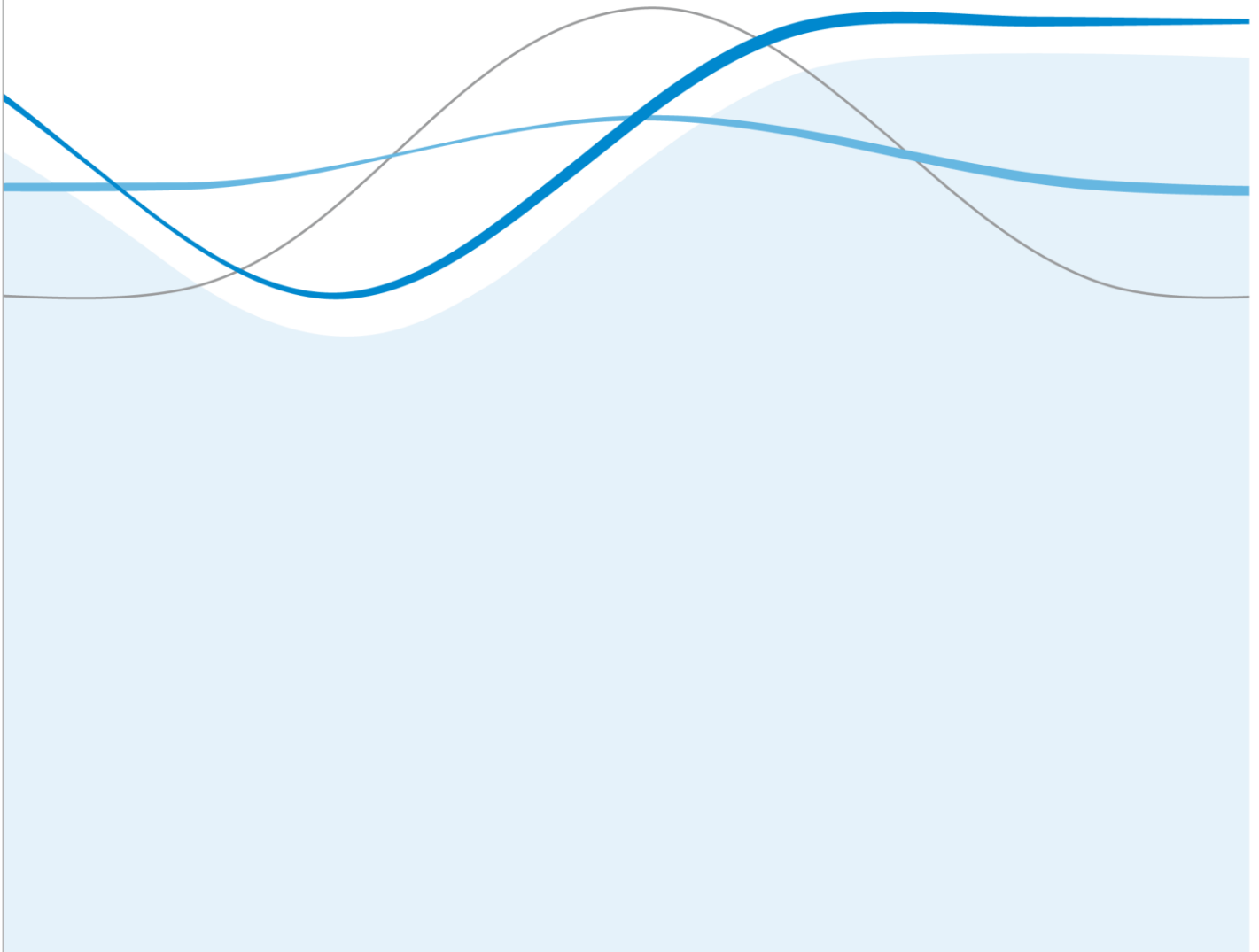


***Assessing the Use of Multi-
indication Medicines:*** a Review of
Current Data Capabilities in the UK

March 2015

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Consulting Report prepared for The Association of the
British Pharmaceutical Industry (ABPI)

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Executive summary

A multi-indication medicine is a medicine that is prescribed for more than one condition or more than one specific patient sub-group. Data on the uptake of multi-indication medicines according to what they are used for is extremely useful information for manufacturers and other stakeholders, but there is the perception that such information is currently incomplete for many drugs, particularly for those used in secondary care.

In all four countries, data on prescriptions and data on patient diagnosis are collected separately in both primary and secondary care, which therefore requires a linking process using a unique patient identifier. The infrastructure to complete this linkage activity is at different stages of development across the UK. Moreover, the degree and ease of access to data that the national systems allow is variable, leading to differences in the environment for research across the UK.

In this report, we explore current capabilities for linking data on medicine use and patient diagnosis across the four countries of the UK, and then investigate whether there are any local initiatives that address the issue. By outlining the gaps in the current information base, we set out an agenda for what further actions might be required to fill them.

To obtain the information used in this report, we conducted semi-structured interviews with information managers or directors at:

- Clinical Practice Research Datalink (CPRD)
- Health and Social Care Information Centre (HSCIC)
- Public Health England (PHE)
- IMS Health
- Secure Anonymised Information Linkage Databank (SAIL)
- Electronic Data Research and Innovation Service (eDRIS)
- Health and Social Care Northern Ireland (HSCNI).

We found that, in England, the development of HTI-CRPD GOLD – a joint venture between CPRD and IMS Health – means that it is possible to match prescriptions and diagnoses across primary and secondary care by a patient's NHS number. However, a critical issue with the linked dataset is that the coverage is limited: around 332,000 individuals across England (as of June 2014).

In Northern Ireland, Scotland and Wales, the picture is less complete, as information on secondary care prescriptions is not routinely collected in any of the three countries. Further, linkable data for primary care diagnoses are not yet available in Scotland or Northern Ireland, although the Information Services Division (ISD) will begin collecting this information from a sample of Scottish GPs in 2015.

Across all four countries, there have also been significant efforts to collect cancer data. Again, the data are richest in England: the National Cancer Registration Service (NCRS) collects and links detailed information on chemotherapy treatment through the Systemic Anti-Cancer Therapy Dataset (SACT). However, whilst efforts are underway to make these data more widely available for research purposes, barriers persist, thus posing constraints on research which could improve patient care.

In response to a call to the Academic Health Science Network, we received notification of three relevant initiatives (discussed further in the main report) which highlight best practice and demonstrate the potential for assessing medicine use by indication:

- Prescribing Information and Communications System (PICS), a unique computer system used at University Hospitals Birmingham (UHB) NHS Foundation Trust
- Eclipse Live, a primary care risk-stratification software system used by a number of Clinical Commissioning Groups (CCGs) across England
- NorthWest EHealth's FARSITE (Feasibility And Recruitment System for Improving Trial Efficiency), a software system traditionally used to assist in the identification and recruitment of participants for clinical trials.

Given the findings of this report, we make the following policy recommendations that would significantly improve data-linking capabilities across the UK and thus the ability to measure uptake of medicines according to indication:

Summary Recommendations

- **Hospital e-prescribing and electronic patient records are a necessary starting point;** policies to speed-up uptake and reduce variation are therefore imperative, and should be adopted across the UK.
- Examples of successful local prescribing information systems should be built upon, with a view to **create national centralised datasets for the collection of data on medicines dispensed in hospitals.** To facilitate this, national information centres such as the HSCIC would need to take responsibility for collecting data.
- Routinely collected data from which we can infer medicine use by indication can facilitate effectiveness research and value assessments, but this requires improved **access to data**, which should be granted within the appropriate arrangements for governance.
- There should be **improved patient-level recording of the use of medicines dispensed from ward supplies in hospitals.**

1. Context

Analysing the use of innovative medicines in the UK population is valuable for identifying variation in access to treatments, monitoring implementation of the National Institute of Health and Care Excellence (NICE) and other bodies' guidance, and supporting the Pharmaceutical Price Regulation Scheme (PPRS). Currently, uptake metrics are severely limited by the inability to determine the indications for which multiple-use medicines are being used.

This report was commissioned to explore the current capabilities to link medicine use data with patient diagnosis (representing the 'indication') in the four countries of the UK: to characterise what is possible with the information available, to outline current initiatives, and to propose next steps for the routine utilisation of data to capture medicine use by indication.

1.1. Multi-indication medicines

A multi-indication medicine is a medicine that is prescribed for more than one condition or more than one specific patient sub-group. For example, novel oral anticoagulants (NOACs) are licensed for patients with atrial fibrillation as well as venous thrombosis and thromboprophylaxis. Whilst overall use of NOACs can be monitored, our ability to keep track of what they have been used for is currently limited. This information gap impedes our understanding how medicines are taken up and used in clinical practice, and how access might vary geographically or according to indication.

