better

The technology behind OneLondon's shared care planning solution

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Urgent Care Plan: From zero to live in seven months

On 23 December 2021 Better signed a contract to deliver a new shared care planning solution across the city of London – a footprint covering approximately 10 million people, 5 Integrated Care Systems, 1400 general practices, over 40 NHS Trusts, and 33 local authorities.

On 27 July this year, the service went live across this entire footprint. Going from zero to a live service of this scale in a period of only seven months is a tremendous achievement and was only possible through exceptional teamwork and collaboration between a massive group of stakeholders – including (but not limited to) health and care providers, governance leads, change management teams, national bodies, third-party suppliers, our partners Atos, CareIS, ReStart, and FreshEHR, and of course the Better team.

It also included quite a bit of work on the thing that people often refer to as "the easy bit". So, this article is an overview of just that – the technology behind the service.

BUT FIRST, LET'S REVIEW THE PROBLEM WE SET OUT TO SOLVE

OneLondon has a vision for London to become the "healthiest city globally" through transformative digital solutions and regional transformation. This will be supported through the sharing of data, standards and best practices, and platforms that support regional benefit.

The London Health Information Exchange has allowed a lot of data to be shared in the best way possible, but if London were to move to the next level of maturity, where structured data is consistently captured for the purposes of direct care, thus supporting service improvement, research, and patient engagement, a new platform approach was required.

WHY IS A PLATFORM APPROACH REQUIRED?

Because data is key — and it is everywhere. Unfortunately, a lot of it is "dirty", inappropriately modelled and captured, classified incorrectly, coded improperly, and not fit or safe to use.

Platform governance and a "data-first" approach enables data (and inputs) to be designed so it has the appropriate data governance for the desired usage.

