Healthcare Improvement Scotland | SHTG Advice on health technologies

SHTG Assessment
October 2022

In response to an enquiry from Scottish Radiology Transformation Program (SRTP)

A national Radiology Information System (RIS) for Scotland: perceived benefits and constraints to implementation

What were we asked to look at?

The Scottish Radiology Transformation Programme (SRTP) requested support from the Scottish Health Technologies Group (SHTG) in assessing the benefits and constraints of a 'Once for Scotland' approach for a national radiology information system (RIS).

Why is this important?

At present, the implementation of radiology information systems is fragmented across NHSScotland health boards. There are high levels of variability in the specifications and capabilities of existing systems. A functionally national system would reduce the complexities arising from operating multiple local systems and improve the provision of radiology services nationally by minimising inefficiencies and expanding on current RIS functionality.

What was our approach?

We undertook a consultation exercise with stakeholders using a combination of interviews and a survey. Stakeholder views were collected on the benefits and constraints of a national RIS, including the appetite for changing to a national RIS.

What next?

SRTP will use the findings from our assessment to determine the feasibility of a national RIS and to inform strategic plans for any implementation.

Key findings

- There is broad support for the concept of a national RIS across the majority of health boards and the clinical user base. The existing heterogeneity of local systems is considered problematic for the sustainability of radiology in Scotland.
- The perceived benefits associated with a national RIS include efficiency gains, greater levels of standardisation, automation, seamless cross-boundary working and access to national-level data.
- There is strong support amongst clinical users of RIS for improvements that could be implemented on a national basis, including requesting system functionality (that is, for requesting scans and analysis), cross-site operations, reporting capabilities and communication features.
- The main barriers to the introduction of a national RIS were the lack of a mandate for change, the perceived loss of local control, potential for short-term disruption and resource constraints.
- Several plausible routes to achieving a functionally national RIS exist. A route which preserves the autonomy of health boards, minimises short-term disruption and limits the technical complexity of migrating to a new system would be favoured by stakeholders.

Contents

Radiology information systems

A number of information systems are used to support the activities and workflows within a radiology department. The two main systems essential to day-to-day operations are the radiology information system (RIS) and the Picture Archiving and Communications System (PACS).

The RIS is specialised computer networking software used by radiology departments to store patient information and access imaging data. The specific utility of RIS, i.e., its exact functionality and ability to interface with other hospital and patient record systems varies across radiology departments.

A RIS can orchestrate workflow within the radiology department, from planning a study to the storage and distribution of radiology reports. A RIS can interface with other hospital systems and has a range of functions including:

- storage of patient administrative data
- order creation and scheduling of patients
- modality work list generation
- exam vetting and justification
- report generation, storage and distribution
- statistical data analysis and resource planning.

The PACS handles the storage and distribution of image data. The term PACS designates both the image archive itself and, in a broader sense, the system consisting of the image archive and the radiological workstations.

The RIS and PACS together provide the radiologist with the information necessary to interpret an examination, and to deliver the report of that examination to the requesting clinician.

Introduction

The RIS landscape in Scotland is complex with RIS contracts funded and managed independently by each health board. There are 15 local RIS across Scotland provided by four different system vendors:

- Philips (formerly Carestream RIS)
- Wellbeing (formerly Healthcare Software Solutions, Client Registration and Identification Service)
- Intersystems
- Soliton IT.

The Scottish breast screening RIS is an example of a national system that has harnessed the benefits of a national approach, resulting in seamless nationwide reporting with national level data analysis of performance.

In contrast to multiple instances of RIS, a 'Once for Scotland' PACS has been in place for over 12 years and consists of a national PACS archive connected to 15 local health board PACS. There is an NHSScotland national PACS contract, which is highly advantageous to radiology services in Scotland, as it creates a central repository of radiology imaging and reports, acquired at any of the local PACS and available to access by any user of the PACS systems across Scotland. This allows radiologists in one board to see the full patient imaging and report history generated in another health board.

The demand for radiology services is expected to increase in the coming years, against a background of constrained resources. Transformational change may be required to facilitate increasingly efficient ways of working. The successful implementation of the national PACS has drawn attention to the potential benefits of a centralised approach to RIS in Scotland. Centralisation may take the form of implementing a single RIS nationally or facilitating the ability of individual RIS at the different boards to work together as a single system.

There is currently no mandate to consider a national RIS for NHS Scotland, and the Scottish Government Digital Health and Care Directorate has not published a national RIS strategy.

The feasibility of a functionally national RIS is unknown given the complexity of the RIS landscape and local variations in their functionality and implementation. It is also unclear whether there is an appetite amongst local health boards for converging towards a national RIS.

Research question

The primary aim of our SHTG assessment was to identify the perceived benefits and limitations to implementing a national RIS in Scotland, in order to inform strategic discussions about the future operating model of radiology services. To achieve this, we collected information on:

- specifications and contractual obligations of RIS in use at individual health boards
- satisfaction with existing RIS setups
- limitations of local RIS in terms of functionality and interfacing with external feeder systems
- benefits of a national RIS which cannot be realised through existing or planned alternatives (for example, local RIS upgrades, PACS reprovisioning, PACS Plus)
- desirability of added functionality to clinical users of RIS

- barriers and constraints to national RIS implementation from the perspective of health boards.

Methodology

The information obtained for this assessment was collected through a combination of structured interviews and surveys. Interviews were conducted with personnel responsible for the oversight, planning and delivery of radiology services across Scotland. Five one-on-one interviews were completed with individuals who are members of the Scottish Clinical Imaging Network (SCIN), SRTP, Imaging Executive Board (IEB) and NHS National Services Scotland (NSS). All five interviewees either held national roles or were leading national initiatives in radiology services.

