



# Nova Scotia Department of Health eResults Review

A technical review of the electronic medical records  
eResults system.

February 2008  
**FINAL**

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# Executive Summary

In the latter half of 2007, it was brought to the attention of the Nova Scotia Department of Health that a physician did not receive lab results. After some investigation internally, it was determined that an assessment by an independent third party would contribute to the restoration of confidence in the eResults service and acknowledge the concern of all parties for patient safety.

A project was launched whereby Deloitte would review four key areas of the eResults system and provide feedback and recommendations as appropriate. The four areas for review were:

- eResults Interface Logic
- Monitoring and Audit
- Architecture and Performance
- Interoperating Processes including Change Management and Quality Assurance

During the course of these investigations, some recurring messages and themes were discovered:

- Patient matching criteria are generally sound
- Data load procedures need to be augmented to include data quality controls
- HITS-NS needs to take ownership of their environment and partners/vendors interacting with the environment need to adhere to the HITS-NS change management, quality assurance, and monitoring standard requirements
- HITS-NS should function as the hub of communications between partners/vendors and should be responsible for the oversight of vendor/partner activities as issues are managed to close
- HITS-NS should ensure that proper system level testing (including performance) is completed (in addition to vendor application specific testing) prior to releases moving to production

In general, HITS-NS and its business partners did their very best to resolve the crisis that they were faced with at the time. Both HITS-NS and Nightingale Informatix Corporation are young organizations and although they might not have had a clear definition of what their contractual roles and responsibilities were during the crisis, through their experiences have learned to work with one another and are in a good position to be successful in the future.

# Background

The Nova Scotia Department of Health, working with District Health Authorities, is implementing the first province-wide Electronic Medical Record (EMR) system to improve the quality of care and access to treatment for Nova Scotians.

As part of government's commitment to innovation and technology, \$4 million was invested from the Primary Health Care Transition Fund to develop and implement electronic medical records. For generations, physicians and other health care providers have kept patient information in offices and health record departments using a paper filing system.

Now, with the new Primary Health Care Information Management (PHIM) program, clinic charts are being transitioned to computer instead of in a paper file. Electronic medical records are software tools that allow health care providers to easily look through their patients' medical history. This improves the quality and safety of patient care.

In consultation with stakeholders from across the province, Nightingale Informatix's *myNightingale* web-based electronic medical record was selected for clinics that have access to high-speed Internet services.

Primary Health Care Providers subscribe to the *myNightingale* EMR application which is provided using an ASP model by HITS-NS. The application is hosted in the provincial data centre. A master agreement exists between the Nova Scotia Department of Health and Nightingale Informatix. In August of 2006, the Department of Health, through the Primary Healthcare Information Management project, began the electronic delivery of laboratory results, and diagnostic imaging reports to primary care physicians using electronic medical records (EMR's). Laboratory results and Diagnostic Imaging (DI) results from the three provincial clinical systems (NSHIS, IWK, and CDHA) are sent to *myNightingale* using an integration engine (eGate).

## Current Situation

On September 13, 2007, it was brought to the attention of the Nova Scotia Department of Health that a physician did not receive lab results. An immediate investigation was launched and the software provider, Nightingale Informatix Corporation, was contacted. On Monday, September 17, Nightingale determined that under very specific circumstances, test results were not being delivered. Nightingale reviewed all test results initiated since 2007 (293,196) and determined how many patients were affected by this (i.e. those who did not receive test results).

Nightingale confirmed that if duplicate patient records were created, the system could not determine which patient record the test result should be sent to. As a result, these test results were not sent to the patient's record. Nightingale has developed and implemented the software fix. The investigation also revealed that a number of the results were not delivered due to time-outs in the system.

The problems described above existed in the code since August 2006 and were not detected until September 2007. The non-delivery of results to the Nightingale interface was not adequately reported by the existing monitoring tools. Similar non-delivery issues have occurred at other eResult interface points and were also not adequately reported with existing monitoring tools. There is also a concern that other results may have been delivered incorrectly and the existing monitoring tools have not been able to identify these issues.

The system has also been experiencing significant performance (slowness) issues that appear to be caused by the results interface (referred to as eResults). Performance seems to improve when the interface is turned off. Nightingale has made a number of recommendations over the past few months to correct the issue, some of which have been completed; others are in progress, with a few remaining to be completed.

The situation had raised concerns about the adequacy of the existing processes. It was determined that an assessment by an independent third party would contribute to the restoration of confidence in the eResults service and acknowledge the concern of all parties for patient safety.

# Objectives

The objectives of the eResults Review Project were to:

1. Conduct an assessment of the logic being used in the eResults Laboratory and Diagnostic Imaging (DI) results interfaces, from the eGate engine to the Nightingale application, and the Dymaxion (Practimax) application including but not limited to the following:
  - a. Is the logic and code of the matching criteria robust?
  - b. Are the matching criteria consistent with other Nightingale jurisdictions?
  - c. Are there recommendations for changes to increase the robustness of the matching processes?
  - d. What are the causes of duplicate patient records and how can this situation be avoided in the future?
2. Conduct an assessment of current monitoring and audit tools for the eResults program and make recommendations to close identified gaps, including but not limited by the following:
  - a. Focus upon streamlined, efficient processes that facilitate easy tracking of delivery status on all results at all interface points
  - b. Complete audit trail of result delivery processes
  - c. Training and operation manuals describing the functionality of the monitoring tools
  - d. Business continuity plans, and appropriate notification procedures in the event of a failure to deliver at any of the interface points
  - e. Vendor monitoring requirements
  - f. Initiate a process for vendors to provide their business continuity plans, and appropriate notification procedures in the event of a failure to deliver results at interface points
3. Complete a review of the architecture from a system performance perspective including but not limited by the following:
  - a. Provide an opinion on the Nightingale plan to move the eResults process to a separate server. Evaluate Nightingale's proposal, ensuring a solution that is scalable for full adoption of all of Nova Scotia's 2,400 providers receiving lab results, diagnostic imaging reports, consult notes and discharge summaries
  - b. Make recommendations for improvements and provide rationale
4. The eResults system is a complex system of interoperating applications and data (results) sharing. Additionally, Nova Scotia's clinical professionals, responsible for accuracy in the electronic delivery of imaging and laboratory results, require the validation of diagnostic reports in transit from the source systems to the care provider's desktop. The review is to include:
  - a. A review of the change management processes that considers both original implementations and ongoing enhancements and maintenance to interoperating components, and recommending process frameworks for the validation and sign-off of both original implementations and ongoing changes
  - b. A quality assurance review that provides a QA process framework and recommendations regarding validation of the results delivery as required by the various source clinical systems e.g. CDHA Laboratory systems; IWK Diagnostic Imaging Systems

# Approach

The engagement approach consisted of information gathering and stakeholder interviews around four distinct workstreams that represent the specific objectives of the engagement. The workstreams broke down as follows:

- **Workstream 1:** An assessment of the logic being used in the eResults Laboratory and DI results interfaces, from the eGate engine to the Nightingale application, and the Dymaxion Practimax application
- **Workstream 2:** An assessment of current monitoring and audit tools for the eResults program
- **Workstream 3:** A review of the architecture from a system performance perspective
- **Workstream 4:** An inter-operating process analysis, focusing on two key business needs – both of which resulted in Deloitte providing recommendations and process frameworks from which the Department of Health could move forward. The two areas of focus were:
  - a) Change management processes for both the original implementations and ongoing enhancements and maintenance to inter-operating components
  - b) Quality assurance processes around the validation of results delivery as required by the source clinical systems