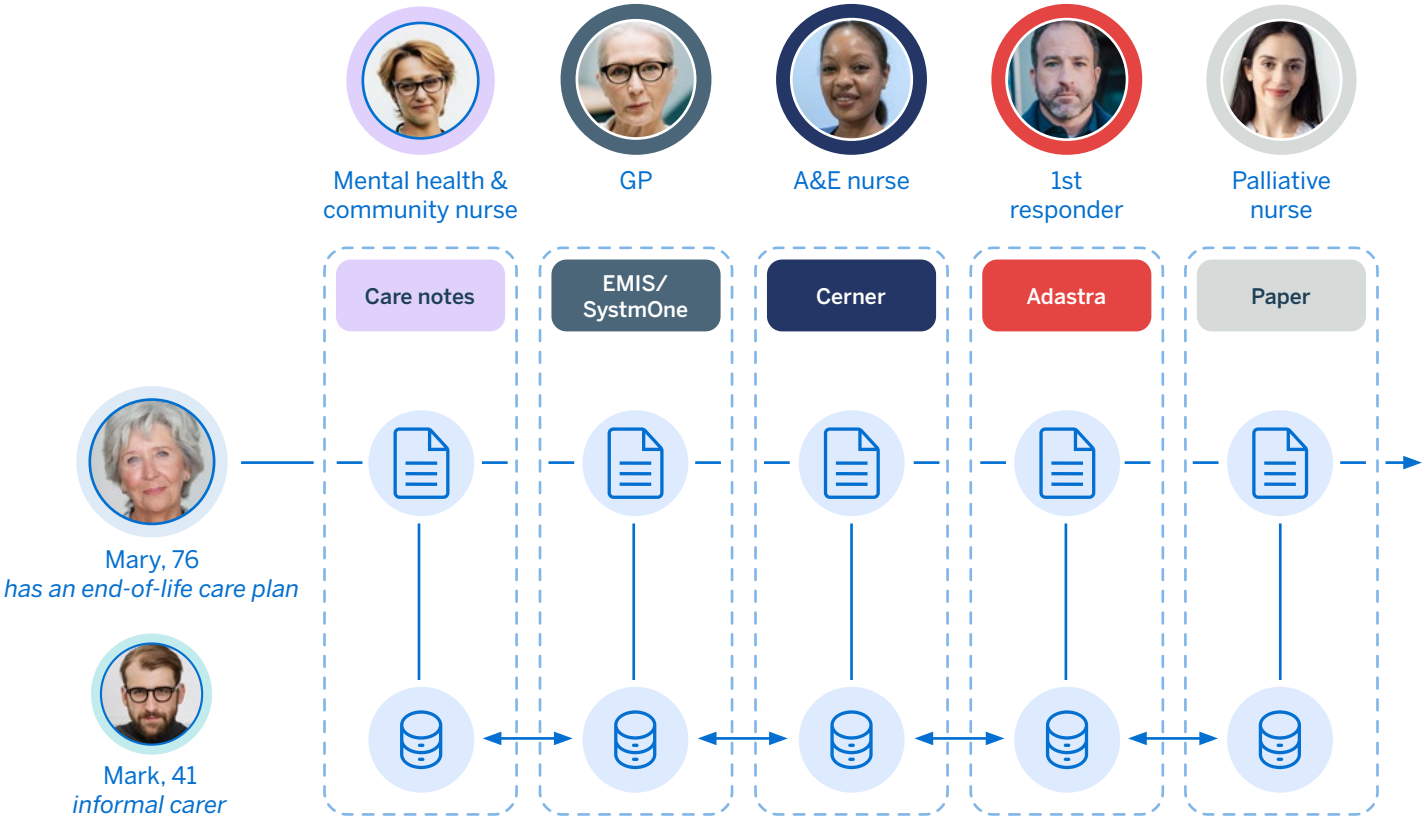
HOWEVER, A PLATFORM BY ITSELF DOES NOT SOLVE PROBLEMS

While a platform approach will allow London to address multiple use cases across the region, it was important that a first use case was implemented allowing benefits to be realised early. The first use case identified was end-of-life care planning.

End-of-life is a complex area, so it was a good test of the platform approach. The complexity comes from a range of things, including a complex data model, lots of integration with regional and national systems, integration to all point of care systems, and access by patients for bi-directional engagement.

However, more than all of that, it is a service that supports people (and their loved ones) through one of the hardest times of their lives, so it is important that we can provide a service that ensures patients can receive the outcomes and care they have requested at the end of their life.

In a typical environment, it is difficult to provide a service that can do this. The image below presents a typical scenario. Here we have Mary, who is 76, and on an end-of-life care plan. Mary, who is supported by Mark, an informal carer, will engage with a range of health and care professionals, each of whom uses their own local systems, with their own local copies of data. As Mary moves between care settings, a complex set of integrations is typically required to move information around between systems to provide a consistent view of key information, such as the DNACPR and a person's wishes at the point of need.