Structured interviews were also conducted with RIS/PACS managers at individual health boards. RIS managers from eleven health boards responded to our request for an interview about their experiences regarding implementation and usage of their local RIS. We were unable to interview representatives from NHS Dumfries and Galloway, NHS Western Isles and NHS Shetland.

Interviews were recorded with the interviewee's permission and automated transcripts were generated. Qualitative analysis was undertaken by a researcher who coded data into broad subject categories to allow a thematic analysis to take place. Common themes and issues identified were examined by a second researcher to confirm their validity.

Additionally, an online survey was developed for clinical users of the RIS (for example, radiographers and radiologists) to assess the desirability of additional features and functionality which could potentially be attained by implementing a national RIS. Twenty-four respondents completed the survey.

Views on current RIS landscape

The current RIS landscape was described as fragmented and heterogeneous. The heterogeneity is a result of product variability and implementation variability. Product variability refers to the existence of multiple versions and suppliers of RIS across the health boards. The same version of RIS may be implemented in different ways by individual boards which leads to variation in the ability to interface with other systems and an over-reliance on local infrastructure.

There are different RIS products in different places. There are RIS products that are installed board by board and some boards took more than one, either more than one instance or more than one RIS product. Within that heterogeneity, there's a further complication because the way that they have been implemented varies from board to board…..That has led to quite a variation in the way that even the same RIS product has been implemented between one board and another. (Interviewee 2)

Interviewees also highlighted a lack of standardisation as a major impediment to a national RIS. The absence of a standardised architecture meant there was no common initial structure for local RIS to adhere to. The implications are that any changes which need to be implemented at a national level could become cumbersome and labour intensive locally.

There's no such equivalence with the way that we do RIS. And that again makes it extremely difficult if you want to introduce something that is Scotland wide. So if you want to make changes to the way that we work, it's extremely difficult to do and it's a slow process….At some point we have to bring standardisation to the initial structure. If the base source of all data and communication is not standardised, then every time you make changes, you still have this problem that you've got to test everything so there's not some idiosyncracy in the local setup that either prevents your data flow or information flow from working, or makes it work in a way that you had not anticipated or intended. (Interviewee 2)

Issues around standardisation also extended to variation in coding. Codes which exist in one RIS are not necessarily identical to codes existing in another RIS. This has led to onerous code mapping exercises and issues with data quality when trying to extract data at a national level for planning purposes. Differences in coding were seen as a major impediment to interoperability and efforts to expand RIS and PACS functionality.

Different systems drive different workflows on the different sites. So not only are things being done differently, they're being coded differently. And that has caused problems. It causes problems when you want to try and work together and share resource, etcetera. It causes problems in PACS because the incoming metadata - because it's different - means that some PACS functionality can't take place. (Interviewee 1)

Overall, there was a sense that whilst the RIS may work well locally, the current setup was not fit for purpose from a national perspective when evaluated on criteria such as shared working, cross-boundary reporting, capacity planning, data analytics and connectivity.

I think from my perspective regionally and nationally, I don't think it is fit for purpose…. it's not fit for purpose to do things like national reporting and cross-boundary reporting, and collation of data that would inform how we might do things differently or sustain services going forward. (Interviewee 3)

The frustration for me is that the data I need to help inform capacity planning, future proofing service, building some kind of sustainability is not available to me. And I have to rely on the boards to do additional work to make that available….. There's probably lots of other information

that we should collect, but we're not going down that road because it's difficult to collect and it's not consistently recorded because they have different RIS systems. (Interviewee 4)

Limitations of local RIS

RIS/PACS managers within health boards were asked about the limitations of their local RIS. RIS managers from five boards considered their RIS to be performing well and meeting most of their needs (Ayrshire and Arran, Fife, Greater Glasgow and Clyde, Highland Tayside). In contrast, managers from five other boards (Orkney, Grampian, Borders, Lanarkshire, and Golden Jubilee) reported their RIS to be performing poorly on a number of attributes.

RIS managers reported that the Philips (formerly Carestream) RIS version 10.1 was an end of life product with no scheduled updates and very limited support from the supplier. There are compatibility issues in trying to get the RIS to function on Windows 10. For one board, this has restricted their ability to upgrade servers and caused them to persist with the use of Windows 7. Where boards have been successful in getting the RIS to work on Windows 10, the system struggles with responsiveness and is open to security breaches. While boards have the option of upgrading to the latest web based version (RIS clinic) most have refrained from doing so both because of the cost of the platform and because the latest upgrade does not address existing issues with functionality.

Having all of your paper reports in filing cabinets and things like that, to be fair, that would probably work better than the system we've got at the minute. Our current RIS is not a good or well-designed system. (RIS/PACS manager)

NHS Highland (North of Scotland excluding Argyll and Bute) reported that whilst the Philips RIS Clinic system was “basic” it was performing sufficiently well to deliver what was asked of it and staff were familiar with its functionality and limitations. Many of the issues noted by other boards with respect to extracting and exporting data out of the RIS were overcome by using databases to run queries rather than relying on applications.

Table 1 provides a summary of the reported performance and limitations of local RIS, based on structured interviews with RIS/PACS managers at the individual health boards. The limitations tend to relate to technical issues and staff frustrations with limited or malfunctioning features. Left unresolved these issues could potentially pose significant risks to patient safety and compromise the provision of high-quality and efficient care.