# Findings

## Workstream 1 – eResults Interface Logic

A summary of our findings for Workstream 1 is contained in the figure below:

### WorkStream 1: eResults Interface Logic

**The purpose of Workstream 1 was to investigate the eResults logic and confirm that the possibility of creating duplicate records in the system is minimized and that the patient matching criteria are robust**

Observations	Actions (Ongoing and Planned)
<ul style="list-style-type: none"><li>Filter is first by provider (License # and clinic location code) and then by patient (either HCN &amp; DOB or DOB &amp; Military or RCMP #)</li><li>If neither criteria is met then the record is considered unmatched</li><li>NIC software also had a secondary match criteria of last name, first, DOB, and sex which is problematic in the Nova Scotia environment as there could be multiple patients with the same name and birth date</li><li>Problem was not caught prior by either NIC or HITS-NS testers, but was identified while investigating undelivered results issue</li><li>Issue is small in magnitude because match would have to be exact and within the same clinic</li><li>Edit checks do not allow duplicate patients to be created within the system</li><li>Duplicates were created during the manual upload process due to duplicates existing in original data or through making records inactive after a load</li><li>Dymaxion Practimax application has not experienced any similar issues</li></ul>	<ul style="list-style-type: none"><li>A defect was identified in the secondary matching criteria and has been corrected</li><li>Patient matching criteria has been confirmed to be theoretically sound after secondary criteria is removed</li><li>A defect was identified in how the software was handling inactive records and has been corrected</li><li>NIC is in the process of improving their data load due diligence by making their data cleansing and upload procedures more robust and intelligent</li></ul>

### Summary Conclusions:

- Secondary patient matching criteria to be removed for next release – beyond that, patient matching criteria is sound
- Adding province as a criteria should be considered for robustness
- The way invalid patients are handled in the system is to be corrected for next release, nullifying the opportunity for this problem to reoccur
- Better data controls should be put in place by vendors during data loads into production to ensure that data quality is adequate and that no new problems (i.e. duplicate records) are introduced into the environment – due diligence on the vendors part

### Key Findings:

During the course of Deloitte's investigation into the eResults Interface logic, a number of key facts were uncovered:

- A number of eResults were not delivered. During the investigation into this issue, a number of questions arose around the matching algorithms and the potential for eResults not to be delivered properly.
- The root cause for the eResults to not be delivered was traced to duplicate patients existing in the provider's database – when a provider office was setup, if the initial data load had been unsuccessful, records would be marked as inactive, and then the load was repeated. When an eResult was received and more than one record existed for a patient (inactive or not) the system could not unambiguously link the result to a patient and thus the result was not delivered. The software defect of not checking active versus inactive records was identified and corrected by Nightingale. This issue will not reoccur.
- During the duplicate patient investigation, another software error was found in the patient matching criteria, whereby it was identified that it was theoretically possible for an eResult matching error to occur due to the application of a secondary matching criterion that did not factor in a Health Card or other unique identifier.

- a. The secondary matching criteria were in the specifications for the purposes of recommending a match to providers in order to assist with the manual matching process. This secondary match was based on name (last and first), date of birth, and sex
  - b. The specifications for patient matching were shared between all eResults vendors in the environment. Primary matching is done based on Health Card Number (or military/RCMP number) and Date of Birth. If these criteria are not met, then the results are unmatched. Practimax has not experienced the problem
  - c. Nightingale Informatix Corporation has corrected the issue by removing the secondary matching criteria completely, eliminating the possibility of reoccurrence of the problem
4. Once the matching issues had been corrected, it was found that the patient matching criteria are generally robust. In order to completely avoid any opportunity of an incorrect matching, the specifications need to be updated to include the province in which the patient holds the health card on the slim chance that two patients under the same healthcare provider with the same name share a birth date as well as a health card number from different provinces. The opportunity for such an error to occur is extremely small

### Answers to Key Questions:

#### **Is the logic and code of the matching criteria robust and consistent with other jurisdictions? What can be enhanced to increase the robustness of the matching process?**

In both the Practimax/LCS and NIC applications, matching is done first by provider and clinic and second by patient - provider matching is accomplished by matching the licence number with clinic ID, patient matching is done by Health Card Number & Date of Birth or Date of Birth & Military number or RCMP number. A bug in the NIC application was found in the existence of secondary matching criteria that did not match patients by a unique identifier, only by the last name, first name, date of birth and sex. This secondary matching algorithm was identified by NIC during the eResults investigation and has since been corrected. The NIC bug was high impact and low probability meaning that had there been identified cases they would have been severe (results would have been incorrectly matched to patients), but the likelihood of experiencing the problem is very low. Two patients would have to exist in the same clinic under the same provider with the same name (first and last), the same date of birth and the same sex to be incorrectly matched.

Deloitte reviewed the original specifications and found that the secondary criteria were intended only to provide a suggested match to try and assist providers with manually matching any unmatched results. A defect was identified where the secondary matching criteria were not offering a suggested match but trying to match the eResults directly. This issue has since been corrected. To eliminate the risk of reoccurrence, NIC has removed the secondary matching criteria altogether. Providers will now have to handle unmatched eResults manually. The patient matching criteria have been confirmed to be theoretically sound now that the secondary criteria have been removed. However, it is recommended that "Province" is added as part of the primary criteria (health card) match due to the duplication of numerical formats between Nova Scotia and other provinces (e.g. Saskatchewan). The probability of a duplicate match between two provinces is extremely low, however it remains within the realm of possibility and should be considered over the long term in the interest of patient matching robustness. Patient matching scenarios should be built into standard test cases to confirm on an ongoing basis with new releases that similar problems do not reoccur.

#### **What are the causes for duplicate patient records and how can this situation be avoided in the future? Are there any other causes for eResults not to be delivered?**

The existence of duplicate records within the NIC system was found to be the cause of the undelivered eResults. Deloitte confirmed that edit checks do not allow duplicate patients to be created within the system when practitioners are entering new patients. It has been determined that the duplicate records were created during the manual patient data upload process for one of two reasons:

1. Duplicates existing in original data provided by the clinic for upload into the system
2. Upon the rejection of a loaded set of records by a clinic, making records inactive after a load – NIC identified a defect in their software that did not exclude inactive records

Ambiguity between duplicate records caused the NIC application to not deliver the eResults (two records with identical matching criteria). It was also determined that timeouts caused some eResults messages to not be delivered (this will be discussed in greater detail in Workstream 3). It should be noted that Practimax eResults clinics have also experienced some delivery issues while using SecuRemote software, but that issue is unrelated to either a timeout or the existence of duplicate patients within the system.

Upon discovery of the issues, HITS-NS escalated them to NIC where the lead developer of eResults took charge of the investigation. NIC worked hard to quickly assess and correct the problem; in the process, the undetected secondary matching criteria error was also discovered and subsequently corrected. The root cause of the undelivered results was identified as being in the NIC software not excluding records marked as inactive during the original data load. This has since been corrected in their software.

NIC is currently working to improve their data load due diligence by making their data cleanse and upload procedures more robust and intelligent. In order to be effective, they will need to check and cleanse data before they load it into the NIC system in order to prevent duplicate records from being loaded in the future.