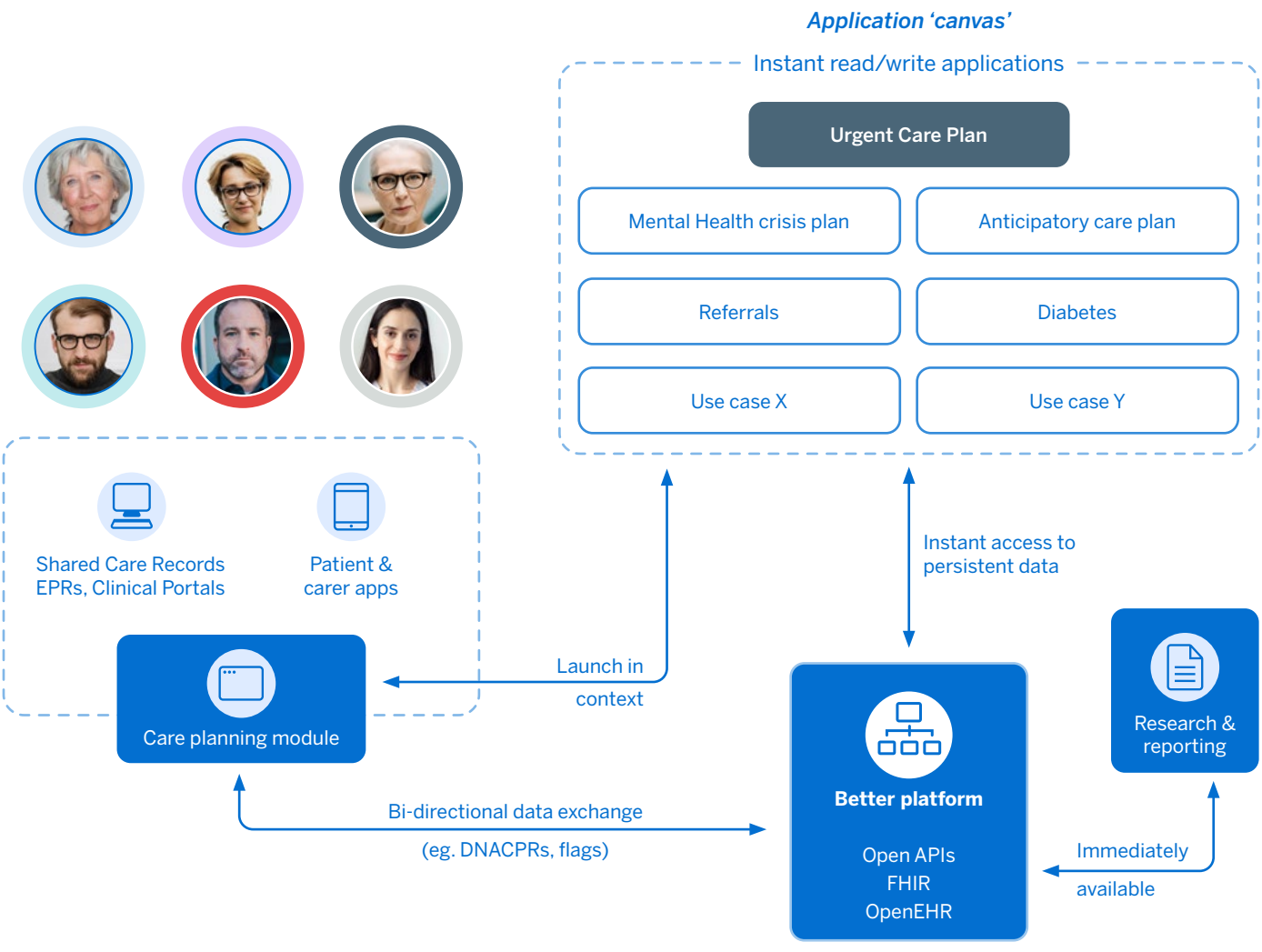


It is of course possible to deliver this solution using traditional approaches, but it will typically require changes to front end applications and/or system interfaces. Each healthcare organisation or ICS will need to prioritise these changes against other local demands. Putting this together is a long, complex, and costly exercise.

WHAT DOES A PLATFORM APPROACH LOOK LIKE?

Taking a platform approach with persistent separated data combined with low-code development is designed to enable a faster pace of change, local flexibility, and reduce the dependencies on application vendors.

The conceptual approach to this is outlined in the image below.



One of the key things we do differently is combining an open data model approach with application integration via contextual launch— illustrated above with the arrow labelled "launch in context". This allows us to move away from traditional models of "interoperability" that involve moving information around via lots of complex and costly point-to-point integrations to an approach where a common set of data models are adopted, and the user interfaces components are embedded inside existing systems, ensuring everyone has real time read/write access (in line with defined access control policies).

Adopting this approach delivers several benefits, including:

- single sign-on access for all users,
- easy access to the forms and applications you need from existing systems,
- development of forms using low-code technology for at-scale co-production,
- making changes for all users at the same time,
- expanding to new use-cases re-using the infrastructure and captured data with minimal dependencies,
- instant data availability for other applications,
- centrally maintaining control of the data model,
- structured data for research and reporting in near real-time.

SHOW ME THE TECHNOLOGY!

Ok, so you came here for the technology, let's get to that without any further ado.