Table 1: Summary table of reported limitations with current RIS at individual health boards

Health board*	Current RIS	Current limitations and issues
Ayrshire and Arran	Soliton RIS	- no interface with clinical decision support - sign-off functionality with Trakcare does not work well - limitations of order comms system causes problems for results acknowledgement - no real-time communication between RIS and order comms - labour intensive workflow for referring patients to Golden Jubilee - duplicate requests for cross-boundary patients - unable to take full advantage of rule-based automation because of lack of staff resources and technical expertise
Borders	Philips RIS Client (migrating to Soliton RIS in August 2022)	- limited statistical analysis functionality - no GP services order comms functionality - no interface with clinical decision support - Windows 7 servers for Philips RIS - requesting and vetting not in same system - inadequate clinical alerts - cannot shorten length of 10 minute booking slots
Fife	Wellbeing (CRIS) with Soliton Reporting+	- no interface with clinical decision support - extra modules for added functionality are expensive (for example, for patients booking their own appointments) - cannot use RIS on mobile devices or tablets - paper-based communication (for example, alerts for unrelated findings and for cross-boundary referrals)
Forth Valley	Philips RIS Clinic	- no interface with clinical decision support - cross-boundary reporting of scans done by email - management reports not set up by company - audit trails are missing information - printing issues

		- a few workarounds which are supposed to be resolved by upgrading to latest version of RIS Clinic
Golden Jubilee National Hospital	Philips RIS Clinic	- no interface with clinical decision support - no reports sign-off functionality for referring clinicians - very limited statistics reporting ability - data extraction is limited and labour intensive - lacking in-house expertise on business intelligence - supplier support can be lacking - very manual, largely paper-based booking processes - referred patients having multiple reports for same exam
Grampian	Philips RIS Client	- no GP services order comms functionality - modality work list limit reached - using statistical packages are a minefield - no interface with clinical decision support - out of date; runs on Windows 8 servers - no support from supplier - poor integration with Trakcare; deceased or discontinued patients not flagged appropriately - frequent missing orders from order comms - MRI worklist and scheduling split across two lists - several bugs which require custom scripts - cannot shorten length of 10 minute booking slots - cannot make edits to contact info on letters - admin burden from printing out and scanning requests from GP referrals - order comms between TRAK and RIS gets 'jammed' every few days - upgrade to RIS Clinic considered unsafe because of persisting issues
Greater Glasgow and Clyde	Wellbeing (CRIS)	- no major critical limitations - some issues with software stability; specifically repeated crashes during reporting sessions** - not preserving formatting of reports with rich text functions**

Highland (North)	Philips RIS Client	- no order comms functionality; paper-based requests - no in built statistical analysis functionality - no interface with clinical decision support - supplier delays in providing support as a result of third party call logging
Lanarkshire	Philips RIS Client	- no GP services order comms functionality - basic statistical package - no interface with clinical decision support - compatibility issues with Windows 10 - performance and responsiveness is very poor - poor integration with PACS - cannot shorten length of 10 minute booking slots - does not always show the full overview of patients' appointments across three sites within board
Lothian	Intersystems (TRAK) with Soliton Reporting+	- paper-based justification and protocolling** - laborious process to update and add new studies to room bookings** - no reports sign-off functionality for referring clinicians (that is, no read and action alerts)** - no GP services order comms functionality** - TRAK RIS module no longer in development by supplier**
Orkney	Philips RIS Client	- no order comms functionality; paper-based requests - no in built statistical analysis functionality - cannot upgrade systems to Windows 10 without losing RIS functionality - poorly designed and unintuitive interface - no alerts and notifications because no order comms - paper-based reports, letters, reminders
Tayside	Wellbeing (CRIS)	- no interface with clinical decision - support system picks up non-attendance but does not automatically report back to order comms

		- having to remember local codes is not ideal - appointment letters cannot be sent by email from the RIS - poor in built text editor which reduces radiologist efficiency**

** based on structured interviews with RIS/PACS managers at the individual health boards. RIS managers from eleven health boards responded to our request for an interview about their experiences regarding implementation and usage of their local RIS. We were unable to interview representatives from NHS Dumfries and Galloway, NHS Western Isles and NHS Shetland.*

***issues reported by clinical users of the RIS during the peer review stage, rather than RIS managers.*

Benefits of a national RIS

Efficiency gains

Interviewees felt that a national RIS functioning as a fully integrated single service across Scotland had the potential to greatly improve the operational efficiency of radiology services. Respondents felt that a national RIS would lead to:

- Standardisation
- streamlined workflows
- reduced administrative burden
- active community health index (CHI) linkage for automatic updates of status
- increased automation
- better waiting list management
- better integration with other hospital management and patient information systems
- less reliance on local workarounds and 'hacks'
- transformational change to image requesting and justification
- easier flexible and hybrid working arrangements.

Improved communication capabilities across the system is considered key to improving efficiency. A national RIS would facilitate better communication of reports by virtue of increased integration with supporting systems such as order comms and by enabling the design and application of intelligent workflows.

Clinical staff in particular highlighted the substantial clinical risks which could be alleviated by upgrading their current RIS capabilities. Simplification of the current landscape and the expected reduction in administrative burden would present greater opportunities for

patient interaction and provide more time to focus on patient care. Specifically, a RIS which incorporates fully electronic requesting, two-way communication with order comms, and audit mechanisms for tracking and actioning of critical reports was viewed as substantially minimising the risk of clinical incidents occurring.

There was a strong belief that the combined impact of incremental gains in efficiency across a range of activities would ultimately lead to improved patient safety and better health outcomes for patients.

Standardisation

Nearly all respondents mentioned that the biggest benefit and by-product of implementing a national RIS was the standardisation that would be required for it to function. The current non-standardisation of codes for procedures and activities that exists across the various health boards was seen as being the greatest barrier to operating an efficient service. Without standardisation, variations in workflows and the interoperability of pathways between board boundaries would continue to exist.

