Southwestern Ontario (SWO)
Imaging Needs Assessment Project

FINAL REPORT OF THE PROJECT OVERSIGHT COMMITTEE
Wednesday September 17, 2003
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1.0 Introduction

In the Fall of 2002, the hospitals of Southwestern Ontario (SWO) engaged Deloitte & Touche LLP (Deloitte) to conduct a Regional Imaging Needs Assessment study (Needs Assessment). An overview of the purpose, scope and objectives for this Needs Assessment are provided below, to provide a deeper context for the work undertaken.

1.1 PROJECT OVERVIEW

1.1.1 Background

There are 22 hospital corporations in SWO, comprised of a total of 33 hospital sites, in addition to several community facilities. SWO hospitals are primary non-academic community facilities, however the network of hospitals does also include London Health Sciences Centre (LHSC) and St. Joseph’s Health Care, London, which are academic hospitals affiliated with the University of Western Ontario (please refer to Appendix A for a listing of the SWO hospitals that participated in this Needs Assessment).

As a part of an ongoing effort to improve diagnostic imaging (DI) services throughout SWO, the SWO hospitals came together and decided to undertake a needs assessment to better understand the potential for working together in the face of continued workload pressures, insufficient capital resources, and medical and technical human resource constraints. This network of hospitals (the SWO DI Network) also wanted to understand opportunities for improving the availability of DI services throughout the Network.

1.1.2 Project Scope and Objectives

The SWO DI Network engaged Deloitte to lead a Needs Assessment to better understand the state of DI throughout the SWO region, and how SWO hospitals might respond to DI challenges as a network, for improved DI service delivery. Specifically, the SWO Needs Assessment had five primary objectives:

1. To develop an accurate and comprehensive inventory of existing DI and Nuclear Medicine equipment and human resources in Southwestern Ontario by:
   - Surveying participating hospitals;
   - Interviewing Imaging Chiefs of Radiology and Nuclear Medicine, select hospital CEOs, and other key stakeholders; and
   - Soliciting input from relevant professional associations and the Ministry of Health and Long-Term Care.

2. To project future diagnostic imaging/radiology resource requirements.

3. To identify current & future strengths, weaknesses, opportunities and threats (SWOT analysis).

4. To generate a current status and future issues report.

5. To develop a regional model (or models) of service delivery based on the inventory, the SWOT analysis and stakeholder consultations. Additional components of the regional service delivery model(s) include exploring adoption of newer information and imaging technologies and other strategies to optimize limited human resource uses.

In summary, the SWO DI Network was seeking to establish a baseline understanding of current DI operations to identify opportunities for improvements in service delivery through a collaborative process. This report provides a summary of the approach, findings, Network options, and recommendations that were established through the course of the Imaging Needs Assessment.
1.2 CANADA HEALTH INFOWAY

It should also be noted that simultaneous to, and independent of, the Needs Assessment, the SWO DI Network also engaged in a proposal to Canada Health Infoway for funding of an initiative to implement certain components of a Network-wide DI service delivery model. Near to the end of the Needs Assessment project, SWO had been awarded funding from Canada Health Infoway.

This resulted in a preliminary conceptual integration of the Canada Health Infoway initiative and the Imaging Needs Assessment, to maximize improvements to DI service delivery across the SWO Network. A brief description of the Canada Health Infoway and its integration with the service delivery model developed through the Needs Assessment project will be presented at the end of this report, in section 7.6.
2.0 Approach

2.1 OVERVIEW

The Imaging Needs Assessment adopted a five-phased approach, as indicated in Figure 1, below. This section of the Final Report provides a high-level overview of the approach, which will be followed by a detailed description of findings and go-forward options for the SWO DI Network.

*Figure 1. Project Approach for SWO Imaging Needs Assessment*

The key principles in the consulting approach included:

- **Consultations** across a spectrum of stakeholders within SWO, and an appreciation of the sensitivity to the needs of constituency stakeholders.
- Incorporation of additional consultation with Imaging Physicians and CEO groups to ensure these key stakeholder groups had sufficient voice.
- A collaborative, participative approach that maximized the experience and insights of the stakeholders.
- Balancing consideration of risks and benefits associated with suggested opportunities for improvement.
- Close working relationship with DI and administrative stakeholders to attempt to resolve and/or highlight data challenges.
- Independence and objectivity to ensure credibility of findings and recommendations.
- Open communications that enabled both internal and key external stakeholders to provide input throughout the project.
- Focus on change requirements (barriers and business enablers), to successfully implement the recommendations.
The project began with a presentation and validation of the consulting process with the Project Oversight Committee in Phase 1 (Project Launch). During this phase the project scope, objectives and workplan were clarified and confirmed, and Deloitte consultants met with Project Oversight Committee stakeholders to communicate and clarify the data and information requests (please refer to Appendix B for Project Oversight Committee membership). Two major events external to this project extended the data and information gathering timeline:

- Canada Health Infoway data request and RFI submission by SWO (November – December 2002).

Given the workload related to these two events, data return dates for this Needs Assessment were ultimately extended to late-February, 2003, resulting in the assessment phase being deferred to the new year.

In Phase 2, a situational state assessment of diagnostic imaging in SWO was completed. The assessment phase included substantial qualitative and quantitative reviews, in addition to a review of DI literature and best practices from the field.

Substantial detail and insight was gained during the assessment phase, which allowed Deloitte to move on to Phase 3, to integrate the findings and conduct a SWOT (Strengths, Weaknesses, Opportunities and Threats) Analysis. In this phase of work, Deloitte presented the preliminary findings and corresponding SWOT Analysis to the Project Oversight Committee. Key to this phase was validation of the findings with the stakeholders and acceptance of the SWOT Analysis before commencing the Strategic Option and Value Analysis development phase. In this phase, Deloitte met with key stakeholders and the Oversight Committee, to present findings and the corresponding SWOT Analysis.

During Phase 4, the findings and SWOT Analysis were integrated into the development of strategic options for collaborative partnering in DI across SWO. A high-level review of potential options was considered, followed by the detailing of the preferred option, as elected by the Project Oversight Committee.

Following these four phases, Deloitte has developed this Final Report as Phase 5. It outlines the project approach, findings, options, and go-forward recommendations for the SWO DI Network.