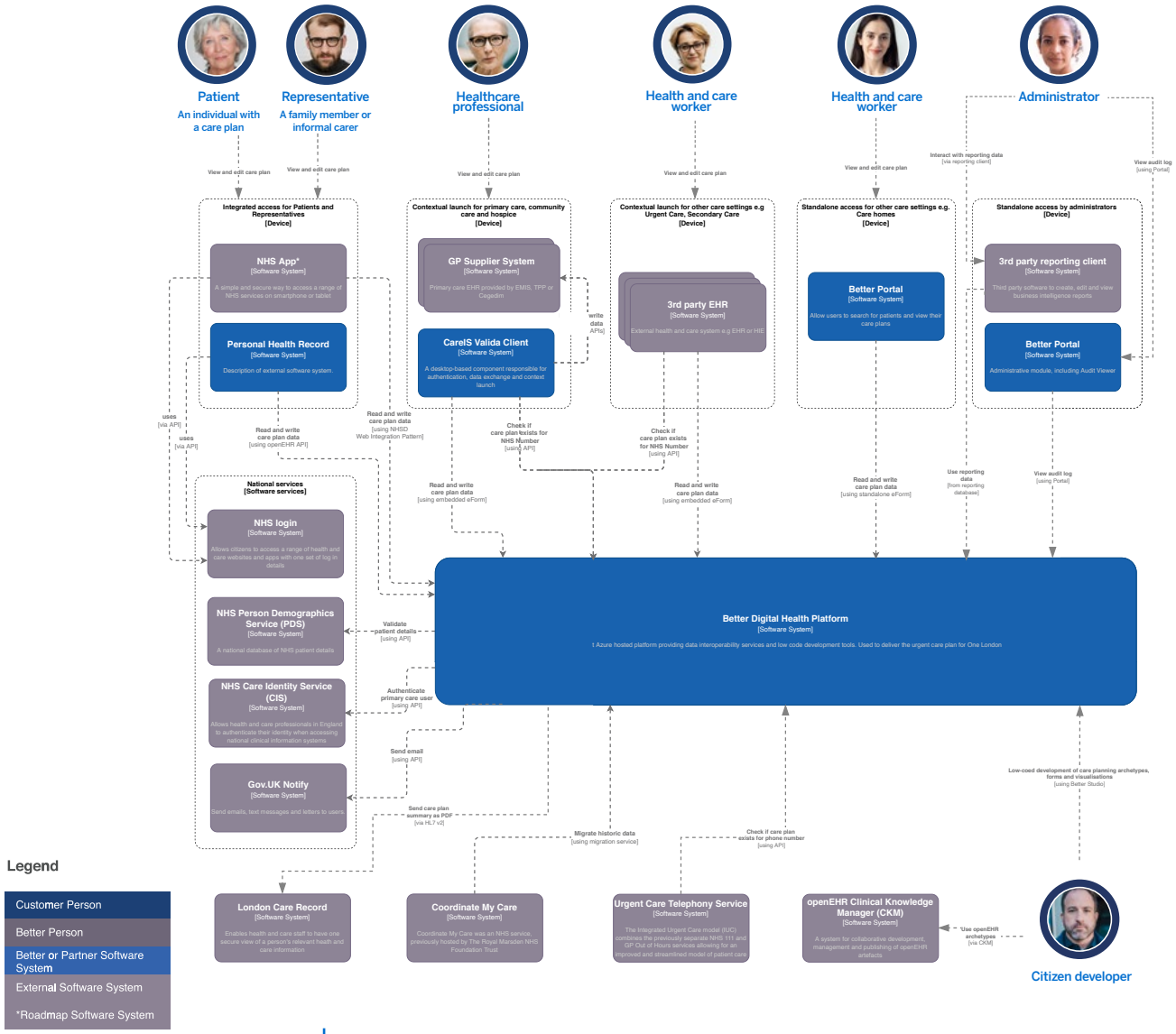
I am a fan of the C4 model for visualising software architecture, so the diagrams below follow that style. First up is the System Context diagram — a zoomed-out view of a software system, allowing you to see the big picture.

The Better platform is represented by the blue box in the middle – we will get back to this shortly. For now, we will consider the other supporting components in the diagram i.e. the people and software elements that are connected to the Better platform.

Let's start with the most important aspect – our users. Patient care often involves teams of professionals working across

different organisations and disciplines, including GP practices, hospitals, care homes, and hospices – so rather than trying to show every type of user, the diagram below groups users according to the technical pattern used to provide them with access.

As outlined above, our preferred pattern to achieve this is to enable access with contextual launch and single sign-on. In his article on "Turning healthcare IT architectures inside out", Tomaž Gornik outlined the background to this approach and its benefits in more detail. In summary, it allows a button (or similar) to be presented inside an existing system that will open a care plan in the patient context, without the need for additional credentials. We also provide a service (called the General Availability Service or GAS, outlined later) that can be used to notify a source system when a care plan exists, so users know when to click through.



These "application-level" integrations provide a foundation that enables change and governance to be controlled centrally but functionality to be delivered locally across an entire region. As we develop additional pathways in the future, this will be a key enabler in doing so in an agile, incremental manner.