> *We need to standardise a lot of things. You could talk about standardisation of what we do clinically and guidance and also how we standardise the image sequences. What we really desperately need to standardise is the way individual records are represented within our RIS system. (Interviewee 1)*

> *There's definitely an issue of coding being non-standard, I think. More importantly, there's an issue of non-standard usage, so some boards have got a code that they would use for urgency and other boards don't……standardised usage, standardised coding and interoperability with pathways. That's the key thing, you know, so that the radiology information and functionality follows pathways better than just being this, what feels like this kind of Radiology Island. (Interviewee 3)*

Whilst the process of standardisation could happen in the absence of a national RIS, there was a strong sense that committing to a national RIS would accelerate the move towards standardisation.

There remains some uncertainty about the optimal strategy for the task of standardisation. The process could be conducted within the existing architecture, prior to implementing within a new, national RIS. Alternatively it could be performed concurrently with changes to the RIS architecture while transitioning to the national RIS. Regardless of the option chosen, the starting point should be getting consensus on what the standards ought to be.

> *The path to standardisation, we need to start now. In fact, we needed to start yesterday. Whether or not we're going to move to a new RIS, it needs to happen. If we are going to move to new RIS, it definitely needs to happen. (Interviewee 1)*

It's taken several years, but we now have submissions coming from all of the boards, however, because they all have different RIS systems the data fields are perhaps collected in different ways. They're not consistent, they're not standardised. There's a lot of code mapping happening and data quality issues emerging. So that's one of the challenges that emerged from having different RIS systems across the country, which a national RIS would address because we would be collecting in the same way; there will be a structured coding system that they would all use. (Interviewee 4)

Access to national data

A common theme when respondents were asked about the benefits of a national RIS was the ability to harness data for monitoring and service improvement activities. Respondents highlighted that currently there is no single source of national data for radiology examinations because health boards recorded data in different ways.

Coding has been developed separately, it's non-standard across the country and all of these things contribute to the inability to maximise the use of data that's going through there to improve patient outcomes. ….You know all the ways in which from my helicopter point of view, looking at the health service and trying to improve things and trying to transform things. The RIS data doesn't lend itself to any of that modelling work or transformation work. (Interviewee 3)

The current non-standardisation of data was again viewed as a major obstacle either as a result of the complete unavailability of national data for any benchmarking or because of the poor quality of data available to guide planning decisions. Whilst recent initiatives such as creation of the National Radiology Information and Intelligence Platform (NRIIP) database were a step in the right direction, the lack of good quality aggregate data as an output was a major hurdle for assessing demand and activity levels.

It [RIS] would give us access to national data. We would have assurance that it was coded in a standardised way that we were comparing like with like. It would allow us to adopt or implement standardised processes and procedures around using the system. It would allow us to undertake national benchmarking around performance and utilisation would allow us to compare demand and activity levels. And through having that data, we would then be able to undertake robust workforce planning and capacity planning in terms of equipment. So all of that, it's done pretty badly, I would say, just because we don't have sufficient data to inform it well. And the ability to extract the data and analyse the data could be done from anywhere. (Interviewee 4)

The successful implementation of the national PACS and its management by NSS was often cited as an exemplary operating model for a centralised source of datasets. In a similar vein, a system capable of providing a national dataset for analysis that circumvents the complexity of extracting data from multiple sources was viewed as being very beneficial.

Automation

The potential for increased automation and application of artificial intelligence (AI) to reduce administrative and clinical workloads was also mentioned as a benefit of a national RIS. Standardisation was again viewed as being essential for implementing such changes. One RIS manager noted that a national RIS would aid the "collective effort towards automation" since currently several health boards do not have the technical staff and expertise needed to implement such advanced features locally.

> *From the coding perspective, the reason it needs to be standardised is, because the workload is so high that we're at the stage where we need automation and intelligence to manage the throughput of patients and that automation and intelligence is impossible. It's not going to happen…..I think to achieve that level of intelligence, automation, AI we need this. And we're looking at this really fancy stuff. We're looking at artificial intelligence, we're looking at orchestration of workflow and there are some expensive products we can buy to do that, but it is not going to work until we come together and start thinking about the patient record and recording the same thing. (Interviewee 1)*

A National RIS would also link well with the recently launched Scottish Medical Imaging Service, providing a valuable opportunity for researchers to analyse and link information from a national RIS to datasets within the national PACS, which would be highly beneficial for developing AI solutions.

Cross-boundary working

RIS managers and clinical users across almost all health boards noted improvements in cross-boundary pathways and workflows as being an area of priority. Current efforts at improving cross-boundary capabilities such as the implementation of Share Plus, whilst welcome, was not considered a long-term solution.

> *When you start to look at cross-boundary pathways: thrombectomy, major trauma, all of which have imaging components within them, cardiology, you know, there's a number and an increasing number of cross-boundary pathways that aren't supported by the current IT infrastructure and radiology easily. (Interviewee 3)*

A national RIS was perceived as essential for streamlined cross-boundary working practices and for optimal sharing of scanning and clinical resources across sites. It would avoid the need to implement local solutions and workarounds to plan undertaking of scans at different sites outwith their own board. A national RIS would facilitate radiographers and radiologist to view exams performed elsewhere at the time of vetting or before performing an exam in their local area, which could prevent numerous potentially unnecessary examinations. This would be the result of developments such as a single patient radiology record, centralised radiology bookings, and streamlined cross-boundary work (that is, reporting, justification and vetting).

A national RIS was also viewed as a means of achieving a central repository for justification and vetting, which could substantially reduce patient wait times. It would facilitate greater opportunities for neighbouring boards to offer scans for patients living closer to a particular imaging facility.

Financial savings

A move towards a national RIS was perceived as an opportunity for financial savings by virtue of procurement via a single national contract as opposed to multiple single board contracts.

Centralisation of contract management avoids the necessity for every board to develop or buy in the knowledge and expertise required to negotiate confidently with vendors.