In an OHE consulting report on the value footprint of oncology drugs (Rejon-Parilla et al., 2014), the authors found that four out of the ten oncology drugs assessed were for multiple indications, and proposed seven different 'types' of value expansion for oncology drugs: initial approval, new condition, different disease stage, different treatment stage, part of different treatment regimen, new route of administration and different sub-population. The findings of this report and others suggest that indications are often expanded post-launch. A white paper produced by the Boston Consulting Group demonstrates that in the U.S. a biologic that has been on the market for six years is expected to have on average two additional indications approved over the remainder of its life (Said et al., 2007). Some research shows that the average number of indications serviced by a given drug is decreasing over time (Dayoub et al., 2014), though this analysis was only conducted up to 2008, and represents the 'average' rather than any specific disease areas. In order to understand the uptake and value of medicines according to how/for whom they are used, it is important to monitor the use of drugs against licensed indications and recommendations by healthcare providers where these exist. This is currently not widely possible.

1.2. Why is monitoring the use of multi-indication medicines important?

Based on the experience of the ABPI and its members, the information gap that exists in linking medicine prescription with diagnosis impedes progress that could be made in understanding how medicines are currently being used, and in what areas access might be suboptimal. OHE's experience with uptake metrics has demonstrated the important impact that this information gap has on monitoring the uptake of medicines approved by

NICE, for which recommendations carry a mandatory funding directive. For example, in reports published by the Health and Social Care Information Centre (HSCIC) on the *Use of NICE appraised medicines in the NHS* (now replaced by the innovation scorecard) multi-indication medicines have generally been excluded due to the fact that indication-specific uptake could not be assessed. Moreover, this information gap also means that the 'goalpost' in terms of the eligible population for a treatment cannot be specified: *"Prescribing data by diagnosis is not available and so proportional usage by indication could not be established to support the development of an estimate of eligible patients"* (HSCIC, 2014c). This clearly impedes our ability to monitor NICE guidance uptake, and means that regional variation in access may not be picked up.

The expansion of data collection in routine clinical practice ('real world data') is important for improvements in patient care. As well as monitoring uptake of decision-makers' recommendations, the place for real world data in supporting the evidence for evaluation of health interventions is rising. Changes in the environment for the licensing and approval of medicines (such as early access schemes (MHRA, 2015) and adaptive pathways (EMA, 2015)) mean that evidence requirements are shifting to the post-marketing phase, and data collected in real clinical practice rather than strictly controlled clinical trials will be used to evaluate the effectiveness and cost-effectiveness of new drugs. Whilst this poses methodological challenges for decision-makers, the informational requirements are also important, and the infrastructure required to routinely collect and/or link indication with medicine use will be critical.

In order to promote a strong and efficient system for drug development, there is a call for medicine prices to be reflective of the value they generate for patients and the health service (Danzon et al., 2015; Towse and Garrison, 2013). Additionally, managed entry agreements and patient access schemes, through which access is granted on the basis of continued data collection and monitoring of outcomes, requires high quality data around medicine use in routine practice. There was a provision of 'flexible pricing' under the 2009 PPRS, which would allow companies to increase or reduce price in light of new evidence, or for a different indication being developed. However to date we are not aware of any proposals for price changes under these flexible pricing provisions. Clearly, a move toward multi-indication pricing requires that data around medicine use according to indication are captured and shared systematically.

1.3. Healthcare data in the UK: datasets and governance

Given the predominantly public provision of healthcare in the UK, there is a large volume of data in NHS healthcare records, and significant opportunity to link information across datasets. In a study conducted by Oderkirk and colleagues (2013) on health information infrastructure across OECD countries, the UK was noted to have the most comprehensive suite of national datasets. However, coverage is generally on a national basis, as are the arrangements for access to that data. Whilst the primary use of healthcare data is by healthcare professionals directly involved in the care of patients, secondary uses include service evaluation and research. The information governance arrangements around the secondary use of healthcare data must ensure that data are used in a manner that protects patient confidentiality and safeguards against improper use.

The information centres involved in the collection and/or dissemination of health data must work within the constraints of the legal environment for the protection of confidentiality. Most notably, the 1998 Data Protection Act (DPA) requires that

organisations handling information that is identifiable to patients must: only collect data that are needed for a specific purpose, keep information secure, ensure data are relevant and up to date, only hold as much as is needed and for as long as needed, and to allow subjects of the information to see it on request (Government, 1998; ICO, 2014). The Human Rights Act (1998) gives patients the right to keep their health records confidential. The sharing of health data is generally on the basis of “consent or anonymise” (i.e. to obtain informed consent from all patients from whom the data are collected, or to make all information completely anonymous). Statutory exemption for accessing patient identifiable data and not seeking consent from all patients is through Section 251 of the NHS Act 2006 (Government, 2006), which allows the secretary of state to set aside the common law of duty of confidentiality for specific purposes, where it is in the public interest and it is either not possible or too expensive to obtain consent from every patient. For most organisations (particularly those in the private sector) wishing to access patient data for research purposes, data are provided in an anonymous format. However, there are various shades of grey in the anonymisation of patient data. For example, pseudonymisation helps to reduce the potential identifiability of patient data whilst still enabling datasets to be linked, but there is always some residual risk of jigsaw re-identification (Roebuck, 2014). Therefore, information governance panels and approval boards are tasked with considering the balance between the risk to patient confidentiality, and the public interest of the research that will be undertaken with that information.

The current EU Data Protection Directive (Directive 95/46/EC) provides a unifying framework for Europe. However, it is commonly acknowledged to have left room for interpretation, and the resulting national policies across Europe are dissimilar in how data can be linked and shared. The UK’s approach is perceived to be relatively permissive, with some other European countries providing no legislative framework for processing any data without informed patient consent (Oderkirk et al., 2013). In recognition of the inconsistencies in data governance across Europe, the European Commission is currently revising the directive. The effect of this could be significant for health research, potentially restricting all secondary use of patient data for which consent has not been obtained (NHS European Office, 2014).

With this context in mind, we set out below our approach for establishing the current capabilities in the UK for assessing medicine use according to indication. The simple question that we ask is: Can we ascertain what a medicine has been used for? We investigate to what extent this is possible across the four countries of the UK using routinely collected data, and then investigate whether there are any local initiatives that address this issue. By setting out what the gaps are in the current information base, we set out an agenda for what further actions might be required to fill them.

Key Points: Context

- A multi-indication medicine is one that is prescribed for more than condition or patient subgroup
- Uptake metrics are severely limited by the inability to determine the relevant indications for multi-use medicines
- This information gap impedes progress in understanding how medicines are used and in what areas access is suboptimal
- This report assesses the extent to which it is possible to measure relative use of medicines by indication in all four countries of the UK

2. Methods

This investigation of the current capabilities of information centres across the UK involved a combination of desk research and interviews. We conducted semi-structured interviews either in person or over the phone with information managers or directors at the relevant national and private information providers in England, Wales, Scotland and Northern Ireland: the Clinical Practice Research Datalink (CPRD), the Health and Social Care Information Centre (HSCIC), Public Health England (PHE), IMS Health, the Secure Anonymised Information Linkage Databank (SAIL), the Electronic Data Research and Innovation Service (eDRIS) and Health and Social Care Northern Ireland (HSCNI). Our findings as presented in this report have been checked for accuracy by the individuals interviewed.

In order to share best practice and stimulate research into novel ways to capture medicine use data, information on local initiatives that could address this question was collected. A call for examples was sent out via the academic health science network of networks (AHSN network) secretariat, and the responses were followed up with phone calls or meetings and further investigations.

With the information collected on the opportunities and limitations of routinely collected data as well as insight from local data initiatives, we then put forward policy recommendations that could advance the capabilities in the UK for monitoring the use of multi-indication medicines.

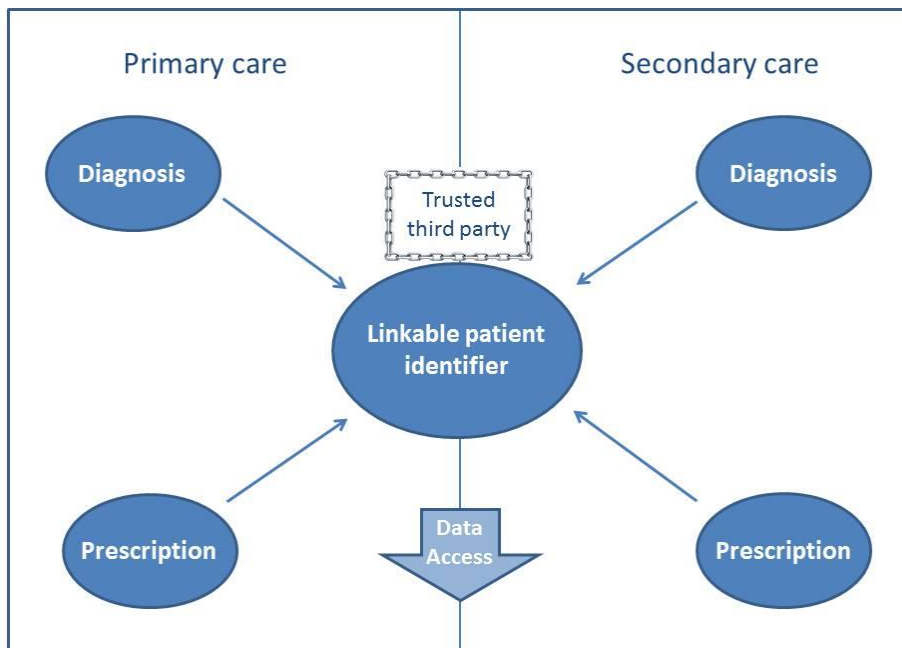
3. Current capabilities for assessing the use of multi-indication medicines using routinely collected data

The key practical issue that inhibits being able to directly assess the use of multi-indication medicines is that, in both primary and secondary care, prescriptions are generally not issued with direct markers for diagnosis. Therefore, in most cases, matching use of a medicine with a particular indication requires a linking process, facilitated by a unique identifier for the patient. In order to have a complete system that could capture the indication that prompted the use of a medicine no matter where it was prescribed, the following information would need to be linked through the use of a patient identifier:

- Primary care diagnoses
- Primary care prescriptions
- Secondary care diagnoses
- Secondary care prescriptions.