The access patterns in the diagram are summarised below:

- **Integrated access by patients and representatives** – We are currently working with NHS Digital and OneLondon to integrate the shared care planning service into the NHS App. We plan to integrate this using the Web Integration Pattern (outlined here). We also support integration with other Personal Health Record systems — either with existing services that a customer may have or via one of our partners. In Suffolk and North East Essex Integrated Care System (SNEE ICS) we are currently deploying the same solution as in London, but in this instance, we have partnered with COHESION who have integrated their app with our platform using native openEHR APIs, providing patients and their representatives (a family member or informal carer with a legal basis to access the record) with real time read/write data capability.
- **Contextual launch for primary care, community care, and hospice** – These users will typically use one of the three GP Supplier Systems used across the NHS — TPP SystmOne, EMIS Web, and Cegedim Vision. We use a desktop client from one of our partners (CareIS) that acts as an authentication and data broker, facilitating the following interactions:
  - **Check if a care plan exists** - The desktop client (called Valida) uses the GAS API from the Better platform to check if a care plan exists for the patient currently open in the GP system.
  - **Single Sign on** – The Valida client will establish a single sign on session and map the user's role based on their NHS Smartcard.
  - **Contextual launch** – The Valida client maintains context with the patient record currently open in the GP System. When a user opens a care plan the patient context is securely passed together with the auth token and the relevant care plan is automatically displayed.
  - **Exchange of structured clinical data** – The Valida client uses the IM1 APIs from the GP Supplier system to read and write a defined set of coded clinical data. A set of business rules are implemented within the Better platform to control what data gets read and written, and under what scenarios.
- **Contextual launch for other care settings e.g. secondary and urgent care** – The Better platform provides a flexible Authentication Broker (outlined later) that enables a range of authentication and contextual launch scenarios to be supported. The end result is that users only need to authenticate with their local EHR, with the Better platform ensuring additional credentials are not required. The GAS API is also used to ensure a user has visibility when a care plan exists for a patient.
- **Standalone access for other care settings** – There are several care settings where a local EHR does not exist — e.g. Care homes — and as a result, context launch is not an appropriate channel for user access. In these scenarios, Better Portal is used, allowing users to search for and view patient care plans.
- **Standalone access by administrators** – There are a range of administrative users including business analysts who run operational reports and those who interact with the audit log. For report viewing any third-party reporting tool (e.g. Excel, PowerBI) can be connected to an anonymised reporting database in the Better platform. For audit reporting, an audit viewer is available within Better Portal for those users who have been assigned the appropriate role.

The only remaining users shown in the diagram are the **Citizen Developers** who use Better Studio to develop all the artifacts required for the care planning application, including the openEHR archetypes, templates, and associated eForms. These artefacts are all published to the Better Clinical Data Repository (outlined later), a foundational component built using openEHR, ensuring all data held by the platform is stored in an open, vendor-neutral format.

We worked closely with our partner FreshEHR, who re-used an extensive collection of freely available and internationally developed openEHR archetypes and other shared resources to develop the core data models and associated data migration paths.

The eventual dataset comprised 23 openEHR templates such as Allergies list, Alerts list, Disabilities, Living arrangements, in turn based on 82 individual archetype components, such as Advance intervention decision, Prognosis, and Problem/Diagnosis.

Of those 82 archetypes, 43 were derived from the international openEHR CKM repository, 21 from the UK Apperta CKM repository, and 18 were developed locally for this project.