### 2.2 PROJECT TEAM

Given the large number of stakeholders in the Needs Assessment project, a collaborative approach was taken, and the Deloitte team formed an integrated project team structure with the SWO stakeholders. As depicted in Figure 2, below, an Operational Coordinating Team (OCT) functioned as a working group on behalf of the larger Oversight Committee. The primary role of the OCT was to validate and provide feedback on draft material before its presentation to the Oversight Committee, and to give direction to the Deloitte team, as required.
Figure 2. SWO Imaging Needs Assessment Project Team Structure

**SWO Oversight Committee**
(See Appendix B for Committee membership)

**Project Leadership**
Hy Eliasoph, Deloitte & Touche
Jim Whaley, Grey-Bruce Huron-Perth District Health Council
Steve Elson, Integrated Strategic Alliances and Networks, LHSC – SJHC, London
Mark Brintnell, Ontario Ministry of Health and Long Term Care

**Deloitte & Touche**
Irene Podolak (Engagement Manager)
Hy Eliasoph (Project Manager)
Mark Fam (Researcher/Data Analyst)
Cynthia Clark (Researcher/Data Analyst)
Ray Foley (Imaging Advisor)

**Operational Coordinating Team**
Dr. Don Taves (SJHC-London)
Dr. Kevin Tracey (HDGH-Windsor)
Dr. Doug Mowbray (Huron-Perth)
Barb Mylemans (LHSC)
Des Morrow (Lambton Hospitals Group)
Anne Robertson (GBHS)
Karen Palmer (Woodstock)

(See Appendix B for Committee membership)
3.0 Situational Assessment

3.1 OVERVIEW

The primary objective of the situational assessment was to examine the current operating performance for DI in SWO, with respect to expenses, revenue, staffing and workload. From this assessment, a baseline understanding of the challenges faced by DI with respect to medical and technical human resource shortages, the need for additional capital equipment resources, and other operating factors were established.

Key components of the assessment, and their linkage to the next phase of the Needs Assessment, are provided in Figure 2 below.

The primary method of data collection was a two-part survey that was distributed to each of the participating SWO hospitals. It consisted of both a qualitative (DI Survey) and quantitative components (Data Request). Although the survey sought an extensive amount of information and data, the overall response to this survey was very high - of the 22 organizations that were surveyed, 21 responded.

The following table (Figure 4) presents an inventory of the organizations surveyed, and the response received-to-date. Areas of the table that are marked with an ‘X’ represent items that were not received from specific organizations.
The following sub-sections of this report will focus first on the quantitative, and then the qualitative findings of the Situational Assessment. In addition, a brief summary of the challenges experienced with respect to the quantitative data analysis and reporting will be provided.

### 3.2 High-Level Quantitative Findings

#### 3.2.1 Introduction

The high-level quantitative findings are summarized into 6 key areas of investigation:

1. Finances
2. Activity
3. Staffing
4. Physician Demographics
5. Technology and Equipment
6. Service Availability and Waiting Lists

An important note for consideration throughout the review of the quantitative findings is that not all hospitals were able to provide the information necessary to complete the analyses. This was due primarily to the number of competing requests for information (e.g. Canada Health Infoway, MOHLTC 3rd Party Reviews, etc.), as well as to the differences in how each of the SWO hospitals track and report data within DI. As a result, a compilation of only select quantitative findings is presented. This quantitative information was used to provide direction to the project, but will not be used to identify specific conclusions, as a complete set of quantitative data would be needed to draw comprehensive conclusions.
3.2.2 Population Demographics

A review of the population demographics in SWO was conducted in order to understand if projected population changes were expected to impact the demand on DI services. This review was based on the assumption that an aging population would place an increased demand on DI services, since an older population (> 65 age group) typically consumes a greater amount of health care resources.

Using information from the Ontario Provincial Health Planning Database, a projected total population growth of 3% in SWO was identified, inclusive of a 5% average growth in the > 65 age group (Figure 5). Given the low overall change in the population, the impact of population demographics was not considered to be significant, and as such, no further adjustment to the DI data was necessary to accommodate for future projected population growth.

![Figure 5. SWO Population Demographics Forecast](image)

3.2.3 SWO Financial Overview

As noted previously, challenges were experienced in collecting data from the participating hospitals – either due to incomplete data submissions, or due to differences in how the data is reported across SWO. In reviewing the operating expense and revenue data collected through the survey process, this same challenge was present, due primarily to:

- Incomplete financial data.
- Inconsistent completion of the financial data survey.

The result of these challenges is that confidence is limited to application of the Technical Fee data only, as a high-level estimate. Deloitte is not confident in reporting:

- Total operating expenses
- Film-related Expenses
- Total Professional Fees
- Total 3rd Party Revenues
3.2.3.1 Technical Fee Revenues

Although incomplete, a review of the Technical Fee revenue data provided suggests that Technical Fees have increased by almost 20% over the past 4 fiscal years (refer to Figure 6, below). This trend is even higher in the ECG and Other Procedures modalities, and supports the fact that the demand for DI is increasing at a much faster rate than the growth of the SWO population.

Figure 6. SWO Technical Fee Revenues 1999-00 – 2002-03 YTD Projected

<table>
<thead>
<tr>
<th>Modality</th>
<th>1999-00</th>
<th>2000-01</th>
<th>2001-02</th>
<th>2002-03 YTD Proj.</th>
<th>% Variance: 2002-03 YTD Proj. vs. 1999-00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiography/X-Ray/BMD/Fluoroscopy/Angio/Interventional/Mammography</td>
<td>$8,179,334</td>
<td>$8,563,980</td>
<td>$9,095,437</td>
<td>$9,921,454</td>
<td>21%</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>$3,974,601</td>
<td>$4,394,716</td>
<td>$4,885,040</td>
<td>$4,736,708</td>
<td>19%</td>
</tr>
<tr>
<td>Nuclear Medicine</td>
<td>$4,695,892</td>
<td>$4,878,862</td>
<td>$5,273,974</td>
<td>$5,283,188</td>
<td>13%</td>
</tr>
<tr>
<td>CT</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>MRI</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>PET</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>ECG</td>
<td>$124,766</td>
<td>$120,405</td>
<td>$123,041</td>
<td>$206,118</td>
<td>65%</td>
</tr>
<tr>
<td>Other Procedures</td>
<td>$6,693</td>
<td>$33,705</td>
<td>$39,748</td>
<td>$114,708</td>
<td>1614%</td>
</tr>
<tr>
<td>SWO Total</td>
<td>$16,981,286</td>
<td>$17,991,668</td>
<td>$19,417,240</td>
<td>$20,262,176</td>
<td>19%</td>
</tr>
</tbody>
</table>

The increase of 20% in Technical Fee revenues since 1999-00 is also in line with expectations, as Ontario hospitals have averaged a Technical Fee growth of approximately 5% per annum. This is an important point of validation for the SWO hospitals, as recent considerations by the Health Implementation Advisory Committee (HIAC) to globalize Technical Fee revenue would have had significant implications for the expected growth in demand of DI activity. The HIAC report was not accepted by the MOHLTC; however, it is possible that other process may replace it to accomplish a similar outcome.