The extent to which this linking process is required varies across the countries in the UK and depends on the data collection infrastructure and the roles of the various parties involved. In cases where the same organisation collects prescription and diagnosis information (such as primary care in England, described below), the link between the two is inferred directly and does not require third party linkage. Where linkage is required, this is generally performed by a “trusted third party” that protects anonymity and conforms to the legal data protection requirements.

Figure 1. Necessary information for data linkage



The necessary pieces of the data-linking puzzle are depicted in Figure 1. For medicines whose multiple indications all fall within just primary care or just secondary care, then to build a picture of use by indication we would need information from just the left or right hand side respectively. However where use falls across both sectors, all four elements

are required. We found that in all four countries of the UK, organisations (public, private or both) had made steps towards creating the infrastructure for the linkage process but that each country was at a different stage of development. At present, the linking capabilities in England are the most advanced, although the coverage remains patchy and is by no means comprehensive.

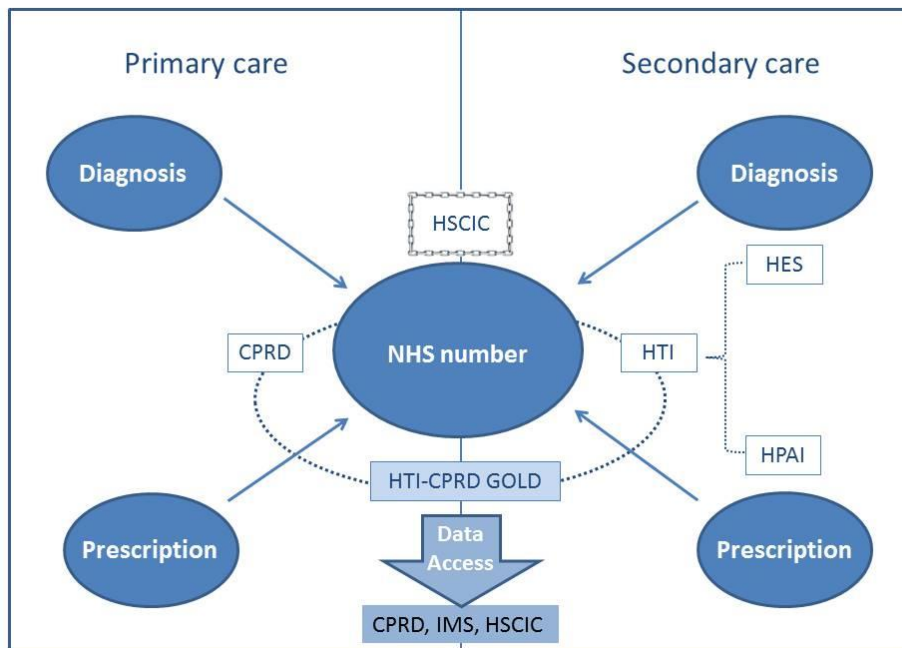
In the remainder of this section we discuss each country in turn. We focus on the extent of current capabilities, including specific limitations and data quality issues. Where appropriate, we also discuss initiatives that appear likely to be implemented in the near future. Finally, we explore current capabilities in the area of cancer specifically, where there are strong national programmes for wide scale data collection.

3.1. England

Current Capabilities

In England, significant efforts have been made to provide a framework to link the relevant datasets that would be required to address the question of medicine use by indication. This is depicted in Figure 2, where all necessary parts of the data linkage process are present (represented by the solid blue arrows).

Figure 2. Data linking capabilities in England



As shown in the centre of Figure 2, the central source of health and social care data in England is HSCIC, which acts as the gatekeeper to a large number of datasets and the trusted third party in the data linkage process. If researchers or private companies wish to link datasets by NHS number (the unique patient identifier in England), HSCIC provides this service: it creates “pseudonym IDs” that are common to the linked datasets and indicate that the records belong to the same person while protecting anonymity (Roebuck, 2014).

On the primary care side, CPRD collects data from a sample of GP practices in England (and the other three countries of the UK). Through GP consultation software, anonymised patient-level data are sent to CPRD at agreed intervals to be added to the CPRD GOLD Electronic Medical Records dataset. These primary care data include diagnoses (Read codes) as well as information on prescribed treatments (therapy codes: NHS Dictionary of Medicines and Devices). Information on formulation, strength and dosing instruction is captured in the dataset (CPRD, 2014b). CPRD has collected prescribing and diagnosis data since 1987. It should be noted that the prescribing data that is captured may differ from what medicines are actually *dispensed* by pharmacists.

At present, CPRD collects data only from practices using VISION GP software (one of four main providers), and they estimate their coverage to be about 9% of the total UK population; coverage is the highest in England. Coverage is expected to expand in the near future as practices using the EMIS GP software are incorporated. Whilst there are other providers and datasets for primary care data (e.g. QResearch and THIN), CPRD is the most accessible for research purposes.

CPRD data thus provides the necessary information to link a medicine prescription with its indication in the primary care context, representing two of the four sources indicated in Figure 2, albeit for a small sample of the population. Although diagnosis is not directly attached to a prescription in the dataset, these can be linked through patient-level data by means of algorithms using consultation identifiers, date of prescribing and date of diagnosis. It is often necessary to specify time windows around the prescribing or respective indication in order to attribute prescribing to indication or vice-versa. Therefore in theory – for medicines where all indications fall within primary care – CPRD could link diagnosis with prescription and thereby provide an idea of relative use by indication for a given medicine (according to the sample of patients captured in the CPRD database).

Although CPRD is depicted in the left of Figure 2, primary care data collected by CPRD can be linked with other datasets, including routinely collected secondary care data on diagnosis, available through Hospital Episode Statistics (HES) data. HES contains information on every hospital episode in NHS Trusts in England (does not contain NHS-funded patients treated in private hospitals, but does contain privately funded patients treated in NHS hospitals). This dataset includes diagnoses by ICD-10 code. CPRD data can also be linked to: Office of National Statistics (ONS) data, Index of Multiple Deprivation (IMD) scores, Cancer registry data and Myocardial Ischemia National Audit Project (MINAP) data. HSCIC acts as the Trusted Third Party by linking the datasets at patient level through NHS numbers. Permission for this linking has been sought by CPRD from English GP practices already submitting data to CPRD, around 70% of which have given approval for this.

There is no centralised system for the collection of data on medicines dispensed in English hospitals. However, IMS health – a global information, services and technology company – collects data from hospital pharmacies across the UK on a commercial basis. Data relates to medicines dispensed. These data are sent to IMS Health each month and collated in the Hospital Pharmacy Audit Index (HPAI) database. Whilst there are other pharmacy data collection activities in hospitals (e.g. Pharmex) the purposes of such databases are largely practical (e.g. for stock-control, benchmarking or procurement), and are currently not set-up for use in research.

IMS Health has created a dataset called Hospital Treatment Insights (HTI), which combines their pharmacy audit data with HES data (Figure 2; centre right). IMS Health has approval from the Confidentiality Advisory Group to be able to extract this data and from the National Research Ethics Committee to hold the combined dataset. Permission to link pharmacy data with HES data is negotiated at individual trust level. The linkage is performed by HSCIC such that IMS Health receives only pseudonymised data. At present, HTI covers a panel of 42 NHS Trusts within England and panel size is increasing a steady rate. Within HTI, 4.1 million “unique patient lives” are linked to at least one medicine (June 2014). Like CPRD, the linkage between patient-level HES and pharmacy records is facilitated by personal NHS identifiers but relies on an algorithmic approach and time window to match the relevant diagnosis with the relevant prescription. This therefore provides the facility to assess medicine use by indication for medicines whose indications all fall within secondary care. Two papers have recently been published using outputs from HTI projects: one looking at the impact of patient factors on the use of antifungal medicines (Stephens et al., 2015) and another looking at antipsychotics prescribing in people with dementia (Stephens et al., 2014).