> *We have very limited support locally for this and feel like we have been left very exposed due to this, especially legally. It also has left us on the 'back foot' the majority of the time with our supplier with their knowledge of 'our' contract making the negotiations very one sided. Contract management is managed nationally for the PACS where expertise and knowledge is centralised, giving the boards' reassurance and confidence that they are covered legally and have the support nationally. (RIS/PACS manager)*

Efficiencies and new capabilities brought about by a national RIS could potentially initiate further savings. One example cited was that of a nationally distributed out of hours acute reporting service. Its implementation would allow many health boards to cease expensive contracts with third party tele-radiology companies, often providing limited or inadequate services which do not meet local need.

Desirability of added functionality within RIS

A survey of clinical users (n=24) was conducted to gauge demand for improved RIS functionality. Respondents were asked to rate the usefulness of improved functionality in requesting, cross-site reporting and report communication, which could be realised with the introduction of a national RIS**.** Rating was on a scale where 1 was not useful and 10 was very useful.

There was moderate to strong support (give score range? i.e. define moderate to strong) for all the proposed improvements, with no option receiving less than an average score of 6.2 out of 10. The functionalities that received strong average scores of 7.5 or greater were:

- a requesting system that supports dialogue between clinicians and radiologists

- the ability to vet and protocol incoming requests cross-borders (for example, specialist examinations)
- the ability to see the status of an examination on another site
- standardised ways of tagging cases (for example, for follow-up, peer review, interesting cases)
- clear identification of examinations for insourcing, outsourcing, urgent reporting or cross-site opinion
- seamless cross-site reporting nationally
- cross-site addends to reports (for example, following multi-disciplinary team (MDT) or tertiary review)
- intelligent routing of examinations to the appropriate reporter based on modality, urgency and specialties
- the ability to alert a clinician to a critical report and allow acknowledgement
- a nationally consistent system that informs a requestor and/or team that a report is now available
- the ability to track whether a report has been read or actioned.

Full details and results of the survey can be found in Appendix 1 of this report.

Barriers and constraints to national RIS

Lack of mandate

The absence of a mandate and cross-board consensus on the need for a national RIS was also identified as a barrier to change. There was uncertainty about where requests for a national RIS would rank amongst a list of competing priority areas, and a sense that this was currently not on Chief Executives' radars. There was a perceived lack of high level strategic direction and a lack of urgency surrounding any discussions regarding the RIS.

> *One of the first things we ask is where's the mandate coming from? Have we got a mandate to move this discussion forward? ….We need to get agreement and look at the options as to whether we're definitely going to have a national RIS or not. I'm not aware of an explicit conversation around that and an intent to move in that direction. (Interviewee 3)*

> *I think we need to really gain the support of executive level decision making on all of the boards. To really say to them diagnostics is in crisis. It needs help. It needs focus and convergence over the next little while. (Interviewee 1)*

Recent work by SRTP in developing the radiology Target Operating Model was viewed as an important contribution towards raising awareness about the need for a national RIS, however there were concerns that its impact on driving change could be minimal because of the lack of accountability.

I don't think they feel the pressure to respond to the Target Operating Model, I think it's quite a loose thing. Nobody to say, 'look, whatever you're doing locally, you need to be aiming for this target within the next five years of interoperable RIS and order comms etcetera because diagnostics in Scotland depends on that.' (Interviewee 1)

Loss of local control

A move to a national RIS would be challenging and would, ideally, require the consensus of every health board. Several RIS managers felt this may not be achievable given the significant investment of time and resources in tailoring their current systems and processes to their local needs. There was anxiety around the anticipated trade-off between aligning nationally and losing the ability to work in a manner that suited the local context.

So people will say, we don't want to lose local control. You know, we're not up for that. We want to be able to adapt things to our local needs now. People will be a bit anxious about that data and that coding being too specific and too available beyond the local context….. But that doesn't stop us saying that 98 % of the usage of RIS should be standardised. You know, we can agree that you can have 2 % local control. (Interviewee 3)

Perceived loss of local control was considered to be a major hurdle. In particular, loss of local control of the differing ingrained clinical workflows as well as the prospect of losing certain key functionalities. Many health boards had implemented local solutions and developed methods of linking the RIS to the various pieces of software used by clinical staff, and there were concerns that the introduction of a 'new' RIS would result in the loss of useful features and functions.

We have a huge worry that we're going to have complicated methods of having things corrected. With all the interfaces that we've actually added and they worked very well, and it is worrying when you know every so often we do hear of the national RIS coming up that, we're going to lose all of that and we've got good functionality there. (RIS/PACS manager)

There was also uncertainty noted about information governance and how data controls would be managed if patient data could be accessed across board boundaries. Consideration would need to be given to issues such as alteration of patient data from different boards and the risks of merging patient records.

For health boards such as Borders and Dumfries and Galloway, who share patient groups with NHS trusts in England, compatibility with RIS and other systems in non-Scottish jurisdictions is another consideration to be taken into account.

Short-term disruption

A move towards a national RIS would be a lengthy process carried out over multiple stages. Many respondents, particularly clinical users, were wary of the potential for significant short-term disruption while migrating between systems.

> *As you do the cutover from the old system to the new system, there is the risk that it will be complete chaos. And clinically, you know that you will end up in a position where you can't do the reports or people can't see the reports or that they don't link properly or something else goes wrong that was not anticipated. It is a major problem. (Interviewee 2)*

The long-term value proposition offered by a national RIS would need to be sizeable in order to convince decision makers to risk short-term operational disruption.

Lack of consensus

The potential inability to gain consensus and agreement on crucial matters relating to the implementation and eventual operation of the RIS was also considered to be a barrier. The most obvious example of this would be if health boards were unable to agree on a set of standards for use of codes. Consensus would be required on a range of other issues such as defining technical specifications for a national RIS and developing a uniform IT security policy to be enforced across all health boards.

