



**INTERWEAVE**  
CONNECTING CARE

Cookbook for Regional Interoperability  
Detailed Design Paper #004

Patient Identity Exchange (PIX/MPI)

PRELIMINARY DRAFT

Version 1.0 – 26<sup>th</sup> May 2019

**Abstract Interoperability Cookbook Anchor Points**

Section	Title
8	Security

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## 1 Introduction

### 1.1 Purpose of this Document

This document is one of a series of design papers which underpin the Abstract of a Cookbook for Regional Interoperability (the Abstract Cookbook). These papers, in their totality, describe the technical components and the standards which form the YHCR System of Systems. They are intended as a basis for developing or procuring software and so are expressed at a level of precision which is intended to avoid ambiguity but with a consequence that they are focussed to technical readers.

Design papers are anchored to topics which are discussed in the Abstract Cookbook. They are elaborations of the concepts which were first introduced by the abstract and new content is further detail rather than variations of previously established core principles.

This document (design paper 004 - "Patient Identity Exchange (PIX/MPI)") describes a regional capability for tracking contact with patients by the participants of the YHCR. This capability involves linking a master regional demographic for a patient to local demographics held by the YHCR participants. The capability serves two purposes:

1. To allow searches for data to be targeted to data providers who have had contact with the patient.
2. To enable all variations in patient demographics and local identifiers to be surfaced by data consumers.

The capability relies on data providers registering their patient identities with the YHCR using the NHS Number as the primary identifier.

### 1.2 Use of the NHS Number by the YHCR

The NHS number is the unique identifier for a patient in the YHCR. The regional FHIR aggregator (design paper 010) will only release patient identifiable data (for a definition see design paper 005 – "Identity and Access Management") which is related to a patient with an NHS number which has been traced against the Personal Demographic Service (PDS)<sup>1</sup>.

This policy obliges data consumers to ascertain the NHS number for any patient for which they wish to obtain regional data. It also obliges data providers to trace NHS numbers for any patient data that they publish.

Responsibility for determining and tracing NHS numbers rests with localities However, the YHCR can facilitate local management of NHS numbers:

- by tracing NHS Numbers with PDS where a patient with an untraced NHS number is registered by a data provider with the YHCR;

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<sup>1</sup> There is an exception for new-born babies.

- by offering patient search facilities which will allow data consumers accessing the YHCR for the purpose of direct care to search centrally held Patient FHIR resources on a defined set of demographics and receive possible matches.

### **1.3 Relationship of this Document with Other Standards**

The patient identity exchange is based on the [Integrating the Healthcare Enterprise](#) (IHE) concept PIX.

Other relevant standards include:

- [HL7v2 version 2.4](#).
- FHIR [Patient resource](#).
- FHIR [Linkage resource](#).
- Spine Mini Services Provider ([SMSP](#))
- NHS [Interoperability Toolkit](#)