HITS-NS should build the identified root causes for eResults not being delivered into standard test cases to confirm similar problems do not reoccur. Data cleansing and loading processes needs to be enhanced by NIC to incorporate some more formal controls in order to:

- Confirm data quality and cleansing from source (clinics and offices)
- Confirm that there are no duplicate health card numbers in the source data
- Minimize the need to de-activate records to inactive status, although the NIC software will handle this situation gracefully going forward

Finally, PHC clients also need to be better educated around the implications of improper data going into the eResults system. Although duplicate records cannot be created by a physician within the NIC system, it is possible to provide out-of-date or inaccurate data for load. A better understanding of the implications of “bad” data could have potentially lessened the impact of this issue.

### **Summary and Next Steps for Workstream 1:**

The root causes for undelivered eResults have been identified (duplicate patient records and timeouts) and steps have been taken to correct these issues. NIC has provided software updates and many of the issues have already been tested and confirmed. Deloitte has determined that the matching criteria for eResults are sound, but, to be completely unambiguous, Province should be added to the matching criteria.

In addition, Deloitte recommends that the data cleansing and load processes need to be enhanced by NIC and any other vendor entering the environment to incorporate more formal controls which will confirm data quality and cleansing from their source (clinics and offices), confirm that there are no duplicate HCN's in the source data, and minimize the need to mark records as “inactive” which was one of the original root causes (although the “inactive” issue has since been corrected by NIC).

## Workstream 2 – Monitoring and Audit

A summary of our findings for Workstream 2 is contained in the figure below:

### WorkStream 2: Monitoring and Audit

**The purpose of Workstream 2 was to understand current monitoring practices and determine whether or not they are adequate. Where gaps are identified, an improvement approach based on best practices is to be provided.**

Observations	Actions (Ongoing and Planned)
<ul style="list-style-type: none"> <li>▪ HITS-NS does not have a global monitoring strategy or the ability to actively monitor transactions through the complete eResults system and relies heavily on vendors and partners (eGate monitoring or users on the system) to inform when there are outages</li> <li>▪ NIC has provided an Interface viewer that is integrated with OS tools – these logs can be monitored by a third party tool that is part of a more systemic monitoring solution</li> <li>▪ A new tool has been created by NIC to facilitate NS eResult monitoring that retrieves daily report data and informs of any messages not processed               <ul style="list-style-type: none"> <li>▪ The original HL7 message can be re-processed on the spot – if it fails again then users can investigate the HL7 or escalate, none that could be processed the second time to date</li> </ul> </li> <li>▪ Other distinct systems have monitoring solutions in place but no escalation process within HITS-NS (eGate)</li> <li>▪ No SLA's exist with vendors or partners</li> </ul>	<ul style="list-style-type: none"> <li>▪ NIC is building a GUI based tool to assist with the unprocessed message reconciliation and re-processing</li> <li>▪ HITS-NS have been discussing the purchase of 3<sup>rd</sup> party tools to assist with monitoring their environment (HP Openview)</li> </ul>

#### Summary Conclusions:

- HITS-NS needs to take ownership of their environment and rely less on vendor support for monitoring
- HITS-NS needs to implement the ability to monitor all of the interfaces systemically and determine when a transaction has failed
- An integrated approach to reporting and escalating alerts needs to be put in place by HITS-NS that incorporates all partners (CDHA, IWK, NSHIS, eGate, NIC, Dymaxion, Concertia) and clearly defines the process by which all systems are notified of an outage and the specific actions that can be taken to rectify the situation once an alert has been raised
- Once an integrated monitoring solution is in place, dummy transactions can be forced through the system from various point at intervals to confirm system health

### Key Findings:

During Deloitte's investigation into the monitoring of the system, a number of key facts were uncovered:

1. HITS-NS can more proactively own the monitoring and operations of their environment. HITS-NS is currently managing the operations of the eResults system in a reactive-mode. If parts of the system go down, HITS-NS relies on users to report the issue, and on their vendors and partners for application/interface monitoring to maintain their environment. To this point in time, HITS-NS has not implemented a global monitoring strategy that incorporates tools, technologies, and procedures to assist them in properly monitoring their entire environment systemically and identifying when and where a transaction has failed. It should be the vendor's contractual responsibility in the environment to provide HITS-NS with the locations and specific text strings to be monitored as well as situational information on the error (i.e. what does the error message mean, who needs to correct and how, does it require escalation to the vendor, are transactions at risk of being lost, etc.)
2. Currently, there are no standardized notification and action procedures for when parts of the system are not performing as they should. Informal notifications using e-mail are sent out once a problem has been identified by a user or system partner. In some cases, it was also found that no escalation procedures had been created for issues identified with some system partners (i.e. eGate). This means that even if an issue were identified by the outside system partner, there is no information available on whom to contact or how to correct it.
3. There is currently no way for HITS-NS to push dummy transactions through the production system in an automated way. By monitoring these standard interval automated tests throughout the day, these automated tests would provide HITS-NS with a means of ensuring

that the system was functioning properly end-to-end and in the case that it was not, a clear picture of where the transaction was failing would be available, allowing them to focus their resources in the right place.

4. There are currently no SLAs in place between HITS-NS and their partners and vendors. This means it is difficult for HITS-NS to push their vendors for fixes and support for their software. Having SLAs as part of their standard engagement contracts will allow HITS-NS to set standard expectations for reaction timelines and performance levels with their vendors and partners so that they have some control over how issues are handled by external stakeholders. Additionally, the SLAs should have well defined penalties in place for non-compliance.
5. Since the eResults issues came to light, NIC has stepped up their involvement with the monitoring of their interface. They have had resources manually monitoring the interfaces nightly and manually push through any transactions that have failed (most of those have been attributed to time-out problems and all of them have been successfully pushed through during the manual attempt (more on the time-outs in Workstream 3).
6. NIC has also been working on a tool that can be used by HITS-NS to self-monitor the eResults interface. This tool is simply a graphical version of the tool that they use to manually push failed transactions through the system. NIC will make this tool available to HITS-NS once it is complete.

#### Answers to key Questions:

#### **Are the current monitoring and audit tools streamlined? Are there adequate controls/alerts in place to track all transactions? How can gaps be addressed?**

There is no HITS-NS integrated strategy for the monitoring of eResults or the overall architecture in place. Currently there is no method of tracking transactions end to end through the eResults system. Interfaces between Lab/DI systems and eGate are monitored by the CDHA eGate team using internally developed tools, but there are no notification procedures in place to inform HITS-NS of a problem. HITS-NS is in the process of investigating third party tools to assist with their monitoring efforts.

The internal tools developed by the eGate team are capable of monitoring specific interface processes to the LCS repository and the NIC application, but none have been setup. When issues are reported, eGate, being the centre of the transaction path, usually gets the first call as they are the only ones capable of confirming that interfaces are up and available. This check is passive in nature and is only done upon request.

Since the eResults issue, NIC has been monitoring the failed transactions nightly, pushing through any that did not work on the first attempt. NIC originally trained one resource within HITS-NS to monitor the NIC application, but that resource has since left HITS-NS as has the knowledge of how to properly monitor the NIC system. NIC is working to refine their existing monitoring tool to be simpler to use and to allow HITS-NS to monitor and attempt to reprocess undelivered eResults.