Resource constraints

Variable levels of resource available to health boards for managing the implementation of a national RIS was considered to be another barrier. There were concerns that not all boards would have the financial resources required to procure a new system. Smaller boards in particular may not have adequate levels of staff or sufficient expertise to manage the migration to a new system. The subsequent training of staff, needed to achieve competency in the operation of a new RIS, was also flagged as a concern.

> *I suppose for a lot of boards it would be cost and that could be the driver. Migrating the data, testing the migration to make sure it's accurate and setting it all up, it's a huge, huge amount of work which cannot be underestimated to be fair. So that could be a barrier for a lot of boards as well. Having the input and the time to do that. (RIS/PACS manager)*

RIS implementation options

As part of the interviews, respondents were asked for their views on potential RIS implementation strategies. In light of the barriers to implementation, the preferred option would be one which preserves the autonomy of health boards, minimises short-term disruption and limits the technical complexity of migrating to a new system.

1) Rip and replace

The most direct option is to procure a RIS from a chosen supplier as a replacement for all local instances of RIS at individual health boards. Local contracts held by health boards with any alternate RIS suppliers would be phased out, and health boards would be asked to migrate to the new national RIS over a specified timeframe.

Boards currently operating on the out of date Philips RIS Client were supportive of this option as the ability to migrate to a modern and fully integrated RIS would represent a clear improvement.

While respondents felt that the negotiation of a single block contract for RIS in Scotland was a positive move, a direct replacement strategy was considered to be rather 'radical.' There was a perceived risk that boards who were largely satisfied with their current RIS might be forced to switch to an alternate supplier. There was also a risk of backlash from clinical users who would be familiar with their existing processes and functionality and resent the need to be re-trained.

2) Maximum standardisation

This option would allow health boards to maintain autonomy with regard to the choice of RIS. Boards would work together to develop and apply a mutually agreed set of standards to achieve parity across Scotland in operational terms. This would involve standardised coding, standardised workflows and standardising any other elements that are required to facilitate cross-boundary working and extract national data.

> *You can allow sites to keep their RIS systems but you apply standards. Essentially standardisation and you force everyone to go with those standards so that means that, although the systems are different, they become interoperable. (Interviewee 1)*

Respondents felt that this would be the 'path of least resistance' as it would circumvent the need to replace local instances of the RIS, yet resolve one of the root causes for a lot of the current limitations. Health boards would retain the option to carry on business as usual without planning for a lengthy transition phase if they were to switch systems. There were some concerns about whether this strategy would adequately futureproof the service. Furthermore, in practice, not only does standardisation rely on agreement between boards, it also requires agreement and cooperation between rival vendors of RIS.

> *Definitely a path of least resistance is; let's agree a set of principles and you go off and buy your own one. Well, that was the same with PACS, you know. We all say that we've got a national PACS, but actually they've all got different interfaces, you know, kind of nuances on it and it causes problems. And that's 20 years down the line, you know. So I think we would be setting ourselves up for some ongoing issues. (Interviewee 3)*

3) PACS plus

This option expands the capabilities of the PACS to include some of the functionality currently situated within the RIS. Expanding PACS to include all reporting activities, that have historically been RIS-based, as is already the case in some boards, is already under consideration as part of proposed upgrades to PACS and there is scope to have even greater combined PACS-RIS functionality.

A 'PACS Plus' option would be advantageous if all orchestration and worklist activities occurring after image acquisition were to take place with the PACS. All activities prior to image acquisition would be coordinated within the RIS. This separation would ensure consistent PACS based orchestration and reporting activities across all health boards. Moving reporting and justification into PACS may reduce the requirement for a single national RIS.

Respondents were not very sure whether this option would be feasible, particularly with functions such as justification, but did consider it the least disruptive. One respondent warned against the risk to business continuity through an over-reliance on a single system.

> *You're putting all your eggs in one basket and for business continuity at the moment, if you have a separate RIS system and a separate PACS system, then if the PACS goes down, you still have your RIS and you can continue to carry out patient examinations. Your workflow would come to a halt potentially if you were to combine all that into one system. (Interviewee 5)*

4) Layering of RIS

The final option mentioned by respondents was to implement a second layer of RIS on top of the current architecture. This would be similar to the way the Soliton Share Plus system has been setup to implement a national reporting service, by serving as an intermediate layer connecting data from the RIS to images from the PACS. The proposed second layer of RIS would interface with individual local RIS in use by health boards and forward requests from the local RIS to the second layer. This would enable the availability of data and patient record information at a national level whilst maintaining the ability for health boards to continue operating using their local RIS.

This option avoids the need for replacing local instances of RIS as long as current systems can integrate with the second layer. If the option was available to maintain separate rules for data transfer based on site of origin, this would provide the ability for boards to exclude data specific to local workflows and maintain autonomy. With the second layer effectively functioning as a national RIS, boards would maintain the option of phasing out their local RIS with minimal disruption if it was deemed to not provide any incremental benefits.

A second layer of RIS which communicates with PACS, interfaces with local RIS's to obtain a synchronised data feed, and provides a reliable output for national data analytics whilst

allaying the main barriers would appear to offer a feasible route forward. However, adding another layer above existing regional RIS instances would add to the existing complexity of the landscape and present specific technical challenges. There is also a risk that it might not actually encourage boards to converge and standardise, and may not offer the full suite of benefits and added functionalities which could be realised from a replacement strategy.

Limitations and caveats of this assessment

Levels of satisfaction with current RIS noted in Table 1 reflect the views of the RIS/PACS managers we spoke to, and is not intended to be an exhaustive list of current views. Stated views may differ from those held by the clinical community who may have very different opinions and levels of satisfaction based on their user experience.