### **1.4 Intended Users of the This Document**

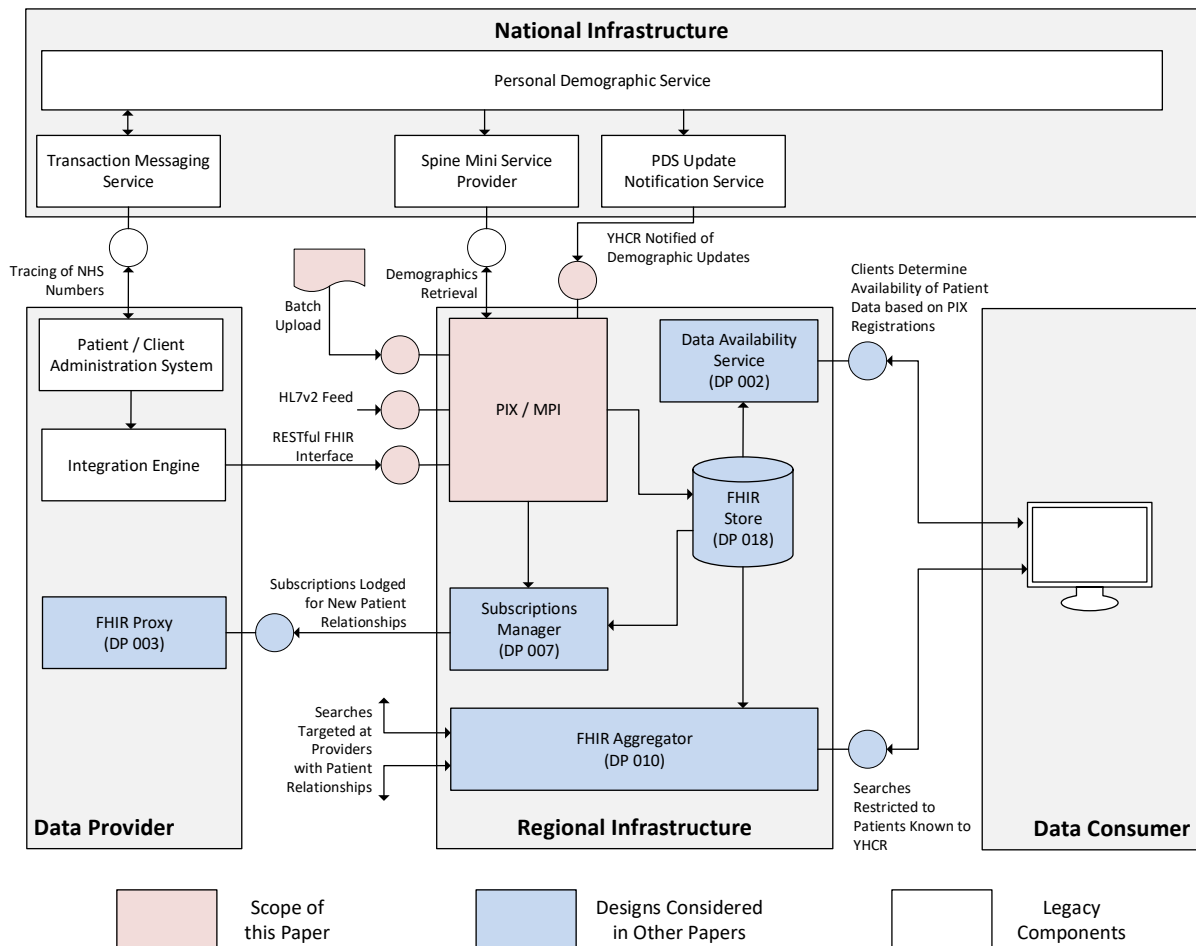
This document is a reference guide for developers and operators of YHCR regional infrastructure, data providers and data consumers

## 2 PIX/MPI Architecture

The PIX/MPI service is a regional component which is hosted and operated as part of the YHCR regional infrastructure.

### 2.1 Relationship with Other Components

The service and its positioning with other regional, local, and national services is illustrated below.



The goal of the service is to manage a regional “golden-record” for a patient’s demographics which is linked to local copies of demographics. These may or may not agree with the regional golden record.

The record is persisted in the regional FHIR store as *Patient* FHIR resources. The regional *Patient* resource is synchronised with the national Patient Demographic Service (PDS) and the regional patient demographics should always reflect the demographics registered with PDS subject to short window of latency.

The PIX/MPI service creates regional *Patient* resources at the time patients are registered with the YHCR. The service is not intended to be a complete and accurate directory of the footprint of the YHCR: patients which have not had contact with a service operated by a participant to the YHCR will not be registered with the YHCR, and conversely, patients which have moved out of the YHCR area may still have a YHCR record.