HITS-NS needs to develop and own an overall, integrated monitoring strategy for their environment. The integrated monitoring strategy should be the framework under which all applications in the system are monitored in a streamlined fashion. Vendors should provide specific locations of logs (ideally integrated with OS level alerts as are the NIC and eGate logs) and specific messages to be monitored for with descriptions of the specific threshold or exception. HITS-NS could then own this process and will be able to manage the alert/issue until close with their partners (i.e. the HITS-NS alert could generate tickets with one or many of their partners and the HITS-NS alert ticket becomes the central management point for the overall issue). SLAs should be negotiated into all vendor contracts and should clearly define the vendors' responsibilities once a ticket for them has been generated.

#### **Are business continuity plans in place in case of failure? Are there appropriate notification procedures in place in the event of a failure to deliver at any of the interface points?**

Currently there is no formalized notification procedure in place in the instance an issue is discovered. Issues are identified primarily by the users of the system and reported to the HITS-NS helpdesk.

Once HITS-NS is notified of an issue they generate a ticket and recruit third-party help to try to identify and correct the issue.

The first point of contact is usually the eGate team as they are central to the system and currently have the most advanced internal monitoring tools. That being said, CDHA/eGate is not actively monitoring the eResults interfaces, but can passively respond to queries.

The NIC application can generate exception alerts within their system, but HITS-NS does not have any staff trained to use their tools. It should also be noted that Dymaxion does not actively monitor the LCS repository, but does provide a summary screen to confirm the provider's last poll for results. This screen is essentially an indicator that there might be a problem, but there is a reliance on the providers to monitor it for an indication.

The current monitoring situation is very disjointed. Although some applications and organizations in the environment may have rudimentary abilities to monitor their own applications, there are no communications plans in place to notify other partners in the system that there is a problem, and in some cases, potential monitoring solutions that are ready for implementation have not been set up.

In order to bolster the monitoring abilities, a system wide, integrated monitoring strategy needs to be in place, and a central organization (ideally HITS-NS) should be the controller of that strategy. In that capacity, HITS-NS should be one of the first to find out about any issues across the system and they should be responsible for the communication between stakeholders as well as engaging the partners within the system to act on the exception. Vendors and application owners in the system need to provide the locations of error (log) files and specific strings to search for. Also to be provided would be a definition of the issue, a proposed action plan, and any known impact that the error might cause or have caused (i.e. lost transactions, increase in system load due to bottleneck, etc.). Specific questions that should be answered with any exception include:

- What is the severity of the issue (critical, urgent, important, warning, notification)?
- Who needs to be notified? What up or downstream applications need to be notified of the issue and what is the specific impact on them?
- Who needs to take action and what is the specific action to be taken?
- What is the management escalation procedure around the issue?

Once HITS-NS owns this process, they need to manage their vendors and partners within the environment to ensure that issues are managed in a timely fashion and at a level of quality that will try to ensure that the issue will not re-occur. Generating and maintaining SLAs with vendors and partners within the environment will assist with clarifying the roles and responsibilities of each partner and it is recommended that these SLAs be added to contracts as they are updated/renewed.

Additionally, no disaster recovery (business continuity) plans have been put into place for the PHIM applications, although the data replication has been set up in some cases. Once solid change management, quality assurance, and monitoring processes are in place, HITS-NS should look at disaster recovery planning as a logical next step.

### **What are the vendor/partner monitoring requirements and what are their responsibilities in the case of delivery failure?**

Currently, HITS-NS relies heavily on vendors, partners, and providers to provide them with the majority of their application monitoring. There are currently no SLAs or agreements between HITS-NS and vendors which specifically outline roles, responsibilities, and expectations of either the vendors or HITS-NS. Because of this, there are no penalties in the contracts HITS-NS has with their vendors to enable them to enforce/expedite issue resolution.

The roles and responsibilities between partners/vendors and HITS-NS need to be formalized as well as performance thresholds and escalation procedures through the use of SLAs in their contracts. HITS-NS should own the operation and monitoring of all applications that exist within their environment, including NIC, Concertia, CDHA/eGate, and the lab interfaces as they already own the user access model (who has access, when access can be granted, and why access is granted).

Vendors/partners should be responsible for providing monitoring specifications for their applications that outline locations of log files and specific log entries to search for that indicate application performance thresholds being exceeded, errors, exceptions, and warnings. For each of these,

complete descriptions of how to react to the alerts should be provided (i.e. Can HITS-NS operators correct the problem with a reboot? Does the issue need to be escalated to the vendor?).

Once HITS-NS has their integrated monitoring strategy in place, their monitoring tools should actively monitor according to vendor-supplied specifications. In addition, the monitoring tools can work in conjunction with dummy transactions being pushed through the system end-to-end that will give production control team operators a clear view into the system – where it is functioning as required and where there may be an issue. Once the strategy and tools are in place, vendors should be expected to comply with the monitoring standard provided by HITS-NS if they want to participate in the environment.

Additionally, with the strategy and tools in place and the vendors complying with the HITS-NS monitoring requirements, HITS-NS will be well positioned to provide the first line of support to users in trying to assess and correct systemic problems.

### **Summary and Next Steps for Workstream 2:**

It is recommended that HITS-NS take additional control over their environment and rely less on their vendors for monitoring. As the owner of the overall environment, HITS-NS should be monitoring all applications that exist within it that are fundamental to their day-to-day operations including NIC, Concertia, CDHA/eGate, and the lab interfaces.

To facilitate this increase in ownership, HITS-NS must develop an overall monitoring strategy which includes specific requirements that each vendor coming into the environment will need to satisfy. This includes the provision to HITS-NS of vendor log file locations and specific text strings to monitor for in the file for each of their applications allowing the overarching monitoring software to identify any exceptions and maintain an overall perspective on system status.

Another key piece of the monitoring strategy is the integrated application of procedures for escalating alerts incorporating all partners in the environment (CDHA, IWK, NShIS, eGate, NIC, Dymaxion, Concertia, and eventually others). These procedures should include how each system notifies production control that there is an issue, identify who needs to be made aware of the issue, who needs to act on the issue, and outline the specific actions that are to be taken to rectify the situation once the alert has been raised. Specific questions which must be answered by this process include:

- What is the severity of the issue (critical, urgent, important, warning, notification)?
- Who needs to be notified?
- What upstream or downstream applications need to be notified of the issue and what is the specific impact on them?
- Who needs to take action and what specific action needs to be taken?
- What is the management escalation procedure around the issue?

Within contracts with vendors, SLAs should be developed to clarify the roles and responsibilities of each partner. These SLAs should outline minimum service levels for each vendor's application and HITS-NS' expectations of the vendor in the event of a problem in the eResults environment.

Once HITS-NS has an integrated monitoring solution in place, dummy transactions can be pushed through the system to ensure everything is in working order on a regular basis. This will allow HITS-NS to be more proactive in their application monitoring and issue identification and alleviate the current situation where clients are required to notify HITS-NS of an environmental issue.