3.2.4 SWO Activity Overview

Three primary sources of data for developing an understanding of DI activity within SWO were used. These are:

- Current Volumes by Modality.
- Current Workload by Modality.
- Top 25 OHIP DI Billing Codes by Volume.

A review of these three indicators of overall DI activity were seen as providing a good sense of how activity trends over time; if the workload associated with patient volumes is stable or changing; and, how SWO compares to the provincial average for the key DI procedures that are driving overall activity.

Unfortunately, due to inconsistent reporting of workload (e.g. Total vs. Service Recipient Workload), Deloitte was not able to report on this measure of activity, so this review focused only on current procedure volumes by modality, and a comparison to the Top 25 OHIP DI Billing Codes by Volume.
3.2.4.1 Current Volumes by Modality

An examination of patient activity demonstrates that outpatient and inpatient volumes have increased between fiscal years 1999/00 and 2002/03, by 12% and 5% respectively (Figure 7). This is in line with provincial trends. Further, the observation that much of this increase in volume is being driven by the high growth in the use of Ultrasound, CT and MRI modalities, is also common among Ontario peers. The primary reasons for this growth, both in SWO and across Ontario, are threefold: 1) DI services are becoming more widely used in replacement of more invasive procedures; 2) Ultrasound, CT and MRI are the specific modalities being used in place of the more invasive procedures; 3) the breadth of DI capabilities is increasing through technological advances, which has resulted in increased demand for DI services.

![Figure 7. SWO DI Procedure Volumes by Modality](image)

The workload management system (WMS) for DI changed in the Management Information System (MIS) Guidelines, as of April 2002. In Figure 7, 2002-03 YTD projected data is presented under the assumption that the majority of SWO hospitals have reported data using the previous WMS (in place prior to April 2002), allowing for a year-over-year comparison of DI activity. For the purposes of reporting, it should also be noted that ‘Radiography’ includes X-Ray, Portable X-Ray, Fluoroscopy, and Mammography, and composes over 60% of total patient volumes.

3.2.4.2 Top 25 OHIP DI Billing Codes

By comparing the top 25 OHIP DI billing codes (by procedure volume) in SWO to the provincial average, it was possible to provide a context as to the types of cases that SWO hospitals are facing in DI, and how this case mix compares to provincial peers. This comparison found that the SWO top 25 OHIP billing code procedures represent approximately 70% of total DI volumes across SWO, which is in line with Ontario peers, but that the specific SWO ranking of OHIP DI billing codes by volume of procedures does not appear to be consistent with the OHIP data (see Figures 8 and 9).

This may be a result of billing or coding errors (E.g., J462 and J162), or may suggest a difference in the type of cases that the hospitals in SWO are reviewing. Defining the true driver of this discrepancy was not possible, as a complete data set from all hospitals was not available for validation.

*Note: Volume data for 2002-03 is based on a new workload management system, and so may not be directly comparable to previous years data.*
Figure 8. Ontario OHIP Top 25 DI Billing Codes for 2000-01

<table>
<thead>
<tr>
<th>OHIP Rank</th>
<th>Fee Code</th>
<th>Description</th>
<th>SWO Rank 01-02</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X091</td>
<td>Chest - Two Views</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>J135</td>
<td>Abdomen/Retroperitoneum - Abdom Scan, Complete</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>X185</td>
<td>Mammogram - Bilateral</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>J162</td>
<td>Pelvis - Pelvic, Complete</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>X410</td>
<td>CT - Abdomen - With IV Contrast</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>X232</td>
<td>CT - Pelvis - With IV Contrast</td>
<td>29</td>
</tr>
<tr>
<td>7</td>
<td>X400</td>
<td>CT - Head - Without IV Contrast</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>X104</td>
<td>GI Tract – Oesoph., Stomach/Duodenum – Dbl Contrast</td>
<td>25</td>
</tr>
<tr>
<td>9</td>
<td>X415</td>
<td>CT - Spine - Without IV Contrast</td>
<td>58</td>
</tr>
<tr>
<td>10</td>
<td>X153</td>
<td>BMD Measure - Low Risk, Two Or More Sites</td>
<td>18</td>
</tr>
<tr>
<td>11</td>
<td>J138</td>
<td>Intracavity Ultrasound</td>
<td>32</td>
</tr>
<tr>
<td>12</td>
<td>J462</td>
<td>Pelvic, Complete</td>
<td>52</td>
</tr>
<tr>
<td>13</td>
<td>X155</td>
<td>High Risk Patient – Two Or More Sites</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>J435</td>
<td>Abdominal Scan, Complete</td>
<td>62</td>
</tr>
<tr>
<td>15</td>
<td>X407</td>
<td>CT - Thorax - With IV Contrast</td>
<td>N/A</td>
</tr>
<tr>
<td>16</td>
<td>X113</td>
<td>Colon - Air Contrast, Primary/Secondary, Incl Survey</td>
<td>46</td>
</tr>
<tr>
<td>17</td>
<td>X409</td>
<td>CT - Abdomen</td>
<td>N/A</td>
</tr>
<tr>
<td>18</td>
<td>X231</td>
<td>CT - Pelvis</td>
<td>N/A</td>
</tr>
<tr>
<td>19</td>
<td>X402</td>
<td>CT - Complex Head - Without IV Contrast</td>
<td>N/A</td>
</tr>
<tr>
<td>20</td>
<td>X125</td>
<td>CT - Thorax - With And Without IV Contrast</td>
<td>N/A</td>
</tr>
<tr>
<td>21</td>
<td>X421</td>
<td>MRI - Head - Multislice Sequence</td>
<td>31</td>
</tr>
<tr>
<td>22</td>
<td>X425</td>
<td>MRI - Head - Repeat</td>
<td>15</td>
</tr>
<tr>
<td>23</td>
<td>J127</td>
<td>Breast - Scan B-Mode</td>
<td>19</td>
</tr>
<tr>
<td>24</td>
<td>X224</td>
<td>Knee (Incl Patella) Three Or Four Views</td>
<td>6</td>
</tr>
<tr>
<td>25</td>
<td>J159</td>
<td>Pelvis - Pregnancy, Complete</td>
<td>60</td>
</tr>
</tbody>
</table>