HTI-CRPD GOLD

In England, the infrastructure exists to link all four parts of the medicine-use “puzzle”. CPRD and IMS Health have collaborated to create HTI-CRPD GOLD, which links HTI secondary care data with CPRD primary care data and allows researchers to investigate the full patient journey. Again, HSCIC manages the data linkage process.

According to our interview with IMS Health, the linked dataset has already been used by companies to carry out research projects. Examples of previous projects include an analysis of the treatment of Hepatitis C: the number of patients diagnosed but not treated; length of time from diagnosis to treatment; therapies prescribed; comparison of naïve vs existing treatment; treatment duration with protease inhibitors and patient demographics. A white paper using the outputs of this study is currently underway.

The full HTI-CRPD dataset is available from January 2010 onwards, when linkage of the pre-existing HPAI dataset to HES began. However, HES data are available from 2005 and CPRD primary care data can be traced back to 1987.

A critical issue with the linked dataset is that the coverage is clearly severely limited: it can only capture patients that appear in both of the relatively small datasets. The HTI-CRPD GOLD dataset covers around 332,000 individuals (as of June 2014).

Access

Access to CPRD data for research is through either (a) commissioning CPRD to conduct a specific analysis, (b) purchasing of ad-hoc datasets, or (c) purchasing of an annual license at a price of £255,000 per year for commercial use (CPRD, 2014a). This provides access to anonymised primary care data. Extra charges are incurred for HES, MINAP and NCIN data. Feasibility inquiries are free of charge, and academics/charities receive a 50% discount. All requests for access to data require the approval of the Independent Scientific Advisory Committee (ISAC) which ensures that the relevant information governance requirements are to be met. Whilst CPRD hosts ONS and IMD data and has full access to HES data, the National Cancer Intelligence Network (NCIN) and MINAP are custodians of their own data and are therefore not hosted by CPRD. Those organisations therefore have their own independent panels to approve data access and use for individual projects.

Although the HSCIC does not offer consulting services in the same way as other organisations, access to data can be made available directly through HSCIC if the appropriate legislative arrangements are in place. HSCIC provides an indicative price list on their website (HSCIC, 2014b) (it should be noted that HSCIC along with other information centres providing public data do not 'charge' for data, but rather they specify a price to cover the cost of administering and preparing the information). In order to ensure transparency, HSCIC publicly discloses all data releases on the website of the 'Data Access Request Service'; on this register HSCIC discloses the type of data released (i.e. identifiable, pseudonymised, anonymised, or aggregated) as well as the legal basis for its release (e.g. informed patient consent, or statutory exemption through Section 251 approval) (HSCIC, 2014a). Additionally, HSCIC is consulting on a strategy to share data through a 'secure data lab': a physical space for the controlled provision of data for pre-authorised analyses.

Access to HTI is through commissioning IMS Health to conduct specific analyses. Initial enquiries and feasibility counts are free of charge, and academics generally receive a discount. Before data analysis can begin, protocols must be submitted to and approved by an Independent Scientific Ethics Advisory Committee. Projects using the dataset must be approved for medical research purposes, such as the improvement of pharmacovigilance, monitoring of uptake and appropriate use of drugs, assessment of the value of medicines and improvement of healthcare management.

For HTI-CPRD Gold, access can be managed either through IMS Health or CPRD. The two organisations have a mutually agreed price for data access, which would be equivalent in value independent of the organisation through which the data is attained. The pricing list is internal, and there are no published price lists as these will depend on the nature of the data enquiry. Consulting fees are charged on top of the initial data access and will vary according to the effort required for the project.

Limitations

The key limitation of HTI-CPRD GOLD is that the contributing datasets each have relatively limited coverage, meaning that the sample of patients that appear in both is even smaller. In addition to this coverage issue, the individual datasets have a number of limitations, which we discuss below.

Although CPRD is able to link primary care prescriptions with diagnoses, this is based on *inferences* between the two variables. This generally involves choosing a time window around the diagnosis, the length of which is informed by the particular medicine/indication of interest. Often, historic diagnoses are associated with ongoing treatments, and it can be difficult to specify the relationships between diagnosis and prescribing.

It is clear that the linking exercise is likely to result in some degree of error, and it is also dependent on the quality of the data that are inputted into the practice management software. Certain disease areas are associated with better coding of data: for example, diseases covered by the Quality and Outcomes Framework (QOF) are generally associated with high quality data, as coding of activity is required for reimbursement.

For the IMS HTI database, it should be noted that poor coding within HES can limit the information available. HPA only includes medicines dispensed in hospital pharmacies, meaning that those distributed in the community (e.g. for home care) are not captured.

Drugs that are dispensed from a ward trolley or ward supplies (especially in life-threatening emergencies) are also not captured.

Current capabilities in England: key points

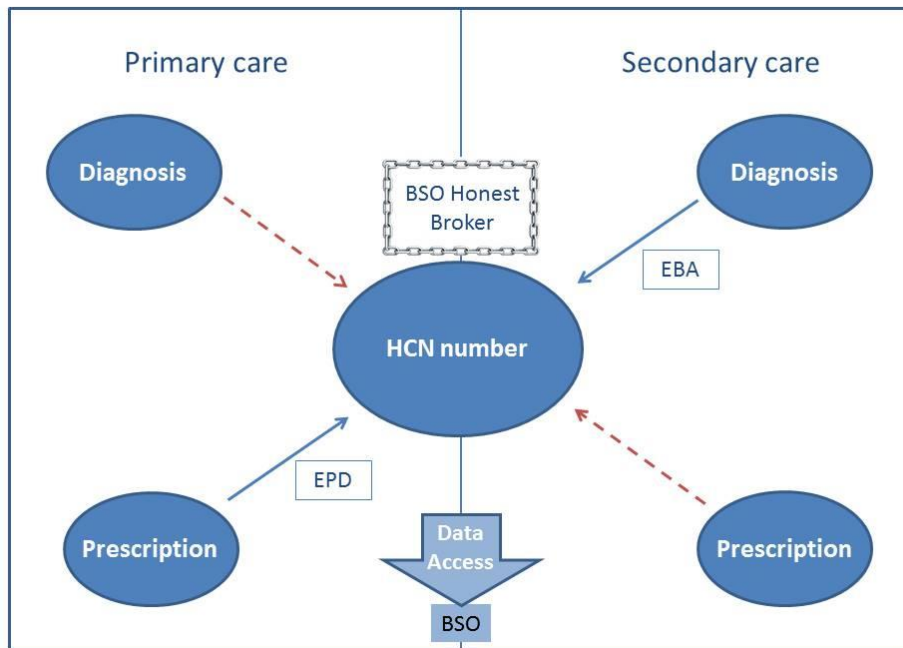
- Capabilities for data linking are more advanced in England than the rest of the UK, and data collection initiatives exist for both prescription and diagnostic data in primary and secondary care
- HTI-CPRD GOLD, a joint initiative between CPRD and IMS Health, can be used to estimate medicine use by indication across primary and secondary care
- The data linking process is managed by HSCIC, using patients' unique NHS numbers while maintaining patient anonymity
- Access to HTI-CPRD GOLD is managed through CPRD or IMS Health– the organisations have a mutually agreed price, which depends on the nature of the data enquiry
- Coverage is limited: the HTI-CPRD GOLD database covers around 332,000 individuals in England (as of June 2014)
- Links between prescriptions and diagnoses are based on inferences using a time window – this is likely to result in some degree of error

3.2. Northern Ireland

Current capabilities

In Northern Ireland (NI), the picture is much less complete (see Figure 3). Health and Social Care Northern Ireland (HSCNI) is the general information hub for health services. The Business Services Organisation (BSO) (part of HSCNI) has recently launched an "Honest Broker" service (HBS) to allow sharing of data within the HSCNI and with the Department of Health, Social Services and Public Safety, as well as with researchers with ethical approval, within a research 'safe haven'. The HBS will act as the trusted third party for the linkage and anonymisation of patient data in NI (HSCNI, 2014).

Figure 3. Data linking capabilities in Northern Ireland



Among the various datasets collected by BSO is the Enhanced Prescribing Database (EPD), which contains information on all dispensed medications for each individual registered with a general practitioner. Unlike for the Prescription Cost Analysis (PCA) database in England, HSCNI are able to track individual patients as all prescriptions are issued with a unique bar code, which links the prescription information with the patient's Health and Care Number (HCN).

However, at present, primary care prescriptions cannot be linked with diagnoses: there is no equivalent to CPRD performing this type of linkage in NI. In addition, no information on secondary care prescribing is collected either centrally or commercially. The missing links are shown as dotted red lines in Figure 3.

The Department of Health, Social Services and Public Safety (DHSSPS) produces episode-based acute hospital inpatient and day case activity data: Episode Based Activity (EBA), which are comparable to English HES data and are, in principle, linkable to the primary care prescribing data by HCN number. Our interviewees from HSCNI explained that the regional information group within HSCNI is to consider expanding data to capture prescribing in secondary care, but nothing has been confirmed.