## Workstream 3 – Architecture/Performance

A summary of our findings for Workstream 3 is contained in the figure below:

### WorkStream 3: Architecture/Performance

The purpose of Workstream 3 was understand the initiatives in place and proposed to better the overall performance of the eResults interface and to determine if the approaches proposed are adequate and complete

Observations	Actions (Ongoing and Planned)
<ul style="list-style-type: none"> <li>▪ Once eResults was brought online, a slow degradation in performance was noticed</li> <li>▪ NIC took an active role at no expense to HITS-NS to investigate the performance issues and numerous strategies were tried with minimal gains</li> <li>▪ NIC brought in 2 specialized contractors to assess the problem and these contractors made 9 suggestions to improve overall system performance including the hardware upgrade undertaken recently by HITS-NS which has had immediate and significant impact</li> <li>▪ NS DoH implementation of eResults is different than the standard NIC implementation and the customized interface has been determined to be the root of some of the problems</li> <li>▪ NIC submitted a proposal for HITS-NS to undertake 2 initiatives to try and further improve performance (move eResults to another server and move away from the custom eResults interface and back to the standard)</li> <li>▪ eGate engine is owned by CDHA and is not controlled by HITS-NS</li> </ul>	<ul style="list-style-type: none"> <li>▪ HITS-NS performed an upgrade recently that has had significant positive impact on performance</li> <li>▪ NIC is actively implementing the suggestions of the 2 specialists and the majority of the fixes are complete</li> <li>▪ NIC has brought one of the specialists onto their full time staff for the purpose of having someone dedicated to ongoing performance improvement of their application</li> <li>▪ NIC has modified their methodology to include load and performance testing as part of their regular processes</li> <li>▪ NIC submitted a proposal to HITS-NS to take on 2 initiatives in the interest of enhancing application performance</li> <li>▪ Real time interface has been scaled back to handle a set number of results in a set timeframe in order to regulate load on the system</li> </ul>

#### Summary Conclusions:

- NIC implemented performance upgrades will positively impact the overall performance of the NIC application and the implementation of load and performance testing as part of their standard procedures will help to avoid similar issues in future
- Optimized eResults timing thresholds need to be established – Batch is more efficient - What is the business need for real time results? NS DoH & HITS-NS business requirements need to be clarified prior to agreeing to NIC proposal to move towards batching the eResults
- Proposal to move eResults to a separate server is valid and in-line with industry standards for high load, lower priority computing solutions
- Opportunity for HITS-NS to take a more active role in performance enhancement through ownership of their environment from Workstream 2 – If HITS-NS owns the environment and the relationships with partners (OS licenses etc.), then they can arrange with partners (i.e. Microsoft or SUN) to use their performance lab facilities to performance test
- As the environment gains complexity (registries, HIAL, etc.) HITS-NS will want to investigate having their own integration layer instead of a shared eGate

#### Key Findings:

During the course of Deloitte's investigation into the Architecture and Performance of the system, a number of key facts were uncovered:

1. The issue centred on timeouts causing eResults to not be delivered during one of three available tries. After three failed attempts, the transaction would not be delivered to providers. NIC has a tool whereby they can search for these undelivered results and push the eResult through during a non peak time (none have failed to date on the manual attempt). NIC are also actively working on simplifying that tool so that they can make it available to HITS-NS.
2. Once eResults was brought online, a slow degradation in performance was noticed. The cause for the performance issue was traced to the custom eResults interface built by NIC specifically for the Nova Scotia PHIM product.
3. NIC took an active role at no expense to HITS-NS to investigate the performance issues and numerous strategies were tried initially with minimal gains. NIC then brought in two specialized contractors who made a series of suggestions to improve overall system performance. The majority of suggestions that the two specialists made to NIC have been completed. These included:
  - Upgrading the database server to a stable build
  - Removing database hints
  - Adding new indexes and converting compound indexes to singular indexes
  - Reducing the number of resource intensive procedure calls and isolation levels

- Upgrading to SQL Server 2005
  - Optimizing worst performing stored procedures and identified table locks
  - Upgrading the hardware
4. NIC has updated their standard development methodology to include performance testing as part of their standard release procedure. Before QA releases the code to UAT, performance testing will be completed.
  5. HITS-NS does not currently have any tools or processes in place to facilitate automated or load testing in their staging environment. Further to that, the staging and production environments are not fully synchronized, so any load results would be suspect. To try and work around this, HITS-NS has slowed the roll out rate to providers and will bring new users on slowly. (More details around the lack of automated tools and de-synchronized environments are discussed in Workstream 4).
  6. The HITS-NS implementation of eResults is different from the standard NIC ASP implementation (real-time vs. batch) and the customized interface has been determined to be the root of some problems. Understanding this, NIC submitted a proposal for HITS-NS outlining two potential changes that they felt would improve overall eResults performance. Firstly, moving eResults to a separate server, and secondly, moving away from the current custom interface to their standard batch eResults Interface.
  7. The eGate engine which HITS-NS is using is owned by CDHA and is not controlled by HITS-NS.

### Answers to Key Questions:

#### Is the Nightingale plan to move eResults to a separate server sound?

The HITS-NS eResults interface is a custom built real time interface designed specifically for their environment and is not in use in any of the other NIC environments which use a more batch oriented delivery model.

NIC and HITS-NS have noticed a steady decline in performance of the NIC application which they were able to trace back to the eResults interface and a number of associated locked tables. Once the eResults interface was turned off, performance went back to almost normal.

Currently the eResults interface and the client facing application are implemented on a single server and sharing resources. When eResults performs a resource intensive action, client access to the application can be impacted in some cases causing slow response times, and in more critical cases can cause the application to become unresponsive.

To remedy this situation, NIC produced a proposal for HITS-NS that entailed moving the eResults interface to a separate server and to consider changing the method of results delivery to comply more with NIC's standard batch model. Best practices for resource intensive activities such as business intelligence (BI) or resource intensive report generation activities is to put them on a server that is not client facing and thus minimizing the performance impact to users of the client facing application.

Our recommendations for the two proposals are as follows:

- 1) **Move eResults to a separate server** - It is our recommendation that HITS-NS considers moving eResults to a separate server because it is in line with industry best practices for resource intensive back office activities.
- 2) **Move the NS implementation of eResults interface to the standard NIC batch model** – Although sound in principal, this option would be difficult as the NS implementation of myNightingale does not include an online physician order entry module. Because of this, there is no way for the system to understand when all of the results for a battery of tests have been completed and are available. That being said, understanding the impact of the requirement to have real-time results delivered, the NS DoH and the PHC Division are now in a position to review this requirement with its users and determine how quickly eResults really need to be delivered, considering that urgent results are still called into the providers from the labs manually. Once the requirement has been clarified, HITS-NS/NSDoH and NIC need to determine a strategy to steady the flow of eResults to the providers in a way that adheres to the requirement but takes system performance and end state load into consideration as well (Practimax/LCS pull model should be considered).

## **Does Nightingale have the ability to scale for full adoption by all NS providers?**

Currently all laboratory and DI results are pushed electronically from the clinical systems through the Meditrain and Cerner interfaces to eGate where they are filtered for providers that accept eResults. Practimax/LCS have experienced no performance issues based on load to date, but deal with a smaller overall user base than NIC. NIC has acknowledged that the eResults custom interface has experienced performance problems and they have endeavored to make it and their overall application perform better.

To help them to achieve this, NIC brought in a Database Administrator (DBA) and a performance expert from Microsoft to analyze their software and make recommendations on how to improve its performance. These two specialists made a series of recommendations to improve the performance of myNightingale, specifically in the Nova Scotia environment, including the hardware upgrade recently undertaken by HITS-NS which has had a significant and immediate impact. NIC has also retained the Microsoft performance specialist as a full-time member of their staff and have dedicated that resource to the ongoing performance of their software. NIC has also adopted automated testing and load testing tools and is making performance testing a standard part of their release process. To date, NIC has not done any load testing that is representative of the total load expected to pass through the eResults interface.