Data providers register patients with the YHCR when:

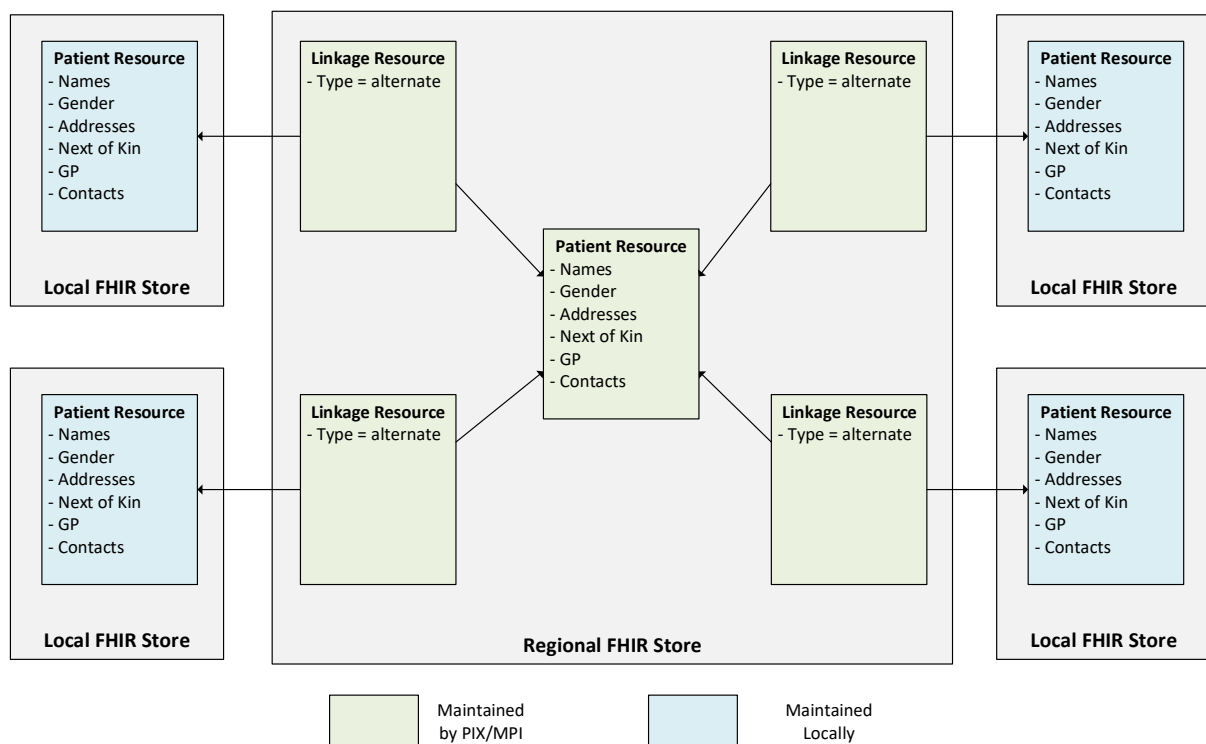
- they onboard to the YHCR using a batch upload process;
- a patient attends a service or an appointment is booked for the first time with a service operated by a provider;
- the patient record changes on the local provider administration system resulting in a new patient record being created or an NHS number being added or amended for an existing record.

## 2.2 Data Structures

The data structures which are built by PIX/MPI are used by other regional infrastructure to orchestrate its interactions with data providers. In particular:

- the regional FHIR Aggregator only issues patient-centric issues queries to those data providers which have registered contact with the patient;
- the Data Availability Service (design paper 002) uses the *Patient* resource and its linkages to local patients to respond to user interface inquiring whether any non-local data is known about a patient by the YHCR;
- the regional Subscription Manager manages patient-centric subscriptions at data providers who have had contact with a patient.

The data structure which is maintained by PIX/MPI is as follows:



A single *Patient* resource is persisted in the regional FHIR store for each patient registered with the YHCR. It has a single identifier: the NHS Number and all demographic details are identical to those maintained by PDS.

*Linkages* resources are persisted in the regional FHIR store for each patient/organisation relationship. The linkage resources have one item linking it to the regional *Patient* resource and one item linking it to Patient resources for the same patient which are maintained by a local data providers.