It is worth noting that the Northern Ireland Longitudinal Study (NILS) is a potentially useful resource for future data linking initiatives. NILS contains a 28% representative sample of the NI population (roughly 500,000), making it proportionally much larger than its counterparts in the rest of the UK. As it comprises census data, NILS contains information on limiting long-term illnesses, which in some cases could allow matching of primary care prescriptions (through the EPD) with self-reported limiting long-term illness. NILS may also host information on cancer registrations through 'Distinct Linkage Projects' but does not give details of treatments.

In summary, while it is possible in theory to match primary care prescription data with secondary care diagnoses, the infrastructure does not exist in Northern Ireland to combine this information with primary case diagnoses or secondary care medicine use.

Access

As described above, BSO data can be accessed by application to the Honest Broker service. Our interviewees stated that if the research can be undertaken in the safe haven setting using non patient-identifiable data then these requests can be “fast-tracked” for NRES ethical approval. Customers have the option to request aggregate data or analyse record level data themselves in the “safe haven” under supervision. Currently, access is limited to DHSSPS, HSC organisations and academic researchers with ethical approval. Private firms such as pharmaceutical companies cannot access the data, though this is being considered as “phase 2” of the project. There is the possibility that if pharmaceutical companies are prepared to enter into a partnership with HSC or academic researchers then this could be a route to accessing the data.

Access to NILS is by application to the Northern Ireland Longitudinal Study Research Support Unit, which must include a research proposal. The NILS website states that all types of applications are welcome. If researchers intended to link the NILS data to other datasets – for example, to EBA using the HCN number – this would involve a meeting between the researcher and representatives from NILS. This is known as a Distinct Linkage Project. The linkage is carried out by a member of NILS Core dataset and the relevant data supplier.

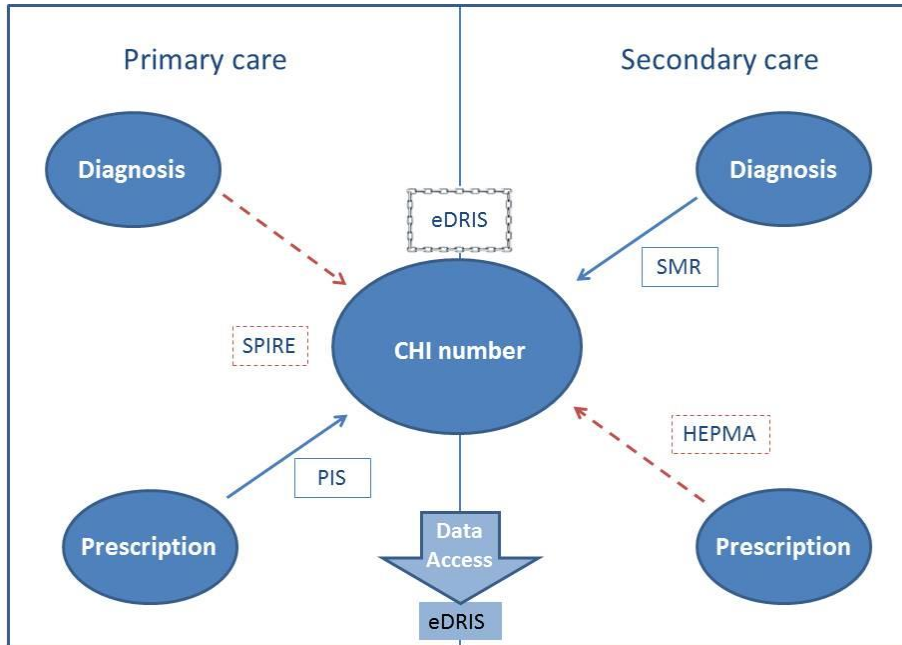
Current capabilities in Northern Ireland: key points

- It is not possible to link prescriptions and diagnoses across primary and secondary care in Northern Ireland: two of the four necessary data sources exist
- Primary care prescription data can be linked to secondary care diagnosis data using patients’ unique Health and Care Number (HCN)
- The recently-launched “Honest Broker” service provides the linkage and anonymisation of patient data
- Data are not yet available to organisations outside HSCNI, Department of Health, Social Services and Public Safety and academia
- The Northern Ireland Longitudinal Study (NILS) is a potentially useful resource for future data linking initiatives, as data on long-term conditions could be matched to primary care prescription data for a sample of the population

3.3. Scotland

In Scotland, the current picture is roughly similar to Northern Ireland, but there are initiatives in the pipeline that would significantly improve data linking capabilities (see Figure 4).

Figure 4. Data linking capabilities in Scotland



Current capabilities

The Information Services Division (ISD) collects a wide range of health related administrative data on behalf of NHS National Services Scotland. ISD runs the Electronic Data Research and Innovation Service (eDRIS), designed to provide a single point of contact for health service data and to assist researchers in study design, approvals and data access. Like HSCIC in England and the Honest Broker in NI, eDRIS provides data linking services to produce anonymous patient data at a national level, available to access in a safe haven. In addition to eDRIS, Scotland has four regional safe havens located in Aberdeen, Dundee, Edinburgh and Glasgow. These institutes collect a range of local data, with some datasets going beyond what is available at a national level, particularly for disease-specific questions.¹

The Prescribing Information System (PIS), which contains information on virtually all community prescriptions dispensed in Scotland, is available by application to eDRIS. The data include Community Health Index (CHI) number (individual patient identifier for NHS Scotland), costs and drug information. Like its Northern Irish equivalent, there is no information on the medical indication for the prescription.

¹ For example, the Health Informatics Centre (HiC), based at the University of Dundee, has formed a relationship with the regional node of Scottish Primary Care Research Network (SPCRN), which facilitates contact between researchers and primary care professionals. As a result, HiC has the capability to request anonymised data from individual GP practices for specific research questions.

For secondary care, the Scottish Morbidity Record (SMR) datasets contain episode level data on all acute and psychiatric hospital admissions, as well as all cancer registrations and death records. The database is the Scottish equivalent of HES and contains over 37 million records linkable by CHI number. In recent years, completeness of CHI number on patient records has been over 99%, and has been over 90% since 2005, an improvement from around 56% in 2000.

There is currently no central collection of hospital prescriptions data because information about medicines is held at hospital ward level and cannot be attributed to individual patients.

SPIRE

The Scottish Primary Care Information Resource (SPIRE) is a forthcoming collaboration between the Scottish Government and ISD that aims to provide a national system to extract data from IT systems of all participating GPs in Scotland. It is currently in development and is expected to be operational by the end of March 2016 (see left-hand side of Figure 4, shown in red to indicate that the data are not yet available).

Discussions about all aspects of the dataset are ongoing but it is likely that information will be sent to ISD to be added to the national dataset on a monthly basis using the existing GP system providers. There is the potential for SPIRE to encompass the PIS data, which would enable researchers to match primary care diagnoses (via Read codes) with primary care prescriptions. In theory, historic data would be available from 2009 (when PIS records begin). The developers are aiming to cover all GP practices in Scotland, but SPIRE will not be compulsory and financial incentives will not be offered. Nevertheless, coverage could exceed that provided by CPRD in England, as SPIRE is not limited to particular IT systems.

It should be noted that SPIRE will face the same inference issues as CPRD does currently: primary care prescriptions will not be issued with a diagnosis, and the indication will have to be inferred using an approach such as determining a time window around the prescription.

Hospital electronic prescribing

The second missing connection in Scotland is linkable information on secondary care prescriptions. However, there appears to be significant interest in developing these capabilities. Both the Scottish Parliament and Audit Scotland urged the Scottish Government to implement a Hospital Electronic Prescribing and Medicines Administration (HEPMA) system across Scotland as soon as possible. Beyond improving safety, the ultimate aim of HEPMA is for electronic prescribing and medicines administration to be an integrated package as part of the electronic patient record, linkable by CHI number.

Five of the 14 regional NHS Boards in Scotland have begun to implement HEPMA in their hospitals, with the system at NHS Ayrshire and Arran the most developed. The stages of implementation are summarised in Table 1, reproduced from a 2014 Healthcare Improvement Scotland report (HIS, 2014).

Table 1. Implementation of HEPMA in Scotland

NHS Board	Current stage of planning or implementation of a HEPMA system
NHS Highland	Early planning
NHS Grampian	Developing a business case
NHS Dumfries and Galloway	Approval of a business case
NHS Lanarkshire	Recent implementation
NHS Ayrshire and Arran	Early adopter

Source: HIS (2014)

Access

Access to ISD datasets, including SPIRE when it becomes operational, is available by application to eDRIS. Only researchers employed by an “approved institution” have direct access to data: these are public sector organisations, including universities, NHS, Local Authorities and Scottish Government (ISD, 2013). Our interviewees stated that for private companies to access the data, they would be required to collaborate with an academic institution that would make the application to eDRIS.

If an application is successful, eDRIS extracts from the national dataset the minimum data required for analysis, performs any necessary data linking (using the CHI number) and provides the finished “product” to the applicant. These data are completely anonymised and are accessible to the client only in the safe haven. eDRIS have a menu for their services – they do not charge for access to the data but for the time of the eDRIS team used to discuss data requirements and to help applicants to obtain the necessary permissions. The charge also includes an element to cover the processing and storing of the data in the safe haven.