Figure 9. SWO Top 25 OHIP DI Billing Codes

<table>
<thead>
<tr>
<th>SWO Rank</th>
<th>Fee Code</th>
<th>Description</th>
<th>SWO Volume 01-02</th>
<th>OHIP Rank 2000-01</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X091</td>
<td>Chest - Two Views</td>
<td>109,155</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>X090</td>
<td>Chest - Single View</td>
<td>38,401</td>
<td>N/A</td>
</tr>
<tr>
<td>3</td>
<td>X185</td>
<td>Mammogram - Bilateral</td>
<td>26,275</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>J202</td>
<td>Peripheral Vessel Assessment - Duplex Scan</td>
<td>22,357</td>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td>J135</td>
<td>Abdomen/Retroperitoneum - Abdom Scan, Complete</td>
<td>18,721</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>X224</td>
<td>Knee (Incl Patella) Three Or Four Views</td>
<td>13,925</td>
<td>24</td>
</tr>
<tr>
<td>7</td>
<td>X069</td>
<td>Foot - Two Or Three Views</td>
<td>13,365</td>
<td>N/A</td>
</tr>
<tr>
<td>8</td>
<td>X400</td>
<td>CT - Head - Without IV Contrast</td>
<td>13,266</td>
<td>7</td>
</tr>
<tr>
<td>9</td>
<td>X101</td>
<td>Abdomen - Two Or More Views</td>
<td>12,573</td>
<td>N/A</td>
</tr>
<tr>
<td>10</td>
<td>J162</td>
<td>Pelvis - Pelvic, Complete</td>
<td>12,408</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>J850</td>
<td>Bone Scintigraphy - General Survey</td>
<td>10,631</td>
<td>N/A</td>
</tr>
<tr>
<td>12</td>
<td>X053</td>
<td>Wrist - Two or Three Views</td>
<td>10,327</td>
<td>N/A</td>
</tr>
<tr>
<td>13</td>
<td>X067</td>
<td>Ankle - Two or Three Views</td>
<td>10,035</td>
<td>N/A</td>
</tr>
<tr>
<td>14</td>
<td>J128</td>
<td>Abdomen/Retroperitoneum - Abdom Scan, Limited Study</td>
<td>9,474</td>
<td>N/A</td>
</tr>
<tr>
<td>15</td>
<td>X425</td>
<td>MRI - Head: Repeat (Another Plane, Different Pulse Sequence)</td>
<td>9,193</td>
<td>22</td>
</tr>
<tr>
<td>16</td>
<td>X212</td>
<td>Shoulder - Three or More Views</td>
<td>7,999</td>
<td>N/A</td>
</tr>
<tr>
<td>17</td>
<td>X155</td>
<td>High Risk Patient - Two or More Sites</td>
<td>7,774</td>
<td>13</td>
</tr>
<tr>
<td>18</td>
<td>X153</td>
<td>BMD Measure - Low Risk, Two Or More Sites</td>
<td>7,774</td>
<td>10</td>
</tr>
<tr>
<td>19</td>
<td>J127</td>
<td>Breast - Scan B-Mode</td>
<td>7,570</td>
<td>23</td>
</tr>
<tr>
<td>20</td>
<td>X410</td>
<td>CT - Abdomen - With IV Contrast</td>
<td>7,510</td>
<td>5</td>
</tr>
<tr>
<td>21</td>
<td>X100</td>
<td>Abdomen - Single View</td>
<td>7,500</td>
<td>N/A</td>
</tr>
<tr>
<td>22</td>
<td>X037</td>
<td>Pelvis and/or Hip(s) - Two Views</td>
<td>6,082</td>
<td>N/A</td>
</tr>
<tr>
<td>23</td>
<td>X065</td>
<td>Knee (Incl Patella) Two Views</td>
<td>5,982</td>
<td>N/A</td>
</tr>
<tr>
<td>24</td>
<td>J163</td>
<td>Pelvis, Limited Study - For Other Than Pregnancy</td>
<td>5,698</td>
<td>N/A</td>
</tr>
<tr>
<td>25</td>
<td>X104</td>
<td>Esophagus, Stomach and Duodenum - Double Contrast</td>
<td>5,378</td>
<td>8</td>
</tr>
</tbody>
</table>
3.2.5 SWO Staffing Overview

The review of the staffing complement within SWO is presented through the following three components:

- Staff Demographics.
- Current Staffing by Modality and Type.
- Current and Projected Technologist Vacancies by Modality.

Although information was collected on technologist productivity, this data could not be analyzed due to inconsistencies in how the information was completed.

### 3.2.5.1 Staff Demographics

A review of staff demographics was conducted to understand both the gender and age mix within the DI staffing complement across SWO. From Figure 10, below, it is apparent that there is a high predominance of women in the DI hospital workforce (82%). This is especially the case among nurses and technologists in Mammography, Interventional Radiology, Ultrasound and MRI. This higher predominance of women in the general DI hospital workforce, and in these modalities specifically, is common across Ontario.

Reports from the SWO DI surveys suggest that this high predominance of women in the technologist workforce presents a staffing challenge, due to a higher incidence of maternity leave, and a lower proportion of overtime work by female technologists. It should be noted, however, that all reports suggest a high level of quality diagnostic work from both female and male technologists.

![Figure 10. SWO DI Staffing Demographics](image)

In examining the age demographics of the SWO DI staffing complement, it is important to note that 20% of hospital staff are aged > 50 years. This suggests that there is a significant need for recruitment in the next 10-15 years to replace retiring staff. Specifically, General X-Ray, Mammography and Angio/Interventional represent areas with the oldest technologist population, suggesting a need for targeted recruitment efforts in these areas. In addition, over 50% of DI managers are aged > 50 years, suggesting that SWO will be further challenged with the need to recruit and train strong DI managers over the 10-15 years, to ensure a viable management structure to coordinate DI service delivery, and to maintain continuity of DI services.
3.2.5.2 Current & Projected Staffing FTEs

Current and projected staffing full-time equivalents (FTEs) were examined to further identify areas within DI that are facing a higher need for targeted recruitment and retention efforts, and to determine how the recruitment drive will need to change over time to accommodate the continual introduction of new technologies into DI (e.g. PACS). As demonstrated in Figure 11, below, the introduction of digital equipment and a Picture Archiving and Communication System (PACS) are projected to reduce the number of administration and support staff by 15% in 2005.