The five in-depth interviews conducted were all with individuals who either hold national-level roles or were involved with national planning initiatives for radiology services. As a result, the dominant voice in this assessment embodies a national perspective and should not be interpreted as being of sole relevance. Board-level perspectives might vary substantially from a national one, based on the local context.

The survey was administered to a convenience sample of radiologists and radiographers with a relatively low response rate. Hence, the survey results should not be interpreted as being wholly representative of the clinical user community.

Input from local health board directors, e-health/digital executives, and other RIS users such as administrative staff was not included in this exploratory assessment. A wider consultation seeking the input of all relevant stakeholders would be a worthwhile exercise as a next step.

The implementation options discussed in this assessment are not a comprehensive list of available strategies. The views and opinions of interviewees and survey respondents expressed in this assessment primarily reflect the assumption that a national RIS would entail the adoption of a single instance of RIS. It is plausible that the benefits of a functionally national RIS could be achieved without necessarily converging towards a single RIS. Alternate options such as a federated approach, involving multiple instances of the RIS working together as a single system, should also be considered as part of future discussions.

Conclusion

This assessment examined stakeholders views and perceptions around the proposal of a 'Once for Scotland' national RIS. The data analysed in this report, collected through interviews and surveys, suggests there is broad support for a national RIS within the radiology community across the majority of health boards and amongst clinical users. Support stems from a wish to minimise current inefficiencies attributed to the current RIS architecture and a desire to achieve more consistent and sustainable radiology service delivery, resulting in improved patient care.

The existing heterogeneity of RIS products combined with the lack of standardisation in implementation and processes was considered problematic from a national perspective and leads to sub-optimal ways of working. RIS managers at five health boards were satisfied with the performance of their current system; and managers from another five health boards were more critical about their RIS.

There were many perceived benefits associated with a national RIS around the themes of efficiency gains, greater standardisation, greater automation, seamless cross-boundary working and access to national-level data. Resulting incremental gains in RIS capabilities and functionality were viewed as not only enhancing the resilience and sustainability of radiology services but also contributing to improved patient safety and quality of care. The desire to change the way radiology workflows are delivered will require employing different tools. Our survey of clinical users found strong levels of support for several added features and functionalities which could be introduced by means of a national RIS.

The interviews also identified several barriers and constraints including the current absence of a mandate for a national RIS, the perceived loss of local control, potential for short-term disruption, potential lack of consensus and resource constraints.

Several routes to achieving a national RIS exist including choosing a single supplier/system for all boards, maximum standardisation within existing systems, 'PACS Plus' and adding a second layer of RIS. In light of the barriers to implementation, the most palatable option is likely to be one which preserves the autonomy of health boards, minimises short-term disruption and limits the technical complexity of migrating to a new system.

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Appendix 1: Survey of clinical users of RIS

Introduction

A survey of clinical users was conducted to explore demand for greater RIS functionality. The survey was anonymous with no designation or health board information recorded and 24 responses were received.

The survey explored the current context of how local RIS systems operate and whether there was support for the introduction of a national RIS. The survey then went on to explore functionality in the following specific areas: requesting, cross-site working, reporting and report communications.

The current context and support for a national RIS

The survey initially explored the context around introducing a national RIS in relation to the current move towards a greater national focus on cross-boundary ways of working and challenges experienced by local RIS systems. These challenges were identified as including issues with: interfacing; interoperability; non-aligned upgrade and refresh periods across health boards; non-standard data storage models by vendor; the inability to fully utilise the functionality of PACS such as display protocols, MDT coordination and report distribution.

Against this background respondents were asked whether they agreed that challenges identified were valid. Twenty-three respondents agreed that the issues identified were valid. A follow-up question specifically asked whether a nationally functional RIS would solve the issues identified. There was a general belief that a national RIS would be a positive move forward but this was qualified by a number of respondents:

Do you think that a nationally functional RIS would solve the issues noted in the problem statement? (n=23)

Yes	9
Yes potentially contingent on other factors	6
Partially/to some extent	6
No	2

Free text comments from respondents provided additional insight into respondents' reasoning. In terms of being contingent on other factors, issues such as integration with other systems, a need to retain local flexibility and attaining certain types of functionality were identified as requirements t to be met to ensure the benefits of a national RIS. Those who thought that a national RIS would only be a partial solution to current issues highlighted the challenges of integrating with other systems such as order comms and doubted whether this could be done effectively. Reasons given for a negative viewpoint related to a belief that a national RIS would not be able to effectively meet the bespoke requirements of individual boards taking into account historical and intended future working practices and doubts about integrating a national RIS with PACS.

Functionality

Respondents were asked to rate the usefulness of functionalities in requesting, reporting and report communication which could be potentially realised with the introduction of a national RIS. Rating was on a scale where 1 was not useful and 10 was very useful. Respondents were then given the opportunity (using free text) to identify additional or specific functionalities in these respective areas. These comments in some cases also provided additional information on the rated functionalities.

The results are presented by function area below.

i) Requesting

Respondents were asked to rate the usefulness of the following requesting functionalities which could be enacted with a national RIS. These are ranked in order by the highest rating of usefulness.