### 3 Publishing Patient Contact for Data Providers

Data providers should register those patients with the YHCR for which they have publishable data and a traced NHS number (with the exception of new-born babies). The YHCR offers 3 methods for registering patients:

- an HL7v2 feed;
- a RESTful service for posting a FHIR *Patient* resources;
- a batch service for uploading bulk *Patient* resources as part of the onboarding process.

#### 3.1 HL7v2 Service

The service accepts an HL7v2 ADT\_28 Add Person Message in an [ITK compliant](#) pipe-and-hat format. The IP address and port number for the service are published in the YHCR Operations Guide.

The service is secured with certificates signed by the regional certificate authority (design paper 016 – “Securing the YHCR”).

In compliance with the ITK specification the only segments which are required are:

- MSH
- EVN
- PID

Other segments, if present, are ignored. The PID segment must contain exactly one entry in the patient identifier list (PID:3). The entry must have an assigning authority of NHS and the patient identifier must conform to the NHS number format. The implication of presence of this identifier is that the NHS number has been traced by the organisation sending the message.

Other required fields comprise:

- Patient Name (PID:5) – at least the family name and a given name must be present.
- Date/Time of Birth (PID:7)

The message is acknowledged with an HL7v2 ACK. The acknowledgement code is one of:

- AA – the message was accepted, and a linkage created.
- AE – an error occurred the sending organisation should retry after a delay.
- AR – the message was rejected and the sending organisation must investigate the reason.

In the last two cases an ERR segment provides an explanation of the error or reason for rejection.

#### 3.2 RESTful FHIR Service

The service accepts a FHIR *Patient* resource POSTed using the HTTPS protocol. The body of the request is a single resource rendered as JSON or XML.

The service is secured with certificates signed by the regional certificate authority (design paper 016 – “Securing the YHCR”).

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The resource must comply with the Care Connect *Patient* resource profile and contain the following mandatory properties:

- A logical id.
- Exactly one identifier of the system <https://fhir.nhs.uk/id/nhs-number> with a value which conforms to the NHS number format and with an `nhsNumberVerificationStatus` of 01 (implying that the NHS number has been traced) or 08 (implying a new born baby yet to be traced).
- A name with given and family name parts.
- A data/time of birth.

The service responds with an HTTP response code as follows:

- 200 - the resource was accepted, and a linkage created.
- 500 – an error occurred the sending organisation should retry after a delay.
- 400 – the resource was rejected and the sending organisation must investigate the reason.

### 3.3 Batch On-take

The service accepts a file containing a bundle of FHIR *Patient* resources. The file is sent to the YHCR using FTPS secured with certificates signed by the regional certificate authority (design paper 016 – “Securing the YHCR”).

The file will be uploaded to a directory whose name embeds the organisation code which was assigned to the data provider during the onboarding process (design paper 020 – “Onboarding Data Providers”).

Details of the service address, login requirements, and directory formats are published in the YHCR Operations Guide.

Requirements for the content of the *Patient* resources are as detailed in section 3.2 for the RESTful service.

The service will return a file containing a bundle of *OperationOutcome* resources. One *OperationOutcome* will be written for each resource in the incoming file which was not accepted by the YHCR. The *OperationOutcome* will include an expression which locates the *Patient* resources in the incoming bundle. An empty bundle signifies that all resources were accepted.

The response file will be written to a directory on the YHCR FTPS server. The filename will reference the filename of the inbound request. Organisations submitting patients for batch on-take must poll for response files and act on their content.

### 3.4 Generic PIX Processing

Regardless of the method which an organisation chooses to register patients, the YHCR PIX/MPI service performs the same processing.