Figure 11. SWO Current and Projected DI FTEs

<table>
<thead>
<tr>
<th>DI Technologists</th>
<th>2002</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-ray</td>
<td>167.7</td>
<td>179.3</td>
</tr>
<tr>
<td>Fluoroscopy</td>
<td>9.4</td>
<td>10.9</td>
</tr>
<tr>
<td>Portable x-ray</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Mammography</td>
<td>20.4</td>
<td>27.7</td>
</tr>
<tr>
<td><strong>Total Radiography</strong></td>
<td><strong>200.5</strong></td>
<td><strong>221.0</strong></td>
</tr>
<tr>
<td>Interventional</td>
<td>12.7</td>
<td>15.4</td>
</tr>
<tr>
<td>Angiography</td>
<td>4.4</td>
<td>4.4</td>
</tr>
<tr>
<td>Bone Mineral Densitometry</td>
<td>6.0</td>
<td>11.2</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>71.8</td>
<td>82.8</td>
</tr>
<tr>
<td>Nuclear Medicine</td>
<td>44.7</td>
<td>47.2</td>
</tr>
<tr>
<td>Computed Tomography</td>
<td>26.8</td>
<td>34.1</td>
</tr>
<tr>
<td>Magnetic Resonance Imaging</td>
<td>26.5</td>
<td>32.9</td>
</tr>
<tr>
<td>Biopsies &amp; Aspirations</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Other Procedures</td>
<td>11.2</td>
<td>15.0</td>
</tr>
<tr>
<td>Echocardiography</td>
<td>5.1</td>
<td>7.0</td>
</tr>
<tr>
<td>Positron Emission Tomography</td>
<td>0.2</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>Total DI Tech</strong></td>
<td><strong>409.9</strong></td>
<td><strong>474.8</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Admin/Support</th>
<th>2002</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manager</td>
<td>10.6</td>
<td>10.6</td>
</tr>
<tr>
<td>Coordinator</td>
<td>22.2</td>
<td>24.3</td>
</tr>
<tr>
<td>Education</td>
<td>5.7</td>
<td>4.1</td>
</tr>
<tr>
<td>Projects</td>
<td>0.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Secretary</td>
<td>25.0</td>
<td>23.0</td>
</tr>
<tr>
<td>Clerks</td>
<td>100.9</td>
<td>70.4</td>
</tr>
<tr>
<td>Typists</td>
<td>35.6</td>
<td>21.3</td>
</tr>
<tr>
<td>Aide</td>
<td>14.1</td>
<td>18.4</td>
</tr>
<tr>
<td>Nurse</td>
<td>15.5</td>
<td>17.5</td>
</tr>
<tr>
<td><strong>Total Admin</strong></td>
<td><strong>233.2</strong></td>
<td><strong>197.9</strong></td>
</tr>
</tbody>
</table>

In parallel to this, the increasing demands for DI procedures are projected to increase the demand for DI technologists by 16% (65 FTEs) in 2005. Of this 16% increase, Total Radiography represents 32% (21 FTEs), Ultrasound represents 17% (11 FTEs), CT represents 11% (7 FTEs), and MRI represents 10% (6.5 FTEs) of the projected FTE increase by 2005. These increases are in line with provincial growth trends in the demand for DI services, which are especially high for Ultrasound, CT and MRI services. It is further anticipated that if CT and MRI services are expanded in the future, additional technologist FTEs, above and beyond those estimated in Figure 11, would be required. Given the current and projected level (to 2005) of DI services in SWO, however, a net increase of only 30 FTEs is projected for the region over the next three years, due primarily to a decrease in Admin/Support staff (refer to Figure 11, above).

3.2.5.3 Current FTE Vacancies

As of March 2003, there were 38.5 technologist FTE vacancies across DI in SWO (Figure 12). Given the projected need for 65 additional technologists (as per Figure 11), it is predicted that SWO will face a total technologist shortfall of over 103 FTEs in 2005, unless significant recruiting initiatives are undertaken – for both the current vacancies, and projected additional staffing requirements.
3.2.6 SWO Physician Overview

The review of the current state of human resources in SWO DI, thus far, has focused on hospital staff. In order to gain a complete understanding of human resources challenges, specific attention must also be directed towards the imaging physicians. Figure 13, below, presents the current distribution of Radiologists and Nuclear Medicine physicians (imaging physicians) across SWO, along with the gender breakdown of those physicians. As this distribution is based on a survey of physician group and hospital affiliations within SWO, some overlap exists in the physician distribution across the SWO sub-regions.

Figure 13. SWO Imaging Physician Distribution and Gender Demographics
In total, SWO has 82 Radiologists (64 male, 18 female) and 16 Nuclear Medicine Physicians (15 male, 1 female). Overall, 45% of Imaging Physicians in SWO are above the age of 50 years, suggesting a significant need for increased recruitment efforts in the next 10-15 years. This proportion of human resources aged > 50 years is much greater than that observed for technologists. Although physicians often work beyond the traditional retirement age of 65 years, this high degree of an aging workforce indicates a need to target recruiting efforts to introduce and train additional imaging physicians in SWO.

Further to the current imaging physician complement in SWO, as presented in Figure 13, survey respondents also identified the need for an additional 12 Radiologists in 2002/03. This further accents the need for strong recruiting efforts to increase the total imaging physician complement across SWO.

3.2.7 SWO Technology and Equipment Overview

One of the primary drivers for initiating the Imaging Needs Assessment for SWO was the current state of DI equipment, and the need for additional capital funding resources to implement new DI technologies across SWO. An overview of the current DI technology and equipment infrastructure in SWO was conducted to gain an understanding of this primary driver. This overview focused on the following:

- Modality-specific assessment of need for equipment replacement (equipment age analysis).
- Modality-specific investment required to replace out-of-date equipment.
- Inventory of CT and MRI throughout SWO.
- Degree of PACS implementation throughout SWO.