Current capabilities in Scotland: key points

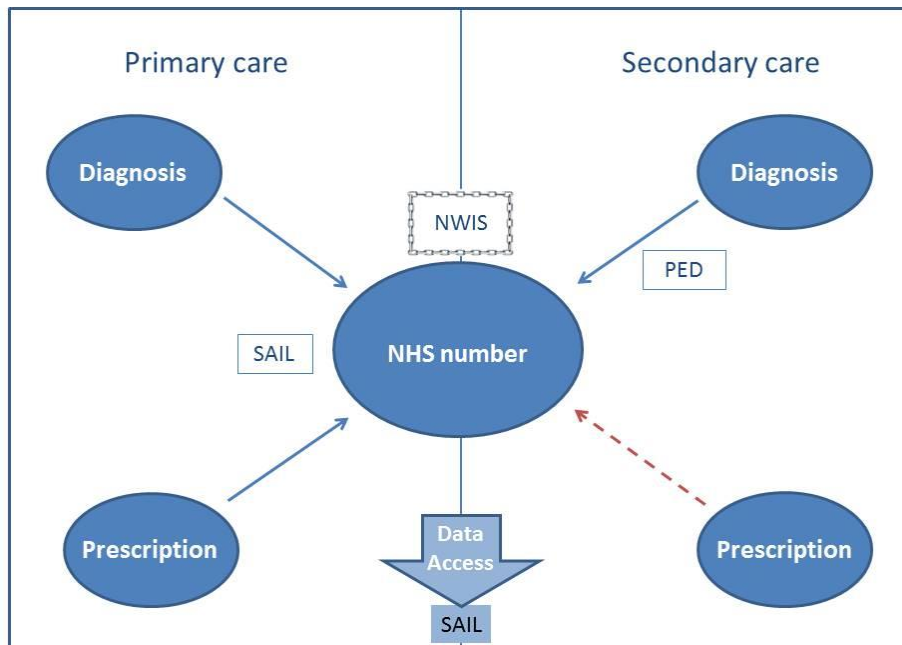
- It is not possible to link prescriptions and diagnoses across primary and secondary care in Scotland: two of the four necessary data sources exist
- Primary care prescription data can be linked to secondary care diagnosis data by patients’ unique Community Health Index (CHI) number
- Anonymised, linked data is provided by the Electronic Data Research and Innovation Service (eDRIS)
- In April 2016, the Information Services Division (ISD) will launch the Scottish Primary Care Information Resource (SPIRE), which will extract data from IT systems of participating GPs
- SPIRE will allow primary care prescription and diagnosis information to be linked with secondary care diagnosis data
- Coverage of SPIRE may be limited, particularly in the short term
- Access to national datasets (including SPIRE when it is launched) is available by application to eDRIS
- Access is available only to public sector organisations – private companies must collaborate with academic institutions

3.4. Wales

Current capabilities

After England, Wales has the most developed capabilities currently for linking medicine use to indications across primary and secondary care (see Figure 5).

Figure 5. Data linking capabilities in Wales



The Secure Anonymised Information Linkage (SAIL) Databank is a large scale data warehousing technology hosting Welsh routinely-collected health data from many sources (SAIL, 2014b). These sources include *NHS Wales* (Emergency department dataset, National Community Child Health Database, Outpatient Data set, Patient Episode Database for Wales [PEDW], Welsh Demographic Service), *Public Health Wales* (Bowel Screening Wales, Breast Test Wales, Cervical Screening Wales, Congenital Anomaly Register & Information Service), *Office for National Statistics* (ONS – birth and death extract), *Welsh Cancer Intelligence and Surveillance Unit* (WCISU) and individual *GP practices*. It represents a single repository holding pre-linked data from all of the above sources. Organisations that provide SAIL with the data do so via the NHS Wales Informatics Service (NWIS), which acts as a trusted third party for anonymisation and encryption.

Individual GP practices submit data to SAIL – this is similar to how English practices submit to CPRD and Scottish practices are expected to begin submitting to SPIRE. The information includes data on prescribed medicines and diagnoses (Read codes), linkable by NHS number and other identifiers (when NHS number is not present or not valid, a probabilistic matching process using other identifying fields is undertaken). The majority of the data are entered by the clinician during the patient consultation, and test results and prescribing data for outpatients are electronically transferred. Submission of data is not mandatory: it is provided on a “good will” basis. However, coverage of GP practices that provide primary care data is around 70% across Wales, which is high in comparison to the proportion in England covered by CPRD.

Again, the matching process involves inferring links between prescriptions and diagnoses and thus instances where patients are diagnosed with more than one relevant indication for a medicine would pose difficulties for the researcher. Our interviewees from SAIL suggested that doctors do not generally repeat diagnosis entries: they would generally link prescribing information with *historic* diagnosis information.

In secondary care, the Patient Episode Database for Wales (PEDW – PED in the figure above) is the equivalent to HES, so contains details of diagnoses (coded using ICD10) and procedures (OPCS4 classification). SAIL also holds outpatient data, but the coding is limited.

Hospital prescriptions are still generally only held in paper format, and thus there are no (routinely) captured in-patient care prescribing data held electronically.

In summary, three of the four data sources needed to link medicine use with indications exist in NHS Wales, but for medicines whose multiple uses are all within the primary care setting, understanding use by indication may be feasible.

Access

Depending on requirements, clients can either submit a request for in-house analysis, or SAIL can provide the limited (anonymised) dataset extracted specifically for the project via a secure remote desktop environment. SAIL accepts pharmaceutical company enquiries but does not grant direct data access to these clients, requiring that SAIL or another party access the data on their behalf. To gain access to the data, the client would have to submit a query to SAIL which would be submitted to the Information Governance Review Panel (IGRP) for approval (SAIL, 2014a).

Costs of data access/in-house analysis will depend on the project. Customers do not pay for the data (which is funded through public grants), but rather the time of analysts to prepare/work with the data. Our interviewees informed us that the cost per project would start from “a few thousand pounds”. Customers of SAIL are mainly academics and researchers from the NHS, but they have completed a number of projects for pharmaceutical companies. Unlike for eDRIS in Scotland, there appears to be no pre-requisite for collaborating with an academic institution, though due to recent changes in policy at SAIL access by pharmaceuticals must now be through SAIL conducting analyses on the company’s behalf.

Current capabilities in Wales: key points

- It is not possible to link prescriptions and diagnoses across primary and secondary care in Wales: three of the four necessary data sources exist
- Primary care prescriptions and diagnoses can be linked to secondary care diagnoses using patients’ unique NHS number and other identifiers
- Anonymisation is performed by the NHS Wales Informatics Service (NWIS)
- Primary care information is collected by the Secure Anonymised Information Linkage (SAIL) – data cover 70% of GP practices across Wales
- Links between primary care prescriptions and diagnoses are based on inferences using a time window – this is likely to result in some degree of error
- Data are available by application to SAIL, who accept applications from pharmaceutical companies
- Costs of access to SAIL data depend on the amount of time required by analysts to prepare/work with data

3.5. Cancer registries

Across all four countries, there have been significant efforts to collect cancer registration information.

England

In England, the National Cancer Registration Service (NCRS) is a unified cancer registration service that has permission under Section 251 of the NHS Act 2006 to collect patient identifiable data without individual consent. The aim of the registry is to provide near-real time, comprehensive data collection and quality assurance over the entire cancer pathway on all patients treated in England. Data is submitted monthly from most providers and processed by teams in the eight offices of the NCRS. The NCRS is part of Public Health England (PHE).

The Cancer Outcomes and Services Dataset (COSD) is a dataset that has been adopted as an NHS standard that forms part of the submission to the NCRS. COSD contains data on all the main tumour sites with a core dataset on all cases and site-specific extensions for individual tumours; most COSD data items are derived from multi-disciplinary team meetings. The NCRS collects, quality assures and links this COSD with other data including pathology, imaging, molecular diagnostics, cancer stage and treatment data. Specific additional datasets such as the Systemic Anti-Cancer Therapy Dataset (SACT) are also collected and quality assured by the NCRS. SACT includes detailed information on inpatient chemotherapy treatment (NCIN, 2014). The registry also collects details around the stage of the cancer.

In theory, the information base is huge and would enable researchers to measure drug use by cancer diagnosis. However, submission of data and completion of the various fields remains inconsistent and patchy, according to our interviewee from PHE.

Given the sensitive nature of the information collected by the NCRS and that it is collected under Section 251, access by researchers and third parties is inevitably restrictive. In order to ensure the huge potential value of the dataset for research is realised, PHE intends to begin to offer access to the fully anonymised dataset to outside parties (including pharmaceutical companies) by April 2015. It has been proposed that PHE would offer a "membership" scheme, to allow access to a secure safe haven and participation would require compliance with rules to protect the integrity of the data held in the safe haven. They anticipate a cost of around £100k per year for a desk at the safe haven, though they are considering price differentiation according to the type/size of applicant. If successful, expansion to other locations will be considered.

