected on a balanced relationship between patients and providers. To enable such a future, an open, interoperable approach – where patient-owned data can be securely and easily exchanged – is fundamental.

How can we ensure that the momentum does not wane?

Interoperability implementation is demanding and requires a good understanding of local contexts to really move the dial in this area. Existing technologies and processes in a health care system should ideally not be replaced completely and not all at once (so-called “rip and replace”), and according to the costs involved and regional setups, transitional phases will be necessary. Here, the role of subject matter experts with knowledge of historical context (i.e. technologies and use cases) versus an understanding of future direction (i.e. new standards and modern use cases) will be crucial in bridging the path towards interoperability by setting the right expectations for the transition, and vouching for the capabilities that an open ecosystem unlocks.



References

- 21st Century Cures Act. (2016, Dec. 13). Public Law 114-255. 114th Congress. Retrieved from <https://www.congress.gov/114/plaws/publ255/PLAW-114publ255.pdf>
- Bella, G., Dalmiani, S., Dufflot, P., Keunen, V., Nicolas, L., & Whitehouse, D. (2022, May). Towards interoperable health data: the contribution of InteropEHRRate. InteropEHRRate. Retrieved from <https://www.interopehrate.eu/wp-content/uploads/2022/05/InteropEHRRate-Third-White-paper.pdf>
- Diaz, N. (2023, March 7). 96% of US hospitals have EHRs, but barriers remain to interoperability, ONC says. Beckers Hospital Review. Retrieved from <https://www.beckershospitalreview.com/ehrs/96-of-us-hospitals-have-ehrs-but-barriers-remain-to-interoperability-onc-says.html>
- eHealth. EU4Digital. Retrieved from <https://eufordigital.eu/thematic-area/ehealth/>
- Information blocking. HealthIT.gov. Retrieved from <https://www.healthit.gov/topic/information-blocking>
- Marvel, F.A., Dowel, P., & Mossburg, S.E. (2022, August 5). Emergence of application-based healthcare. Patient Safety Network. Agency for Healthcare Research and Quality. Retrieved from https://psnet.ahrq.gov/perspective/emergence-application-based-healthcare#_edn1
- Digital primary care: The good practice guidelines for GP electronic patient records – (GPGv5). (2023, May 15). Interoperability, version 1.1: The need for interoperability in healthcare. NHS England. Retrieved from <https://www.england.nhs.uk/long-read/interoperability/#the-need-for-interoperability-in-healthcare>
- Emergency healthcare: a national emergency. Public Services Committee, House of Lords. (2nd Report, Session 2022-23, HL Paper 130). (2023, Jan. 19). Retrieved from <https://committees.parliament.uk/publications/33569/documents/187215/default/>
- ‘Fit for the future?’: Rethinking the public services workforce. Public Services Committee, House of Lords. (1st Report, Session 2022-23, HL Paper 48). (2022, July 19). Retrieved from https://publications.parliament.uk/pa/ld5803/ldselect/pubserv/48/4804.htm#_idTextAnchor002
- GDHP Vision. Global Digital Health Partnership (GDHP). Retrieved from <https://gdhp.health/about/our-vision/>
- Goodday, S.M., Geddes, J.R., & Friend, S.H. (2021, Jan. 27). Disrupting the power balance between doctors and patients in the digital era. The Lancet Digital Health, Volume 3, Issue 3, e142 - e143, March 2021. Retrieved from [https://www.thelancet.com/journals/landig/article/PIIS2589-7500\(21\)00004-2/fulltext#articleInformation](https://www.thelancet.com/journals/landig/article/PIIS2589-7500(21)00004-2/fulltext#articleInformation)
- Green, J. “Who are the largest EHR vendors?” (2023, March 16). EHR in Practice. Retrieved from <https://www.ehrinpractice.com/largest-ehr-vendors.html>
- Hira – connecting health information. Te Whatu Ora. Health New Zealand. Retrieved from <https://www.tewhatauora.govt.nz/our-health-system/digital-health/hira-connecting-health-information/#news>
- HL7 Smart App Launch, Overview. HL7 International – FHIR Infrastructure WG. Continuous build for version 2.2.0-preview. Retrieved from <https://build.fhir.org/ig/HL7/smart-app-launch/>
- Interoperability. Global Digital Health Partnership (GDHP). GDHP workstreams. Retrieved from <https://gdhp.health/work-streams/interoperability/>
- Joining up and sharing health and care data. Digital transformation. NHS England. Retrieved from <https://www.england.nhs.uk/digitaltechnology/connecteddigitalsystems/joining-up-health-and-care-data/>
- Kang, H.S., & Exworthy, M. (2022, July 13). Wearing the Future—Wearables to Empower Users to Take Greater Responsibility for Their Health and Care: Scoping Review. JMIR MHealth Uhealth. 2022 Jul 13; 10(7): e35684. National Center for Biotechnology Information, National Library of Medicine. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9330198/>
- ONC’s Cures Act Final Rule. HealthIT.gov. Retrieved from <https://www.healthit.gov/topic/oncs-cures-act-final-rule>
- ONC Fact Sheet. (2019, August). “What is FHIR?” Office of the National Coordinator for Health Information Technology. Retrieved from <https://www.healthit.gov/sites/default/files/2019-08/ONCFHIRFSWhatIsFHIR.pdf>
- Online Version of the NHS Long Term Plan. Digitally-enabled care will go mainstream across the NHS. National Health Service, NHS.UK. Retrieved from <https://www.longtermplan.nhs.uk/online-version/chapter-5-digitally-enabled-care-will-go-mainstream-across-the-nhs/>
- Smart App Gallery. Featured apps. Retrieved from <https://apps.smarthealthit.org/apps/featured>.
- Sullivan, T. “Why EHR data interoperability is such a mess in three charts.” (2018, May 16). Retrieved from <https://www.healthcareitnews.com/news/why-ehr-data-interoperability-such-mess-3-charts>
- Wiederrecht, G., Darwish S., & Callaway, A. The healthcare data explosion. Royal Bank of Canada (RBC). Retrieved from https://www.rbccm.com/en/gib/healthcare/episode/the_healthcare_data_explosion
- What is C-CDA? (2022, February 10). Particle Health. Retrieved from [https://www.particlehealth.com/blog/what-is-ccda-consolidated-clinical-document-architecture#:~:text=C%2DCDA%20stands%20for%20Consolidated,Document%20Architecture%20\(CDA\)%20style](https://www.particlehealth.com/blog/what-is-ccda-consolidated-clinical-document-architecture#:~:text=C%2DCDA%20stands%20for%20Consolidated,Document%20Architecture%20(CDA)%20style)
- What is information blocking? Part 1. American Medical Association (AMA). (2021, January). Retrieved from <https://www.ama-assn.org/system/files/2021-01/information-blocking-part-1.pdf>