In addition to the findings presented in this overview, which examines the current state of technology and equipment in SWO, several hospitals identified planned capital purchases, primarily related to:

- Implementation of PACS, RIS and CR.
- Upgrading equipment in Ultrasound, Mammography, and Nuclear Medicine.
- Acquisition of CT.

The implementation of these planned capital purchases will likely be dependent on the findings and outcome of this Needs Assessment, and how the SWO hospitals choose to collaborate to improve overall DI services across the geographic region.

3.2.7.1 Equipment Age and Replacement Analysis

A review of the equipment inventory within each modality across SWO revealed a significant need for capital investment (Figure 14). By identifying all minor and major DI equipment > 5 years old (a guideline identified in the Ontario Association of Radiologists (OAR) Outdated Equipment Report), the degree of replacement required was determined: 46% of equipment is out-of-date. This finding is consistent with earlier findings identified in the OAR report, and suggests a significant impact on efficiency and service levels, as well as a potential risk to patient care.
3.2.7.2: Equipment Replacement Investment Required

Considering the high level of outdated equipment, a high-level estimate of the investment required to update the SWO equipment, by modality, was undertaken (Figure 15). Overall, an estimated investment of $75M would be required to update all out-of-date minor and major equipment in Diagnostic Imaging and Nuclear Medicine.

Figure 15. Estimate of SWO DI Investment Required to Replace Outdated Equipment

<table>
<thead>
<tr>
<th>Modality</th>
<th># of Pieces of Equipment to Be Replaced</th>
<th>Estimated Replacement Investment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiology/X-Ray</td>
<td>101</td>
<td>$13,130,000</td>
</tr>
<tr>
<td>Fluoroscopy</td>
<td>46</td>
<td>$25,300,000</td>
</tr>
<tr>
<td>Mammography</td>
<td>4</td>
<td>$1,320,000</td>
</tr>
<tr>
<td>Angio/Interventional</td>
<td>4</td>
<td>$4,400,000</td>
</tr>
<tr>
<td>Bone Mineral Densitometry</td>
<td>4</td>
<td>$400,000</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>15</td>
<td>$2,700,000</td>
</tr>
<tr>
<td>Nuclear Medicine</td>
<td>12</td>
<td>$7,200,000</td>
</tr>
<tr>
<td>CT</td>
<td>4</td>
<td>$8,000,000</td>
</tr>
<tr>
<td>MRI</td>
<td>3</td>
<td>$7,500,000</td>
</tr>
<tr>
<td>ECG</td>
<td>1</td>
<td>$180,000</td>
</tr>
<tr>
<td>Printers and Processors</td>
<td>48</td>
<td>$1,680,000</td>
</tr>
<tr>
<td>RIS and PACS</td>
<td>1</td>
<td>$3,000,000</td>
</tr>
<tr>
<td>SWO Total</td>
<td>250</td>
<td>$74,810,000</td>
</tr>
</tbody>
</table>

Understanding the magnitude of investment required is a critical component of determining the overall state of affairs in DI across SWO. Clearly, there is a significant need for investment in DI throughout SWO. This will be an important point of consideration when requesting funding support from the Ontario MoHLTC, Federal Medical Equipment Fund II, Hospital Foundations, and other external funding sources.
3.2.7.3 Equipment Analysis: CT and MRI Inventory

In addition to the high-level review of the replacement investment required to update DI equipment throughout SWO, the Ontario Association of Radiologists (OAR - 2002) compiled an inventory of the current and recommended number of CT and MRI scanners for the SWO region. The OAR inventory suggests that a total of 18 CTs and 16 MRIs are needed in the SWO region, an increase from the current inventory of 13 CTs and 7 MRIs (refer to Figure 16, below).

Figure 16. SWO DI CT and MRI Inventory – Current and Additional Equipment Required

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>Additional</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>MRI</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The additional CT and MRI scanners recommended for SWO by the OAR indicates an additional significant investment in DI equipment required to help SWO meet the DI demand of its patient care population. The estimated cost of these additional CT and MRI scanners is $35M. This suggests that the total capital equipment investment required to update existing equipment and purchase additional needed equipment would be approximately $110M. This underscores the need for creative funding strategies in DI across SWO.

3.2.7.4 Technology Analysis: PACS Implementation

The final component of the Technology and Equipment Overview involves an examination of the current state of digital radiology or Picture Archive Communication System (PACS) implementation across SWO. A review of the degree of PACS implementation throughout SWO reveals that few hospitals have installed a full PACS system or a mini-PACS system. In total, 11 of 33 hospital sites across SWO have implemented PACS systems, and an additional 5 sites have implemented mini-PACS solutions (Figure 17). This suggests that significant investment and effort are still required to enable digital imaging across SWO.
3.2.8 SWO Service Availability and Waiting List Overview

In order to gain an understanding of the availability of DI services throughout SWO, two final analyses were performed for the quantitative component of the Needs Assessment. First, an inventory of the range in hours of operation for each modality was developed. Second, the current waiting list within each modality was reviewed to determine the magnitude of this challenge, and the impact on DI service availability across SWO.

### 3.2.8.1 Range of Hours of Operation

A review of the range of hours of operation in DI across SWO shows that there is a fair degree of variation in the modality-specific operating hours at each hospital within SWO, ranging from 3 hours/day – 24 hours/day (Figure 18). Overall, larger hospitals tend to have longer operating hours than smaller hospitals – this is particularly observed during the weekend.

A more detailed review of the range of operating hours presented in Figure 18 indicates the following:

- Modalities that are a common component of Ontario hospital emergency services are typically provided on a 24/7 basis. This typically includes on-site General X-Ray service, with call coverage provided for Ultrasound, CT, and MRI. Where SWO hospitals do not provide this level of services, there may be an impact on overall DI service availability, with respect to emergency DI services.

- Modalities such as Mammography, Angio/Interventional, BMD, and Ultrasound are typically provided 12 hours per day, Monday – Friday. In SWO, these modalities are typically provided on an 8-10 hour per day basis. This indicates that the availability of these modalities may be more limited in the region, relative to other areas of Ontario.

- CT and MRI are two DI modalities that are typically provided on a minimum 16-hour per day, Monday – Friday basis, with many Ontario hospitals providing services on weekends, and even on a 24/7 basis. Based on the information provided in Figure 18, this suggests that the SWO region may
have more limited CT and MRI availability than other areas within Ontario, relative to a comparable number of CT and MRI scanners.