1. The inbound data structure is validated for content and format.

2. The presence of mandatory fields is validated.
3. The format of the NHS number is validated.
4. The regional FHIR Store is searched for a Patient resource with the registered NHS Number.
5. If a resource is found, then it is verified as matching the patient being registered (see below) and that no existing active Linkage exists for the organisation registering the patient.
6. If a resource is not found, then a Patient resource is created with an identifier being the NHS number and a nhsNumberVerificationStatus of 03 (Trace Required).
7. A *Linkage* resource is created in the FHIR store linking the regional resource to the equivalent local resources.

Linkage resources reference the local equivalent resource using an absolute path (for registration processes involving submission of a FHIR resources) or an NHS identifier and assigning organisation if the registration was performed using HL7v2.

NHS number identifier references will be overwritten by the regional FHIR Aggregator (design paper 010) with an absolute resource reference when the equivalent *Patient* FHIR resource is first seen from the assigning organisation.

### **3.4.1 Demographic Verification Algorithm**

The following algorithm is used by the NHS Spine when verifying an individual's identity and is also used when the YHCR PIX/MPI needs to ascertain the equivalence of two patient demographic records.

1. The NHS Numbers match.
2. At least 2 out of 3 parts of the Date of Birth match (YYYY or MM or DD).
3. The first 3 characters of the Surname match.
4. The initial character of the forename match.

### **3.5 Tracing with PDS**

Newly created patient resources are populated with a minimal data set which is supplemented by data obtained from PDS. When the data is obtained from PDS, demographics are validated according to the algorithm detailed above and the nhsNumberVerificationStatus uplifted to 01 (Traced).

PDS access is undertaken asynchronously from the registration request and so it is possible (although unlikely) that verification fails. An operational process will be set up to follow up on failures with the organisation who registered the patient and the national PDS team. Asynchronous tracing is normally scheduled immediately except for new-borns where tracing is deferred to 6 weeks after the birth date.

Only Patients with nhsNumberVerificationStatus of 01 (traced) or 08 (new-born baby yet to be traced) are included in searches.

### **3.6 Revoking a Linkage**

A *Linkage* resource may be updated in the regional FHIR Store to change the active property of the resource from true to false. The operation will only be permitted to the organisation to which the *Linkage* refers. This is the only operation that is permitted on a *Linkage* resources.

Inactive linkage resources are not included by the FHIR Aggregator when determining how to distribute a search.

### **3.7 Auditing**

All Patient and Linkage resource create, and update operations undertaken on the regional FHIR Store are audited in accordance with design paper 009 – “Auditing”. The PIX/MPI service also audits access to its three patient registration services. The following data is audited for each patient registration:

- service type;
- organisation accessing service;
- data and type of access;
- batch file path;
- outcome;
- error code and message;
- Patient resource reference created;
- Linkage resource reference created;

### **3.8 PIX and Subscriptions**

There is a dependency between the PIX/MPI service, and the regional subscription manager. This is detailed by design paper 007 – “Subscriptions Infrastructure” and summarised again here for completeness.

Subscriptions to an individual patient’s or a cohort of patients’ data which are made with the regional Subscription Manager is delegated to data providers. Only those data providers who have registered their contact with the patients are notified of the subscription. When a new patient registration occurs then it is possible that pre-existing subscriptions may be under the management of the YHCR.

The subscription manager registers pre-existing subscriptions with a new organisation creating a linkage with a patient. Subscriptions are revoked when a linkage is revoked by an organisation.

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## 4 Querying Patient Resources

Design paper 005 – “Identity and Access Management” enumerates the possible reasons for access for the YHCR and determines the implications for the scope of data which can be retrieved.

If access is for the purpose of direct care, then normally a data consumer is restricted to searches for patient identifiable data where the patient being treated is the subject of the data. The rationale being that direct care is targeted at an individual and access to other patients’ data is inappropriate.

The exceptions to this rule are searches over the *Patient* resource where the reason for accessing the YHCR for emergency care defined by design paper 005 as:

Code	Reason
1.1	Direct care (Emergency). Access is in the context of a patient;

For emergency care, searches are permitted over the *Patient* resource as a means for locating an NHS number for a person with the following restrictions:

- The search cannot include, or reverse include any other patient identifiable resource type. Including non-patient identifiable resource types such as *Practitioner* are permitted.
- The search must not return more than 100 results.