All told, NIC is taking the correct measures to try and ensure that their application performs under load and has shown that they are comfortable being accountable for the overall performance of their application in the future. There is also an opportunity for HITS-NS and NIC to work together to test under stress conditions, the total transactions over the course of a busy day as well as the total transactions during a peak hour over time to ensure the ongoing performance stability of the application.

## **Are there any recommendations for further architectural improvement?**

At this time, HITS-NS does not have any internal capacity to do any automated testing, or load testing, or to push dummy transactions end-to-end through the pieces of their environment or through the entire transaction path. Without these abilities, it is difficult to determine what impact adding additional components or user load will have on the system. To compensate, HITS-NS has scaled back the rate at which eResults is being rolled out to providers to more adequately understand the impact of additional users on their system resources, which is a good approach in the short term, but does not address their long term need.

Further complicating the current situation is the fact that HITS-NS relies very heavily on their vendors to manage their own applications as well as any relationships with their infrastructure and operating system vendors, and the fact that HITS-NS does not currently own the eGate integration platform which functions as the centre of their architecture.

In response to these issues, HITS-NS has started to make performance and application monitoring a priority and have asked their vendors to do the same. Also, HITS-NS and the Department of Health have verbalized their intent to purchase an eGate interface engine that will be used solely for ongoing eHealth initiatives (Registries, HIAL, etc.) that will be internal to and completely controlled by HITS-NS.

NSDoH and HITS-NS should continue with and formalize their intent to implement their own eGate engine as well as introduce automated and load testing tools in order to be able to test the end-to-end transaction path under load conditions (including the NIC application). HITS-NS needs to also ensure that the staging environment and production environment mimic each other sufficiently that test results in staging can be used as a benchmark and true indicator of how the system will run under load in the production environment. Finally, there is an opportunity for HITS-NS to be involved in performance enhancement – If HITS-NS owns the environment and the relationships with partners (OS licenses etc.), then they can arrange with partners (i.e. Microsoft or SUN) to use their performance lab facilities to performance test.

## **Summary and Next Steps for Workstream 3:**

NIC has implemented numerous performance upgrades to their software since the identification of the performance issues which will positively impact the overall performance of their application. They have also incorporated load and performance testing into their standard methodology which will help to avoid experiencing similar performance issues in the future. Deloitte recommends that HITS-NS and NIC work together to test under stress conditions – total transactions over the course of a busy day, transactions during a peak hour over time – to ensure ongoing performance and stability of the application in the HITS-NS environment.

During the course of identifying these performance upgrades to their own system, NIC provided a proposal that recommended that the eResults interface be moved to a separate server. This proposal is sound and is in-line with industry best practice for high-load, lower priority computing solutions.

The second part of the NIC proposal recommended that HITS-NS and the NS DoH move towards a more batch oriented delivery model for eResults. Understanding the impacts of the requirement to deliver eResults in real time, the NS DoH/PHC and the PHC providers can potentially negotiate a compromise that will allow results to be delivered in a timely fashion, but not as to stress the system any more than necessary. Once the requirement has been clarified/amended, HITS-NS and NIC can determine a strategy to steady the flow of eResults to the providers in a way that adheres to the requirement, but takes system performance and end state load into consideration. As well, this change will help move the Nova Scotia implementation of the NIC application closer to the NIC standard ASP offering which employs a more batch oriented model of delivery. Any move away from a customized interface towards a more standard NIC approach will reduce risk of future problems.

There is also an opportunity for HITS-NS to further their role in performance enhancement through increased ownership of their environment as discussed in workstream 2. HITS-NS needs to consider adding automated load and performance testing tools in their staging environment that have the ability to test the performance of the system end-to-end. This will allow HITS-NS to gain additional confidence in their applications running together as a system. Additionally, many of the automated tools for this type of testing will facilitate the pushing of dummy transactions through the production system as described in workstream 2 that will allow HITS-NS to effectively and actively monitor their environment and ensure ongoing performance within their production environment. In order to be effective, however, HITS-NS needs to endeavour to have their staging and production environments synchronized. The environments must mimic each other so that test results in staging can be used as benchmarks and are true indicators of how the system will run in the production environment under production load.

Finally, if HITS-NS increases their ownership of their environment, then they will also be able to leverage relationships with external partners (i.e. operating system, middleware, or hardware providers) to potentially be able to arrange with these partners to use their specialized facilities to carry out performance and other testing. Both Microsoft and SUN have performance test lab facilities that can be used by customers for these purposes.

## Workstream 4 - Interoperating Processes including Change Management & Quality Assurance

A summary of our findings for Workstream 4 is contained in the figure below:

### WorkStream 4: Interoperating Processes including Change Management and Quality Assurance

The purpose of Workstream 4 was understand current QA & CM processes and determine whether or not they are adequate. Where gaps are identified, a framework based on best practices is to be provided.

Observations	Actions (Ongoing and Planned)
<ul style="list-style-type: none"> <li>NIC has a formalized process for promoting standard code through its environments (DEV, QA, Staging, PROD)</li> <li>In the past year NIC has brought in a RUP methodology specialist to further formalize their process</li> <li>HITS-NS environment is separate from NIC environment – DEV and QA are NIC, after QA accepts code is promoted to HITS-NS Staging and after UAT promoted to PROD</li> <li>HITS-NS staging environment does not completely mimic production</li> <li>At the time eResults custom interface was delivered, custom dev group was fairly new and had not fully adapted to NIC processes – it has since been amalgamated with the other development teams processes</li> <li>HITS-NS does not have a formal change management policy – only an informal process followed by internal staff using e-mail as the communication medium</li> <li>HITS-NS internal testing process is long and difficult to schedule due to having to pull lab employees from “real work” and is based on functional end to end testing – no automation or performance possible</li> </ul>	<ul style="list-style-type: none"> <li>NIC has incorporated load and performance testing into their methodology</li> <li>NIC is following a standard methodology that has been modified for their environment for quality and version control (RUP)</li> <li>Communication and understanding of roles and responsibilities informally has improved between HITS-NS and NIC as both organizations mature together</li> <li>Both NIC and HITS-NS are learning from experience with mistakes made when trying to save time during the performance crisis and when code was moved into QA and UAT simultaneously – not actually a time saver</li> <li>HITS-NS is starting to think about how to formalize business continuity plans</li> </ul>

#### Summary Conclusions:

- Roles and responsibilities need to be formalized between HITS-NS and vendors – specific accountabilities should not be ambiguous
- HITS-NS need Automated testing tools, end to end dummy transactions to monitor all points of the system, as well as load and performance abilities
- HITS-NS need to formalize business continuity and disaster plans including procedures to test point and system wide failures
- HITS-NS Staging and PROD need to be completely synchronized – same versions of OS, Middleware, Application modules, drivers – the more separation between the parallel environments the better (i.e. not ideal for virtual servers on the same hardware)
- NIC needs to manage the communications for releases more closely with HITS-NS so that they have adequate time to inform their user base of changes
- Change management policies need to be formalized (currently 50+ informal processes within HITS-NS) as is the case in other areas (HITS-NS & NS DoH)
- eGate engine being shared will complicate CM processes and HITS-NS ability to be expedient with issues – especially after the environment gains complexity with additional registries, HIAL, and other integration dependant applications