### Figure 18. SWO DI Range of Operating Hours by Modality

<table>
<thead>
<tr>
<th>Modality</th>
<th>Mon</th>
<th>Tues</th>
<th>Wed</th>
<th>Thurs</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
<th># of Hospitals Sites That Responded</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-ray</td>
<td>8-24</td>
<td>8-24</td>
<td>8-24</td>
<td>8-24</td>
<td>8-24</td>
<td>3-24</td>
<td>3-24</td>
<td>29</td>
</tr>
<tr>
<td>Fluoroscopy</td>
<td>2-10</td>
<td>2-10</td>
<td>2-10</td>
<td>2-10</td>
<td>2-10</td>
<td>24</td>
<td>24</td>
<td>13</td>
</tr>
<tr>
<td>Portable x-ray</td>
<td>16-24</td>
<td>16-24</td>
<td>16-24</td>
<td>16-24</td>
<td>16-24</td>
<td>4-24</td>
<td>4-24</td>
<td>17</td>
</tr>
<tr>
<td>Mammography</td>
<td>3-24</td>
<td>3-24</td>
<td>3-24</td>
<td>3-24</td>
<td>3-24</td>
<td>3-24</td>
<td>3-24</td>
<td>16</td>
</tr>
<tr>
<td>Angio/Interventional</td>
<td>8-10</td>
<td>8-10</td>
<td>8-10</td>
<td>8-10</td>
<td>8-10</td>
<td>N/A</td>
<td>N/A</td>
<td>5</td>
</tr>
<tr>
<td>BMD</td>
<td>3-8</td>
<td>3-8</td>
<td>3-8</td>
<td>3-8</td>
<td>3-8</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>4-10</td>
<td>4-10</td>
<td>4-10</td>
<td>4-10</td>
<td>4-10</td>
<td>4-8</td>
<td>4</td>
<td>23</td>
</tr>
<tr>
<td>Nuclear Medicine</td>
<td>7.5-10</td>
<td>7.5-10</td>
<td>7.5-10</td>
<td>7.5-10</td>
<td>7.5-10</td>
<td>N/A</td>
<td>N/A</td>
<td>10</td>
</tr>
<tr>
<td>CT</td>
<td>8-24</td>
<td>8-24</td>
<td>8-24</td>
<td>8-24</td>
<td>8-24</td>
<td>8-24</td>
<td>8-24</td>
<td>7</td>
</tr>
<tr>
<td>Biopsies &amp; Aspirations</td>
<td>3-8</td>
<td>3-8</td>
<td>3-8</td>
<td>3-8</td>
<td>3-8</td>
<td>N/A</td>
<td>N/A</td>
<td>6</td>
</tr>
<tr>
<td>Echocardiography</td>
<td>2.5-9</td>
<td>2.5-9</td>
<td>2.5-9</td>
<td>2.5-9</td>
<td>2.5-9</td>
<td>5</td>
<td>N/A</td>
<td>8</td>
</tr>
</tbody>
</table>

#### 3.2.8.2 SWO Service Availability and Waiting List Overview

A review of the average waiting list for each DI modality across SWO shows that the wait is longest for Ultrasound, CT and MRI, where the wait can be up to 4 months, 5 months, and 1 year, respectively (Figure 19). Some hospitals have also reported the need to reduce service hours due to lack of technologist staff and/or Radiologists – resulting in a further increase to the waiting lists.

### Figure 19. SWO DI Waiting List by Modality (as of March 2002)

<table>
<thead>
<tr>
<th>Modality</th>
<th>Average Wait List (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-ray</td>
<td>1</td>
</tr>
<tr>
<td>Fluoroscopy</td>
<td>2</td>
</tr>
<tr>
<td>Portable x-ray</td>
<td>0</td>
</tr>
<tr>
<td>Mammography</td>
<td>4</td>
</tr>
<tr>
<td>Intervventional</td>
<td>3</td>
</tr>
<tr>
<td>Angiography</td>
<td>2</td>
</tr>
<tr>
<td>Bone Mineral Densitometry</td>
<td>6</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>1-16</td>
</tr>
<tr>
<td>Nuclear Medicine</td>
<td>2</td>
</tr>
<tr>
<td>Computed Tomography</td>
<td>5-20</td>
</tr>
<tr>
<td>Magnetic Resonance Imaging</td>
<td>1-52</td>
</tr>
<tr>
<td>Biopsies &amp; Aspirations</td>
<td>2</td>
</tr>
<tr>
<td>Echocardiography</td>
<td>2</td>
</tr>
<tr>
<td>Positron Emission Tomography</td>
<td>N/A</td>
</tr>
</tbody>
</table>
The especially long waiting lists for CT and MRI underscore the need for additional equipment in these modalities, and highlight a patient care risk that is created by the low access to these modalities. An important caveat to this waiting list analysis, which further emphasizes the need for additional investment in equipment and staffing resources, is the fact that the waiting list data analyzed does not capture the patients who are never referred to CT or MRI due to the long waiting lists. Further, it does not capture the volume of patients who are also being referred to ‘second-best’ DI tests (e.g. Ultrasound, X-Ray), until CT and/or MRI tests are available. This creates duplication in workload and expense for DI service delivery across SWO. Since access to the most appropriate DI modalities is not always available, the use of these ‘second-best’ DI tests creates a reduced level of patient care.

### 3.3 DATA ANALYSIS AND REPORTING

As has been identified, the data collection component of the SWO Imaging Needs Assessment presented several data reporting challenges. In considering the future evaluation and monitoring of SWO DI services, staffing, finances and technology, it will be critical to identify the key metrics that can be easily obtained and measured by all participating organizations.

Although the specific Network option/model will determine the complete list of metrics that will be most appropriate, Deloitte suggests that the following information should be collected annually by each SWO hospital:

- **Financial**
  - Total Operating Expenses.
  - Total Film and Related Expenses.
  - Total Technical Fee Revenue.
  - Changes in MOHLTC Funding Levels.

- **Activity**
  - Total Procedures by Type of Patient by Modality.
  - Total Workload by Type of Patient by Modality.

- **Staffing**
  - Current and Projected FTEs by Job Category and Modality.
  - Current and Projected Vacancies by Job Category and Modality.
  - Technologist Staff Productivity by Modality (Total Worked Hours/Total Patient Workload).