## 5 Interactions with PDS

The goal of the PIX/MPI service is to synchronize the regional demographic with PDS.

Synchronisation takes place in two stages:

1. When a new *Patient* resource is created in the regional FHIR Store then it is initialised with the demographic record sourced from PDS.
2. When the demographic record changes on PDS then the YHCR is informed of the change and the regionally held *Patient* resource is updated.

### 5.1 Spine Mini Services

Spine Mini Services will be used for the initial access to the PDS when a *Patient* resource is created.

The service will be accessed using the NHS Digital hosted Spine Mini Service Provider. This is a SOAP-based web service. YHCR will use the `getPatientDetailsByNHSNumber` action to obtain:

- Title;
- Surname;
- Given Name(s);
- Date of Birth;
- Date of Death;
- Gender;
- Address;
- Temporary Address;
- Correspondence Address;
- Home Telephone;
- Mobile Telephone;
- Email Address;
- Practise Code.

The practise code will be used to reference an *Organisation* resource created in the regional FHIR Store through an upload from ODS (design paper 013 – “Interfaces with the Organisational Data Service (ODS)”). Should the practise not be known to the YHCR then a new *Organisation* will be created using the practise name, address, and contact telephone number included in the service response.

### 5.2 PDS Update Notifications

At the time of writing NHS Digital have not yet specified the service which will provide notifications of changes to PDS to LHCRs. However, the need for the service has been acknowledged. In the absence of the specification it is assumed that that it will follow the following pattern:

- the YHCR will maintain a list of NHS Numbers on PDS for which it has a local registration in PIX/MPI;
- PDS will issue the demographic record to the YHCR for changes to the record of any of these patients.

### **5.2.1 NHS Number Merges**

Occasionally, more than one NHS number is issued to an individual by PDS. When the error is corrected on PDS then records are merged. It is anticipated that a future PDS Update Notification service will notify the YHCR of merges.

In this eventuality the YHCR will 'merge' its *Patient* resources by creating a *Linkage* resource. The *Linkage* resource will cause searches by either of the merged NHS Numbers to be issued to data providers for both patients.

### **5.2.2 Contingency**

It is essential that the YHCR has access to the latest demographics for its patients. However, the PDS Update Notification service is only in the planning stages and there is a significant possibility that it will not exist in time for the System of Systems to transition to high volume operation.

NHS Digital currently operate the Demographic Batch Service which allows a file of demographic records to be requested for a batch of NHS Numbers. With 5.4 million patients to manage this approach is sub-optimal but is a viable contingency to a PDS update notification service.

## Appendix 1 – Maturity Matrix

Section	Narrative	Consultative	Draft	Normative
<b>1 Introduction</b>	X			
1.1 Purpose of this Document				
1.2 Use of the NHS Number by the YHCR		X		
1.3 Relationship of this Document with Other Standards	X			
1.4 Intended Users of the This Document	X			
<b>2 PIX/MPI Architecture</b>			X	
2.1 Relationship with Other Components				
2.2 Data Architecture			X	
<b>3 Publishing Patient Contact for Data Providers</b>			X	
3.1 HL7v2 Service				
3.2 RESTful FHIR Service			X	
3.3 Batch On-take			X	
3.4 Generic PIX Processing			X	
3.4.1 Demographic Verification Algorithm				
3.5 Tracing with PDS			X	
3.6 Revoking a Linkage			X	
3.7 Auditing		X		
3.8 PIX and Subscriptions	X			
<b>4 Querying Patient Resources</b>		X		
<b>5 Interactions with PDS</b>			X	
5.1 Spine Mini Services				
5.2 PDS Update Notifications			X	
5.2.1 NHS Number Merges				
5.2.2 Contingency			X	