Northern Ireland

The Northern Ireland Cancer Registry (NICR) serves a similar purpose in NI. The data are collected electronically from Hospital Pathology laboratories, Hospital Administration Systems, death registrations and other records, and are managed by Queens University Belfast. The data include the HCN patient identifiers as well as diagnoses, but the extent of information on treatments (i.e. whether there are data on medicine use) is uncertain. The NICR covers all trusts in NI, though patients are able to opt-out if they wish. Access to the data is by application to NICR – it is not clear if this option is available to private companies. As explained above, the NICR data have been linked to the Northern Ireland Longitudinal Study database.

Scotland

In Scotland, cancer registrations have been collected as part of the Scottish Morbidity Database since 1958. Approximately 45,000 registrations are made annually in Scotland and the cancer registration database currently holds over 1,400,000 records. The Scottish Cancer Registry contains information on CHI number, patient characteristics, diagnosis, treatment and geographical information. Like other ISD databases, access to non-patient identifiable data is available by application to eDRIS. The quality of Scottish cancer registration data is generally considered to be high (ISD, 2014). However, like for Northern Ireland, we could not establish the level of detail collected on treatments used.

Wales

The Welsh Cancer Intelligence & Surveillance Unit (WCISU) is the National Cancer Registry for Wales, which collects data on all incidences of cancer in the country. WCISU currently holds around 686,000 records going back to 1972.

Access to WCISU is negotiated through SAIL – the SAIL website states that the dataset includes treatment information from 1995. However, our interviewee from SAIL informed us that the only treatments listed were “procedures”, i.e. no drug use or prescription information. It is possible that similar problems exist for the Northern Irish and Scottish cancer registries.

Cancer registries: key points

- There are cancer registries in all four countries of the UK
- In England:
 - Clinicians to submit monthly data to the National Cancer Registration Service (NCRS)
 - This includes the Cancer Outcomes and Services Dataset (COSD) and the Systematic Anti-Cancer Therapy Dataset (SACT), which can be linked
 - Public Health England intends to offer access to certain fully anonymised data to outside parties by April 2015
- In Northern Ireland and Scotland, respectively, the Northern Ireland Cancer Registry and the Scottish Morbidity Database contain data on cancer diagnoses, but the extent of information on treatments is uncertain
- The Welsh Cancer Intelligence and Surveillance Unit is the national cancer registry for Wales – in addition to diagnoses, it appears to hold information only on “procedures”, as opposed to medicines used for treatment

3.6. Summary

It may be important to note that none of the contacts within the information centres interviewed had received an enquiry relating to the specific question of capturing use according to indication for multi-indication drugs, with the exception of IMS Health.

By describing the healthcare data that is collected on a routine basis, we have shown the current capabilities and gaps in the information to facilitate assessment of medicine use by indication. In no UK country is such data available across the entirety of the health

service. Therefore, whilst relative use according to indication can be assessed in some areas based on sample data, for no therapy area is it yet possible to assess actual total use by indication without (a) making assumptions for the linking process and (b) without making inferences from sample data. With this in mind, is it useful to consider more local initiatives which may similarly provide data on relative medicine use by indication. We consider this in section 4.

4. Local Initiatives

In response to a call to the Academic Health Science Network (AHSN), we received notification of three relevant initiatives which may have the potential (either currently or in the future) to address the question of monitoring medicine use by indication: PICS, Eclipse Live and FARSITE.

4.1. Birmingham Prescribing Information & Communications System (PICS)

The University Hospitals Birmingham (UHB) NHS Foundation Trust uses a unique computer system known as the Prescribing Information and Communications System (PICS) to organise and monitor the treatment of patients. According to an article in *The Economist*, the system was developed following a visit by the Chief Executive of UHB to a local BMW garage which had enviable system processes that result in 99.9% of tasks being completed with no errors (*The Economist*, 2014). The bespoke computer system which was developed in-house manages 30,000 new prescriptions every week and has been in operation for over 12 years.

PICS was developed to provide functionality to safely administer and review patients, and using rules-based algorithms analyses data to inform clinicians at the bedside about drug interactions, contraindications, dose limits, etc. (Servelec Healthcare, 2014). As well as collecting and sharing information throughout the ward on the exact treatments provided to each patient, the system also collects data on performance such as infection levels, and frequency of bedsores and falls; needles on a visual dashboard in the system indicate performance levels. These dashboards are located in every in-patient ward, and allow for real-time monitoring and adjustment of treatment, for example alerting staff to missed doses. In a study published in the *Journal of the Royal Society of Medicine*, PICS was shown to improve prescription accuracy, with reduction in medication errors leading to lower local mortality rates (followed-up using HES data) (Rosser et al., 2012).

The study described above utilised medication administration records within the audit database of PICS, and demonstrates the functionality of the system for research purposes, beyond the direct treatment of patients. As the system collects detailed medication information as well as diagnostic data, PICS has the capability to assess drug use by indication at a local level. The Director of Informatics at UHB indicated that this type of query would be feasible, and whilst the data is currently only being used by local clinicians or academics for research purposes, the Trust would consider engaging with other organisations to appropriately use the data in bringing about greater benefit for the Trust's patients. This would be in the form of in-house analysis by the informatics team within the Quality and Outcomes Research unit at UHB (UHB, 2014).

PICS represents an advanced electronic prescribing system that appears to be unique in that it has not been replicated elsewhere in the country. The barrier to the roll-out of this sophisticated system to other hospitals across the NHS may be financial: the complete system (with all modules) would cost £3.5 million to implement and support over 5 years (The Economist, 2014) for a large hospital but the medicines management module could be implemented and supported for <£1m over 5 years. However, this should be set against the costs associated with medication errors in the form of adverse events and poorer patient outcomes. Moreover, the potential to offer a valuable resource for research and service evaluation should be considered.

4.2. Eclipse Live

In response to the call for relevant initiatives, the Eastern AHSN notified us of a primary care, risk-stratification software system called Eclipse Live. "Eclipse" stands for "Education and Cost-analysis Leading to Prescribing Safety and Efficiency". The system is used by around 4,000 GP surgeries in England and contains data for around seven million patients (Prescribing Services, 2014).

Its manufacturers, Prescribing Services Ltd, market it primarily as a system to improve the safety of primary care prescribing and therefore reducing emergency hospital admissions due to adverse effects of medicines that are incorrectly prescribed. The software runs automated algorithms on the GP IT system that identifies outlying patients that require urgent review. It is also used to improve prescribing efficiency by identifying cases where more cost-effective alternative medicines could be used.

It appears that in identifying patients who are at risk, the software searches the GP system for diagnoses (Read codes) as well as medications and test results. Thus, in theory, Eclipse Live can be used (by GPs) to match primary care diagnoses to medicines. The data are also matched to HES data, meaning that secondary care diagnoses can also be obtained.

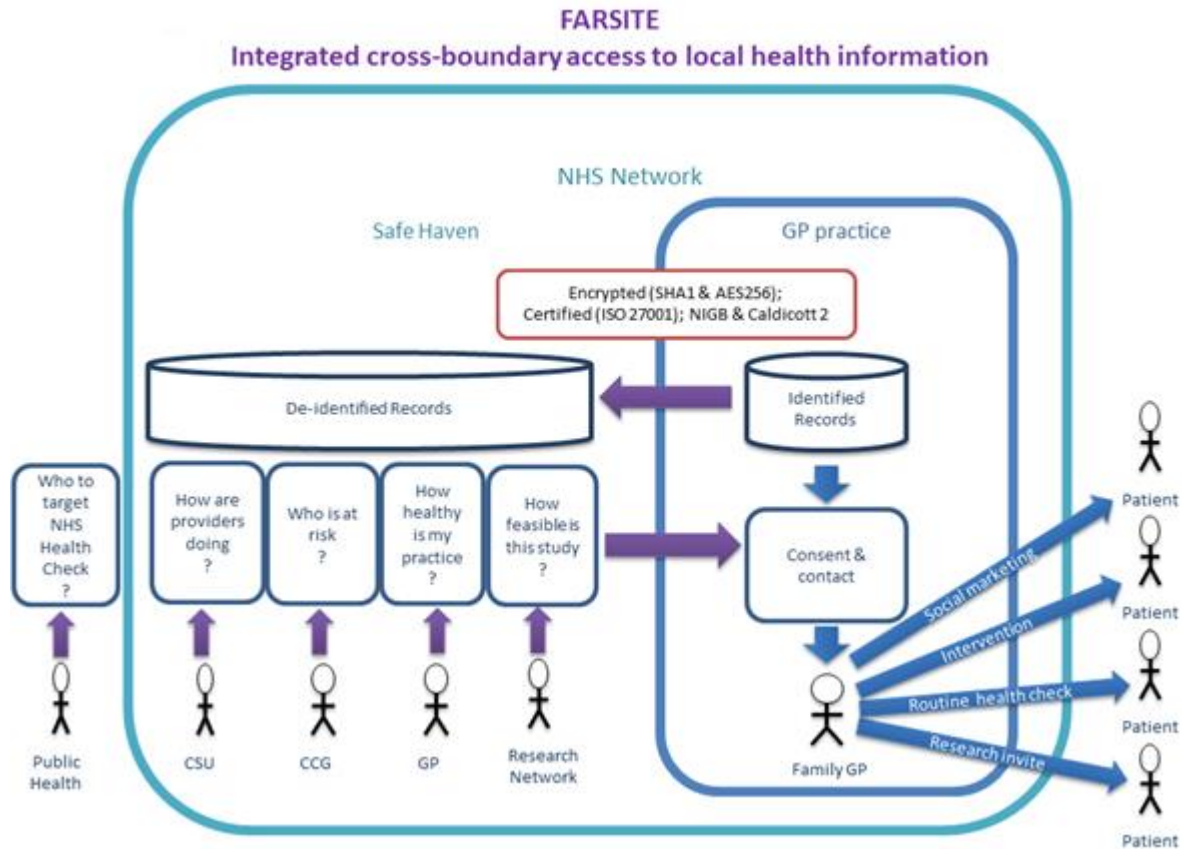
However, it is explicit in documents on Information Governance of Eclipse Live data that no data are passed on to third-party companies outside the NHS. Moreover, the system offers researchers less information than can already be obtained through CPRD.