Requesting functionality	Average	Number
A requesting system that supports dialogue between clinicians and radiologists	8.88	24
The ability to vet and protocol incoming requests cross-border (for example, specialist examinations)	7.50	24
The provision of intelligent, contextual guidance and decision support material to clinicians at the point of requesting	7.21	24
The ability to intelligently auto justify incoming requests based on strict criteria	7.17	24
The ability to request examinations cross-border	7.04	24

Additional and specific requesting functionalities identified included:

- safety features such as alerts for patients across sites, for example for contrast reactions
- access to patient's radiological history and medical records
- the ability to see prior requests and results when submitting a request
- the ability to show all currently requested imaging examinations across Scotland and provide an alert if another request for the same imaging modality is currently active to prevent duplicate requests, and
- full order comms integration in both directions.

ii) Additional RIS functionality enabled by standardisation

A national RIS would promote national standard coding which in turn could enable further functionality. Respondents rated the usefulness of the following additional functionalities. These are ranked in order by the highest rating of usefulness.

Functionality	Average	Number
Ability to see the status of an examination on another site	8.08	24
Standardised ways of tagging cases (for example, for follow-up, peer review, interesting cases)	7.88	24
Clear identification of examinations for insourcing, out sourcing, urgent reporting or cross-site opinion	7.58	24
Ability to book examinations cross-site	6.17	24

Additional and specific functionalities identified that would be enabled by standardisation included:

- prioritisation
    - standardised prioritisation according to https://www.ncepod.org.uk/classification.html
    - include clinical prioritisation code, that is C1, C2 and C3 to facilitate booking and assessment of waiting times in three categories, and
    - the ability for the requester to set prioritisation levels for the request
- communication on status of requests
    - the ability of the system to communicate with clinician directly from the RIS during vetting process (for example, the vetting comment added when a request is put on hold or rejected should be transcribed into a standardised letter format and sent to referring clinician as an alert without radiologist coming out of the vetting page)
    - in addition to order comms seeing the dynamic status of a request, the system should also have the functionality of displaying it as a dashboard without but at the same time withholding the access to other functionalities of RIS (that is, view only function), this is useful to overcome the limitations of the order comms
    - communication or messaging portal - flagging of specialist exams and referral to specialists for vetting
    - the ability to reject or request further information for referral directly to clinician.

iii) Reporting

Radiologist reporting and PACs functionality remains variable across Scotland and a national RIS could 'unlock' some of this functionality. Respondents rated the usefulness of the following reporting functionalities. These are ranked in order by the highest rating of usefulness.

Reporting functionality	Average	Number
Seamless cross-site reporting nationally	8.29	24
Cross-site addending of reports (for example, following MDT or tertiary review)	8.25	24
Intelligent routing of examinations to the appropriate reporter based on modality, urgency and specialties	7.92	24
Nationally shareable Intelligent display (hanging) protocols	6.83	24
Nationally consistent report layouts and display	6.63	24

The free text comments submitted were a combination of aspirations for reporting in a national RIS and highlighting limitations in current reporting processes which could inform the development of this function in a national system.

- aspirations for the reporting function:
    - prior imaging on PACS to automatically appear when vetting referral
    - The linking of reports to be more robust. When multiple examinations are chosen to be reported in a linked fashion, the system should present the reporter with the clinical information from each linked radiology request and a copy of the final linked report should be sent back to each referrer robustly
    - standardised reporting pro formas (for example, cancer, trauma)

- current limitations of RIS systems:
    - SNRRS reporters have no access to the donor RIS, and
    - implement systems and integrations between systems that maintain report formatting between RIS and the myriad systems in which reports are accessed at the referrer level, for example use of underlines, bold, etc. to highlight findings of particular importance. Often paragraphing and line spacing are lost completely and random characters inserted when non-HL7 compliant characters are used, and this can make reports dangerously unreadable.

iv) Report communication

A national RIS would potentially remove barriers to a national solution for the functionalities to provide efficient report communication. Respondents rated the usefulness of the following report communication functionalities and these are ranked in order by the highest rating.

Report communication functionality	Average	Number
Ability to alert a clinician to a critical report and allow acknowledgement	8.90	24
A nationally consistent system that informs a requestor and/or team that a report is now available	8.45	24
The ability to track whether a report has been read or actioned	8.42	24

Specific report communication functionalities identified were:

- the ability to alert a clinician to a critical report and allow acknowledgement
    - there should be an "out of office" function for clinicians to divert urgent action reports to an appropriate backup responsible clinician in their absence. This should be set up so that the backup ticks a box to accept this responsibility, to allow it to function
    - critical results notification also should not be person-specific, but go to a designated shared address/mobile phone for example, to ensure no delay if a single person is absent from work
    - for clinicians who have erroneously been assigned the clinical responsibility for a patient on the RIS/TRAK, there should be a way for clinicians to correct that error by forwarding the report to the correct clinician, again with a tick box on the receiving end to show acceptance of responsibility by a second party. This

will allow the correct clinician to perform e-sign off of reports to say they are actioned

- alerting and messaging functions, and
    - availability of messaging or equivalent
    - possibly alerting a relevant MDT group (that is, unexpected renal cancer also flagged to urology MDT)

- status of reports
    - requesting teams should be easily able to electronically track the status of multiple radiology requests either through integration with order comms, or with a 'requestor access' to RIS, with limited functionality and visibility
    - integration with primary care systems so that GPs can be informed of availability of report
    - to be able to electronically communicate rejection comments to referrer as well as make them aware of patients who have not attended

Conclusion

The survey responses acknowledged the challenges surrounding current local RIS systems and indicated general support for the introduction of a national RIS but this was tempered by some concerns, principally over its ability to integrate with existing systems.

The survey gave an insight into potential functionalities that could be realised by a national RIS and respondents' ratings of these give an indication of clinical users' priorities. In this respect report communication functionalities as a group were rated most highly as being useful. This functionality would enable requestors to be informed that reports are available and give them the ability to track whether a report has been read or actioned and enable the system to alert a clinician to a critical report and allow acknowledgement.

Across other areas, functionalities which facilitated cross-site reporting were highest rated along with a requesting system that would support dialogue between clinicians and radiologists.