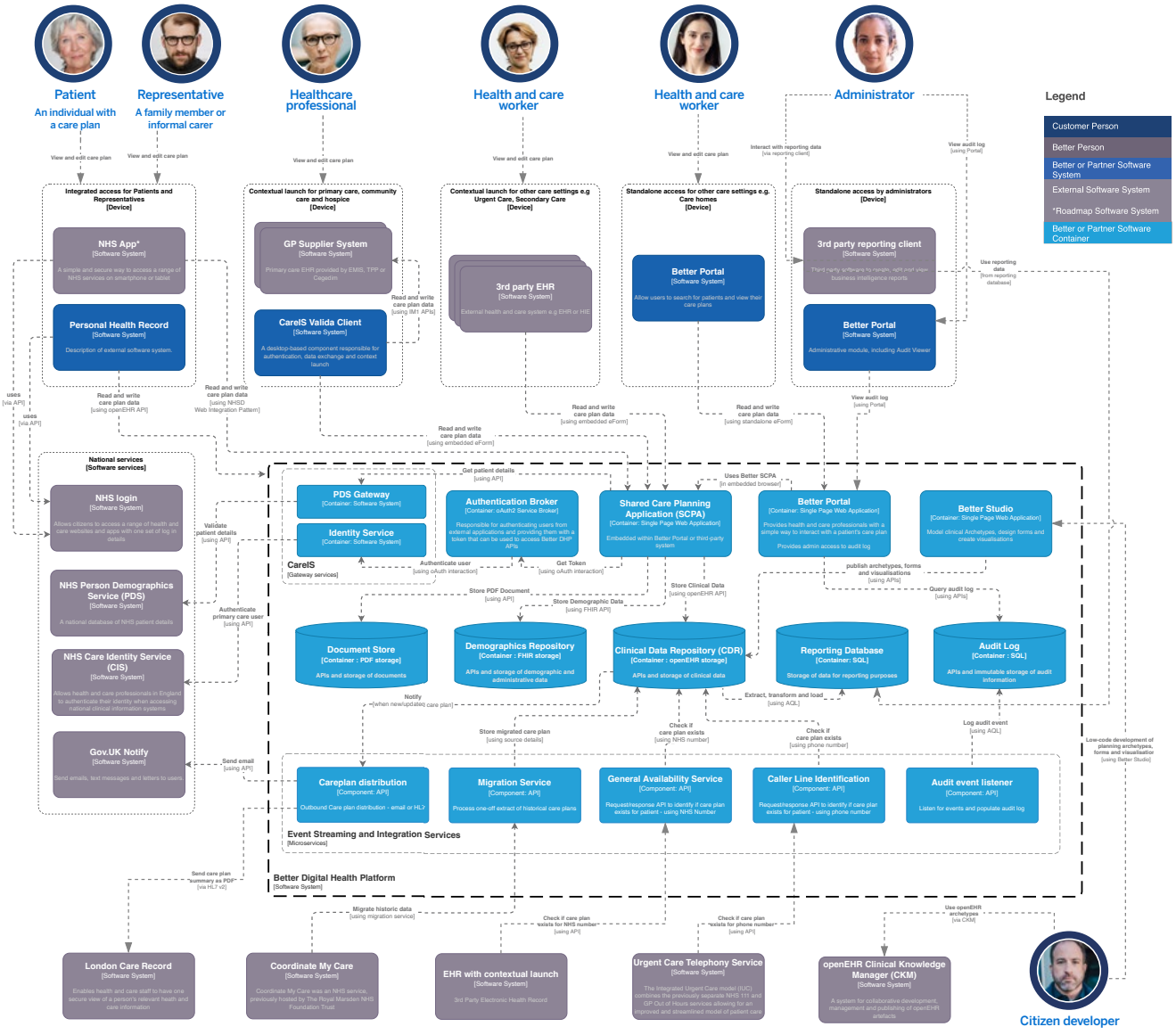
The remaining software systems shown in the diagram are summarised below:

- **NHS login** – As outlined above, this component is being adopted as part of our deployment in SNEE ICS to support patient and representative access to the COHESION app. Future phases of the London service will use NHS login as part of our integration with the NHS App.
- **NHS PDS** – We use this to validate the demographic details of a patient each time a care plan is opened.
- **NHS CIS** – This is used to support authentication of users with an NHS Smartcard.
- **GOV.UK Notify** – This component is not currently used in London, however we will use it in SNEE ICS to send a daily email to a group of administrators on care plan activity.
- **Coordinate My Care** – We created a migration service that performed a full extract, transform and load (ETL) of all care planning data managed by the previous care planning service. All legacy data was mapped to the same set of openEHR archetypes outlined above.
- **Urgent Care Telephony Service** – NHS 111 use a variant of the GAS API to check if a care plan exists for an individual based on their telephone number.

- **London Care Record** – Each time a care plan is created or updated a PDF rendition of the plan is created and sent via an HL7 message to the London Care Record. This is then used by the various instances of Cerner HIE across London to provide a view of the care plan. Among a range of other controls, this also acts as one part of the overall business continuity plan.