#### Key Findings:

During Deloitte’s investigation into the Interoperating Processes including CM and QA, a number of key facts were uncovered:

- NIC has a formalized process for promoting standard code through its environments (DEV, QA, Staging, and PROD), however, the HITS-NS environment is separate from the NIC environment with DEV and QA being at the NIC facility and Staging and Production being in the HITS-NS Datacenter. Once development is completed by NIC, their QA department tests the code and only after it has been accepted internally at NIC does it get promoted to HITS-NS staging for acceptance testing.
- Acceptance testing by HITS-NS is done by internal testers as well as external resources (lab and DI). Once signed off in staging, a production release is scheduled. HITS-NS internal testing process is long and difficult to schedule due to having to pull lab employees from “real work” and is based on functional end-to-end testing – no automated or performance testing is currently possible.
- At the time of deployment of the custom eResults interface the NIC Custom Development Group was new and not fully integrated with the QA and CM processes in place in other areas of NIC. Since that time, NIC has rolled this group into their core processes and instituted the Rationale Unified Process (RUP) as their development methodology across their company. In addition, NIC has incorporated performance testing into their standard QA process.

4. HITS-NS does not have a formal change management policy for many of their applications – only informal processes followed by internal staff using email as the communication medium that is generally controlled by a single resource. These processes are at risk to be lost if there are any staffing changes involving the people involved in administering or controlling those processes.
5. The HITS-NS staging environment does not completely mimic the production environment. Hardware, software, and patch versions must be identical between each separate environment to ensure reliable tests and predictable real-world outcomes.
6. Throughout the lifecycle of the issues identified, both HITS-NS and NIC have endeavoured to work together to the best of their abilities to quickly and effectively resolve the core problems. The youth of both organizations and the fact that the roles and responsibilities of each party during the crisis were not clearly defined, complicated the process; but having gone through the situation together, and learning how to work with one another, both organizations are well positioned to improve the effectiveness of their partnership going forward.

### Answers to Key Questions:

#### **Provide recommendations for a process framework for the validation and sign-off of original implementations and ongoing enhancements and maintenance to interoperating components (change management processes).**

Currently, no formal documentation as to specific roles and responsibilities between HITS-NS and their partners exists. HITS-NS relies on vendors to follow their own change management processes and tries to adhere to the processes of their partners. HITS-NS has many of their own change processes, but few have been formalized and most are not consistently applied across the organization. Communication between partners is primarily by e-mail and there is no formal change management review board in existence.

NIC has worked to formalize their change management procedures and the process for promoting releases through their internal environment (DEV → QA → Staging → Production) and has also brought in a methodology-strong senior level resource to own the development process and promotion of releases within their company. Specific resources within HITS-NS have learned to function without formal procedures by implementing informal procedures that are followed (approximately 50<sup>1</sup>), but the risk is that the processes are owned by people instead of the organization; if the people leave then the processes leave with them.

It is Deloitte's recommendation that discipline and rigour be applied to change management processes. A formal change management process needs to be implemented and adhered to. Specifically, HITS-NS needs the following:

- A change review board with membership representing all of the partners in the system needs to be implemented by HITS-NS and adhered to by all partners in the environment
- Changes to be planned and formal lines of communications between the change owner and the other systems in the environment need to be established
- Changes to be reviewed and signed off by relevant stakeholders – HITS-NS should own the process as to be aware of all changes ongoing in the system and downstream affected systems should have to acknowledge and agree to the changes
- Better communication back up the channels when change is completed in order to close the loop with stakeholders and make monitoring partners aware of potential issues
- All vendors (new and existing) as a condition of partnership participating and adhering to the minimum standard that the HITS-NS change management process requires

Once this process has been put into place, any existing or new vendors wishing to participate in the environment should have to comply and HITS-NS should own the environment explicitly. Any changes within the environment should be owned by HITS-NS and managed by the specific implementing vendors. The change should include the training of HITS-NS personnel in the monitoring, operation, and issue resolution procedures of the application.

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<sup>1</sup> From Eleanor Campbell – HITS-NS

## **Provide a process framework to validate results delivered by various clinical systems (quality assurance process)**

Currently, an internal HITS-NS QA team does function and regression testing in staging environment. HITS-NS then coordinates staging testing with Lab and DI resources from CDHA, IWK, and NSHIS. Test cases between lab and DI teams are not currently formalized. HITS-NS internal acceptance testing process is long and difficult to schedule due to having to pull lab employees from “real work” and is based on functional end-to-end testing, and no automated or performance based testing is currently possible. HITS-NS has acknowledged this as a problem in their testing processes and is looking into ways to remedy the situation. Some suggestions to avoid the bottlenecks created by the difficulty in scheduling clinical resources to test that have come out of our investigation are:

- Using a standardized series of clinical team endorsed test cases can be adopted by HITS-NS and executed, giving the clinical teams more confidence going onto their test cycles
- Having a lab/DI resource on contract that is trusted and approved of by the clinical labs to act on their behalf and execute their test cases could also prevent resource specific lag time
- Automated tools for testing can be used to facilitate more rapid execution of standard test cases and allow load and performance testing to be performed

A problem that will need to be addressed prior to introducing any automated testing tools into the staging environment is that the staging/UAT environment and production environments are not synchronized within HITS-NS. This means that any testing done within staging/UAT cannot be used as a true benchmark when the code is moved to production. In accordance with best practices, the staging environment needs to be an exact replica of the production environment (although not necessarily to scale) and should be maintained with the same change management rigour as the production environment.

Any patches, upgrades, or vendor changes should be moved through internal testing by the vendors and then when released to HITS-NS, through a rigorous change management process to get into the staging environment. If that is the case, once the application or change is signed off in staging, the move to production can be made with relative confidence as the test environment in place can be relied upon to accurately model the real-world production environment.

### **Summary and Next Steps for Workstream 4:**

A formal and rigorous change management process needs to be implemented and adhered to by HITS-NS. The change management process and policies at HITS-NS should include:

- A change review board with membership representing all of the partners in the system – must be adhered to by all partners in the environment
- Changes need to be planned and formal lines of communications between the change owner and other systems in the environment need to be established
- Proposed changes need to be reviewed and signed off by relevant stakeholders – HITS-NS should own this process so that they are aware of all the ongoing changes in the system. Any downstream systems which may be affected should have to acknowledge and agree to the proposed changes
- A communications plan for completed changes which goes back up the channels in order to “close the loop” with stakeholders and make monitoring partners aware of potential issues.
- Conditions of partnership for all new vendors would require them to participate and adhere to minimum standards that the HITS-NS change management process requires

As part of the change management process, strict quality checkpoints need to be adhered to before releases are moved to production. It is imperative that staging and production environments mirror each other so that tests carried out in staging can be used as accurate benchmarks and relied upon when moving the new code into production.

To avoid bottlenecks created by the difficulty in scheduling clinical resources to test, a series of clinical team endorsed test cases can be adopted by HITS-NS and executed, giving the clinical teams more confidence going into their test cycles. Having a lab/DI resource on contract that is trusted and approved of by the clinical labs to act on their behalf and execute their test cases could also prevent resource specific lag time in testing within the eResults environment.