4.3. FARSITE

Notified by the Greater Manchester AHSN was NorthWest EHealth's FARSITE: Feasibility And Recruitment System for Improving Trial Efficiency. FARSITE was developed in 2009 as software to assist in the identification and recruitment of participants for clinical trials, supporting cross-boundary access to primary care data. It has mainly been used as a population profiling tool, whereby primary care records can be interrogated to identify cohorts and investigate the feasibility of clinical trials. Patient confidentiality is maintained by the use of pseudonymised data. As well as identifying patients it also facilitates recruitment, a process which is managed by the GPs. The tool can increase the efficiency of trial design and recruitment. An example of FARSITE's use to assist in a large scale clinical trial is the CLASSIC study (Comprehensive Longitudinal Assessment of Salford Integrated Care), whose recruitment target window of 4530 patients across 50 GPs was only a few months (UK CRN, 2014).

As well as assisting with research studies, the data platform has been used by Public Health Authorities and commissioners to monitor activity and target practices that might need help, and to assist in the early identification of chronic diseases (e.g. the tele-health diabetes prevention programme (NWEH, 2014)). The system infrastructure is summarised in Figure 6.

Figure 6. FARSITE system



The system currently has coverage of around 1 million patients, but it is hoped that this will expand over the coming years. Whilst FARSITE is currently used predominantly as a research tool for clinical trial feasibility and recruitment, it has capability beyond this function which is expected to expand. The tool is cross-platform, and capable of interpreting coded event data captured in all primary care GP systems as well as secondary and other care settings, providing real-time information of patient touch-points in the system. Therefore the data captured in the system could be used to link and assess medicine use by indication at a local level. Support for these sorts of expanded uses of the data for research is being facilitated by providing a dynamic consent tool for GPs to be able to consent to their data being used for these additional purposes. This dynamic consent module should be in place by mid-2015, and the business development team has been expanded to meet the potential demand for the increased functionality of the system².

² The Head of Business Development – Bruce Magill – can be contacted directly and signpost interested parties to current FARSITE using areas: Bruce.Magill@manchester.ac.uk

4.4. Other local programmes

The call to AHSNs for relevant local initiatives brought to light the three initiatives described above. However, there are many more local data projects that could support the collection of better data on medicine use in the UK. For example, GP software systems such as Health Analytics (Health Analytics, 2014) contain longitudinal patient data including prescription data and a patient's various contact points with the healthcare system. According to the company the system can "combine patient information from Primary, Secondary, Social and Community care into one place, for the first time providing commissioners with new insights into how to improve the efficiency of patient care." However, it appears to be clinician-focused and unlikely to provide access to third parties. Additionally, infrastructure projects to create data warehouses to aid commissioning support units could be utilised more widely to facilitate research (provided that the appropriate information governance arrangements have been put in place).

Whilst progress to enhance and expand data capture at a local level are important, in order to address our question of medicine use by indication, and more broadly to facilitate research with data that is representative and generalisable, more effort must be made to capture the relevant information at a routine, national level. We propose some policy recommendations in section 5 to work towards this overall goal.

In England, the objective of creating a system to improve the utility of routinely collected health data was to be addressed by a modern data service labelled 'care.data' (NHS England & HSCIC, 2013). The intention was to bring together patient-level information across all healthcare settings, with the creation of a 'Care Episode Service' managed by HSCIC to include data on hospital care, mental health, GP, community, social care, clinical audit, and disease registry datasets. Due to a public perception that the changes to the way data was handled would lead to breaches of patient confidentiality, progress against these plans was halted. However, NHS England are pursuing a staged roll-out of the programme through initial 'pathfinders', beginning with 265 GP practices (NHS England, 2014). Whilst we have demonstrated that, in some areas, linkage of medicine use and indication is possible, progress towards a centralised system for the management and linkage of patient data is critical for improving the utility of healthcare data captured by the NHS. Below, we provide policy recommendations for improvements in the way national data could be used to address the information gap of medicine use by indication.

Local initiatives: key points

- In response to a call to the Academic Health Science Network (AHSN), we received notification of three relevant initiatives
- Birmingham Systems Prescribing Information Communications System (PICS)
 - A unique computer system used by University Hospitals Birmingham
 - Collects and shares information throughout wards on treatments provided to each patient, and performance indicators
 - Potential to offer a valuable resource for research
- Eclipse Live
 - A primary care, risk-stratification software system, used by around 4,000 GP surgeries in England
 - Possible to infer primary care diagnoses to medicines and to link to HES data
 - No access outside NHS and offers less information than can be obtained through CPRD
- FARSITE
 - Software to assist in the identification and recruitment of participants for clinical trials
 - Coverage is around 1million patients
 - Development of tool may allow assessment of medicine use by indication at a local level

5. Discussion and recommendations

A necessary starting point to facilitate an assessment of medicine use by indication is to improve data collection by ensuring the required data are captured electronically. **It is therefore essential that hospital e-prescribing and electronic patient records are implemented across the UK.** Although significant efforts have been made to encourage the use of hospital e-prescribing systems, coverage is still patchy and particularly so in Wales and Northern Ireland.

A fundamental problem that exists across all four countries of the UK is that there is currently no way of determining for certain the relevant indication for a particular prescription. For primary care, CPRD and SAIL (and SPIRE when it becomes operational) are forced to *infer* a link between diagnoses and indications by choosing a relevant time window around the GP entering a particular patient diagnosis and searching for prescriptions dispensed within this window.

Clearly, this will result in a degree of human error, particularly in relation to determining the size of the time window. There is also the possibility that a patient could present with more than one indication for a multi-use medicine during the chosen period. Therefore, a key policy recommendation that could eliminate this problem would be that all primary care prescriptions are issued with details of the relevant indication. Unfortunately, although this recommendation is very simple, in practice, it may be difficult to achieve as it would involve altering GP systems. However, the SPIRE project is effectively pursuing this model in Scotland, and monitoring its success will be useful for informing policy in the rest of the UK. Such a step would be particularly valuable in Northern Ireland, where there currently exists no CPRD, SAIL or SPIRE equivalent.

Attaching a diagnosis to each prescription would be equally useful in secondary care. However, the data-collection infrastructure is much less developed in secondary care and thus there are several important steps that could be taken before such linkage would be achievable.

Capabilities would be greatly improved if there were **centralised collection of data on medicines dispensed in hospitals.** Although IMS currently collects this information in England to populate the HPAI database, it has obtained permission to link the HPAI data to HES data from only 26% of NHS trusts, meaning that the resulting HTI database is small relative to the size of the English population. If hospital prescription data collection were centralised in England, this linkage might result in a more complete dataset, given that HSCIC, rather than a private company, would own the data.

Another critical aspect of the utility of routinely collected data that cannot be overlooked is a **facilitative environment for data access.** The extraction and linking of data to inform effectiveness research, monitoring of uptake, and value assessments should be performed with the appropriate arrangements for governance, in recognition of the benefit to patients and the public of the research.

A final recommendation would be **improved monitoring of the use of medicines dispensed from ward trolleys / supplies in hospitals,** although (for obvious reasons) data collection will not be a priority in emergency situations.

Acknowledgements

We are grateful for the contributions of the project Steering Group members, in particular Shahid Hanif (ABPI), Cathy Emmas (AstraZeneca), Rob Thwaites (Takeda) and Bina Rawal (ABPI), as well as Jon Sussex, Fraser Lewis and Phill O'Neill from the OHE for their helpful comments and reviews of earlier drafts.

We also wish to thank our interviewees for their time and valuable contributions to the content of the report.

Funding for this report was provided by The Association of the British Pharmaceutical Industry (ABPI).

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