Now that we have a view of the overall IT environment, let's zoom-in on the Better Platform to explore the high-level shape of its architecture and how responsibilities are distributed across it.

I've used a C4 Container Diagram for this. A "container" is essentially a separately runnable or deployable unit that executes code or stores data e.g. single-page application, desktop application, mobile app, database schema, etc.



The following containers are shown in the diagram

- **Authentication Broker** – We have adopted a distributed authentication model to establish trust between the central Better platform and the various health and care applications connected to it. This means that users who access the solution via context launch (as outlined above) do not need an additional set of credentials. Several options exist to establish this trust, including standards-based tokens (where the local application already uses one of the supported standards, such as oAuth2, OpenID Connect or SAML) or non-token-based models where the local EHR uses the Better APIs to generate a token for the user.
- **Better Portal** - Better Portal is a standalone web application that runs on a variety of different browsers and devices. It is written in Angular, a reactive-based framework for front-end web development. Better Portal allows users to search for patients, manage patient lists, and visualise data held within the Better platform. For One London, it also allows users to interact with a patient's care plan where context launch is not an option — for example in care homes that do not have a local EHR.
- **Shared Care Planning Application** – this is a module within the Better Platform that provides end users with access to a patients care plan. It is built using the same technology as Better Portal and can be embedded in a local EHR or natively inside Better Portal.
- **Better Studio** - This is a low-code environment for rapid development of clinical applications and is what we used to create all the care planning data models and forms. It interacts with the Clinical Data Repository, other Better infrastructure components as well as external data sources through APIs. Check out this video for a quick overview of some of its rcapability. This component will play a key role as One London create future care planning services outside of end-of-life.
- **Document Store** - The document store is used to store binary objects, such as PDF renditions of a new or updated care plans. While not currently used in London, we also support IHE Cross-enterprise sharing of documents (XDS) capabilities (such as XDS.Registry and XDS.Repository actors) enabling the Better platform to integrate with an IHE-based Health Information Exchange architecture.
- **Demographics repository** - The demographics server is used to store all patient demographics information and where required any associated administrative data, including encounters and appointments, is stored. This data is stored in the HL7 FHIR format with FHIR APIs provided to read, write, and update data. Each time a patient record is opened we validate their details with the NHS Person Demographics Service (PDS) and refresh the information stored within the demographics repository.
- **Clinical Data Repository** – Based on openEHR, this is a foundational piece of the architecture and is what we use to store all clinical data. For the shared care planning application, data is read from and written to this service using native openEHR APIs, however it is also possible to use FHIR Connect to integrate with this data using FHIR.
- **Reporting database** – The Better platform provides an Extract, Transform and Load (ETL) service that allows data to be loaded into a separate reporting database based on a defined set of criteria. openEHR AQL queries are used to extract the data and the customer can connect to the reporting database using their local business intelligence reporting software.
- **Audit Log** - All auditable events within the Better platform are stored within an immutable audit database. The audit log records the Actor, Location, Date Time stamp, Action, and Target for all audited events.

- **Event streaming and integration service** – While not currently used in the London deployment, the Better platform uses the Apache Kafka event streaming platform (ESP) to provide data streams to other platform components or 3rd party systems. In London, we worked with our partner ReStart to create several custom end points to support each of the integrations outlined in the diagram.

Hopefully this provides an overview of the technology used for the solution deployed across London. The combination of an open data approach and low-code technology is the one that I feel provides several of the core building blocks needed to transform a healthcare system at scale, in a user centred, incremental manner.

Looking back, I think it is a phenomenal achievement to deliver a service of this scale in only seven months. The team have played a huge role in making this possible, but the technology itself has also been instrumental. A platform-based approach like this has allowed us to leverage both existing technical capability (e.g low-code, clinical data repository, etc.) and clinical content (e.g openEHR models), ensuring we can focus more on user needs and less on foundational elements.

Looking forward, I'm excited by the opportunity ahead of us. Now that we have established the technical infrastructure and integrations, we can quickly add new use cases and make these available to all users across London without having to touch any end user systems.

Please reach out to me if you would like to learn more or explore any areas in more detail.

CONTRIBUTIONS

Thanks to the following people who contributed to this article:
Brina Tomovič Kandare, Ian McNicol, Matt Cox, Borut Fabjan, Tomaž Gornik

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