Once the delegates and tests have been endorsed by the clinical teams, HITS-NS can assume responsibility to review and approve clinical test cases with the clinical teams on a regular basis to ensure completeness (i.e.: ensuring complete end to end testing is accomplished) and maintain confidence between HITS-NS and their clinical stakeholders.

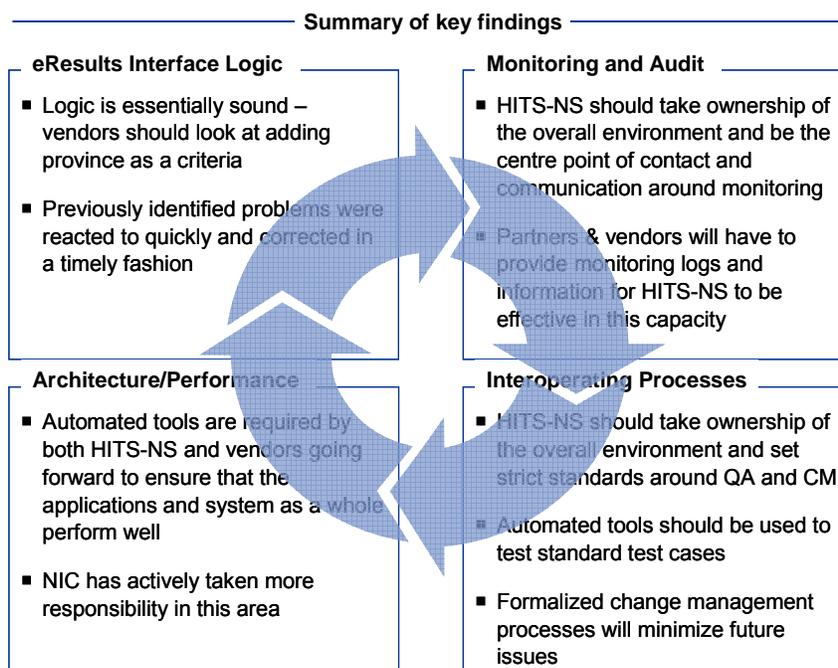
Automated testing tools can be used to execute tests. Automated tools, once added, will facilitate more rapid execution of standardized test cases and also permit load and performance testing within the environment.

Some other important QA and CM considerations which surfaced during our review include:

- Roles and responsibilities need to be formalized between HITS-NS and vendors. Specific accountabilities should not be ambiguous
- HITS-NS should formalize business continuity and disaster plans including procedures to test point and system wide failures

# Summary and Next Steps

In summary, after investigating the four workstreams, HITS-NS and the vendors are in a good position to be successful going forward. It was found that HITS-NS and its business partners did their very best to resolve the crisis that they were faced with at the time. Some key findings by workstream are shown in the figure below:



During the course of the review, a number of recurring messages and themes were identified:

- Patient matching criteria are generally sound
- Data load procedures need to be augmented to include data quality controls
- HITS-NS needs to take ownership of their environment and partners/vendors interacting with the environment need to adhere to the HITS-NS change management, quality assurance, and monitoring standard requirements
- HITS-NS should function as the hub of communications between partners/vendors and should be responsible for the oversight of vendor/partner activities as issues are managed to close
- HITS-NS should try to ensure that proper system level testing (including performance) is completed (in addition to vendor application specific testing) prior to releases moving to production

Both HITS-NS and Nightingale Informatix Corporation are young organizations. Although they might not have had a clear definition of their contractual roles and responsibilities during the crisis, through their experiences they have learned to work well with one another. Going forward, NIC needs to maintain their momentum and continue to follow their development methodology closely as well as continue to try and integrate load testing into as many of their releases as possible. HITS-NS needs to synchronize their environments and focus on being stronger in the role of environment owner. In doing so, HITS-NS needs to implement a strongly integrated change management and monitoring strategy, as well as a quality program that leverages automated tools to assist with load testing as well as pushing dummy transactions through the production environment.

Finally, it is the firm opinion of Deloitte that the above prescribed recommendations be treated as a systematic transformation. Many of the suggestions are tightly inter-related and focus on a common set of underlying themes and messages. Looking at the any of the above recommendations in isolation carries the risk of increasing the impact or severity of some of the other environmental issues.

# Appendix A - Interviews Completed

- HITS-NS Kickoff Meeting – Marc LeBlanc, John MacCallum, Lisa Napier, Eleanor Campbell, November 1, 2007
- Lisa Napier, PHIM Program Manager, November 1, 2007
- Kevin Besner, eResults Interoperability Systems Analyst, November 1, 2007
- Eleanor Campbell, PHIM Service Delivery Manager, November 1, 2007
- John MacCallum, Project Manager, eResults Review, Nova Scotia Department of Health, November 1, 2007
- Mark Cameron, CTO, Nightingale Informatix Corporation, November 9, 2007
- Samer Chebib, President & CEO, Nightingale Informatix Corporation, November 12, 2007
- Nightingale Development and Support Team, November 13, 2007
  - Mark Cameron, CTO, Nightingale Informatix Corporation
  - Zhivago Sivam, VP Software Development, Nightingale Informatix Corporation
  - Jeff Arsenault, Manager, Professional Services, Nightingale Informatix Corporation
- Marc LeBlanc, Executive Director, HITS-NS Nova Scotia, November 15, 2007
- Sandra Cascadden, CIO, Nova Scotia Department of Health, November 16, 2007
- Michael Waugh, Project Manager, Original eResults Implementation, November 22, 2007
- eGate Team, CDHA, November 22, 2007
  - Gordon MacWilliams, Project Manager
  - Mike Mowery, Integration Specialist
- Clinical Labs (CDHA, IWK, and NSHIS) Week of November 23, 2007
- Bob Brown & Team, Dymaxion, November 26, 2007
- Maria Kuttner, Director PHC, Nova Scotia Department of Health, December 5, 2007

# Appendix B - Documents Reviewed

- eResults: Primary Health Care Information Management program
- Electronic Medical Records (eResults): Fact Sheet
- PHIM\_Network\_Eresults.vsd
- NS DOH Infrastructure and eResults Services (Proposal)
- DRAFT: Message Doctors NS sending to members. Subject to their internal approvals.
- eResults Status Report 31 Oct 2007.xls
- eResults\_Tickets 9 Oct 07.xls
- IS Monitor User Guide
- i-PHIM Nightingale ASP EPR Concept Document
- i-PHIM LAB Requirements
- i-PHIM DI HL7 Requirements
- i-PHIM Local Client Server Repository Functional Specification
- eResults: Questions & Answers for Minister - DRAFT
- PHIM Performance Improvement Plan Overview
- i-PHIM LCS Repository Administration Guide
- Schedule H – Second Line Service Levels
- PHIM Record of Planned Changes.xls
- eResults Issues Brainstorming Session
- Trouble Shooting Missing eResults – April to June 2007
- PHIM CM Notification 2 Nov 07
- Result Interface Issue from CDHA – November 7/8 2007
- IT Roles and Responsibilities - Primary Health Care (Electronic Patient Record)
- Schedule F-1 - DOH SUB-LICENCE & SUPPORT AGREEMENT
- SOFTWARE LICENCE AND SUPPORT AGREEMENT
- TemplateSupport with NS Feedback.xls

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