- **Service Delivery**
  - Patient Satisfaction.
  - Average Length of Waiting List per Modality.
  - Referring Physician Population by Specialty and Geography.

- **Other**
  - Equipment Inventory with Age, Purchase Cost, Depreciated Value, Annual Service Cost and Productivity, by Modality.
  - New and Existing Clinical Program Announcements and Expected Workload Impact on DI by Modality.
3.4 HIGH-LEVEL QUALITATIVE FINDINGS

3.4.1 Introduction

To complement the quantitative review, a qualitative review was undertaken. Four primary sources were used:

- Review of Documentation.
- DI Management and Physician Surveys.
- CEO Interviews.
- Imaging Physician Interviews.

In this section of this Final Report, a summary of findings in each of these areas is provided. For the purpose of reporting, the documentation review has been integrated into the DI Management and Physician Surveys section.

3.4.2 High-Level Management and Physician Survey Findings

3.4.2.1 Introduction

The Management and Physician Surveys were developed with the purpose of gathering qualitative information from the frontline DI Managers and Physician Chiefs. The surveys were focused on five key areas of investigation, as identified in Figure 20, below:

![Figure 20. SWO DI Management and Physician Survey Areas of Investigation](image)

1. Service Delivery
   - Operating Successes and Challenges
   - Factors Impacting Service Delivery and Demand

2. Finances
   - Capital Acquisition and Management Process
   - Planned Capital Expenditures on Medical Imaging Equipment and Plant
   - Fee-For-Service Threshold
   - Independent Health Facilities

3. Staffing & Recruitment
   - Recruiting and Retention
   - Attendance Management
   - FTE Distribution and Vacancies

4. Technology and Equipment
   - Current and Future Equipment Needs
   - Impact of Equipment on Service Delivery

5. Network Model
   - Critical Success Factors
   - Barriers and Challenges

Response to the surveys, from both DI Managers and Physician Chiefs, was fairly good (refer to Figure 4, pg. 9), and as such the combined summary of findings presented reflects a good cross-representation of key DI stakeholder input from across SWO. For each area of investigation, key strengths across SWO are presented, followed by specific challenges that are also common.
### Strengths

- Although most hospitals are facing staffing, imaging physician, and funding shortages, many have still managed to increase the scope of DI services offered, and the overall hours of service coverage.
- Success in obtaining limited approval through the Special Retention Initiative (SRI) for Radiologists to have their FFS cap removed has helped some hospitals to better meet the demand on DI services, and to shorten patient waiting lists (4 of 10 hospitals that applied for the SRI were successful).
- In consideration of the impact of Nurse Practitioners and Midwives on DI, 8 of 11 participants that responded noted success in meeting an associated minimal increase in demand; however three hospitals noted a more significant impact. It should be noted, however, that this workload adds to the FFS threshold cap imposed on SWO imaging physicians.

### Challenges

- The number of ER DI referrals is increasing, because the decreasing number of physicians in the SWO communities is increasing the demand on Emergency Rooms.
- Physicians that are entering the SWO communities are typically younger and have trained with a high level of diagnostic support, which is increasing the demand on DI generally, and on new DI tools particularly.
- Lengths of DI waitlists are increasing, especially for ultrasound, CT and MRI.
- Turnaround times are increasing due to increased demand, and staffing and physician shortages.
- Changing population demographics (e.g. aging population) are increasing demand on the healthcare system, including DI.
- There is an overall need for more on-call coverage by radiologists.
- Some organizations are still struggling with efforts to attain efficiency in DI that is spread out over multiple sites, post-restructuring.
- The geography of SWO makes it difficult for hospitals to easily share information and radiologists, and increases patient travel for consultations, in the absence of PACS and a Wide Area Network (WAN).
- High patient workload leaves physicians with little time for innovation and development.
- Even with appropriate funding, staff shortage is preventing increase in some services.
- The problem of outdated imaging equipment, combined with an ongoing difficulty to purchase new equipment, makes it more professionally challenging for existing imaging physicians, and less attractive to new recruits.
- Professional FFS thresholds limits are a major source of physician frustration, and impact the overall level of DI service delivery available within SWO.
### 3.4.2.3 DI Management and Physician Survey – Finance

#### Strengths
- Many hospitals are still able to target additional physical plant renovations and equipment purchases related to DI through Foundation and other funding, even in the absence of additional MOHLTC funding.

#### Challenges
- Many hospitals are operating at a deficit, and funding is not available for improvements in DI equipment, staffing, and service delivery levels.
- Most hospitals, and Radiologists, commented that CT is specifically under-funded.
- Overall, there is low capital funding available for DI – especially when that funding is in competition with capital requests from other hospital programs.
- Some hospitals have begun to use their line of credit to fund capital purchases.
- The Radiologist FFS cap is increasing the financial burden on the hospitals (e.g. where an application for the Special Retention Initiative is denied).
- Some hospitals are covering their ER-related DI fees in their global budget.
- Technical fee clawbacks that have been in place (between 1-10%, 7% for the past three years), combined with no technical fee increase in almost 15 years, have made it very difficult to cover the operating costs of expensive DI services.
3.4.2.4 DI Management and Physician Survey – Staffing & Recruitment

**Strengths**

- Many managers report a high degree of loyalty in the technologist staff.
- Imaging physicians are committed to increasing patient access and improving DI services across SWO, even though it has required working beyond their FFS cap in the past few years.
- Many of the hospitals have found creative staffing arrangements to address shortages and improve retention, using such means as self-scheduling, and cross-site coverage.

**Challenges**

- There is an overall shortage of available imaging physicians and technologists (especially for ultrasound and nuclear medicine).
- These positions are proving to be very hard to recruit and retain staff for, for several reasons:
  - Non-competitive salaries compared to the US.
  - Lack of state of the art technology within the recruiting hospital.
  - Lack of wage parity for technologists with RNs.
  - Unattractive location (rural geography, professional isolation).
  - Lack of time for continuing professional education.
- Imaging physician and staff shortages are causing several other challenges:
  - Most imaging physicians are working at or above the FFS salary cap.
  - Part time vacancies are especially a challenge in recruiting.
  - There is increased difficulty in covering sick-time and vacation leaves.
  - There is a growing need for overtime.
- The increased maternity leave allowance from 6 to 12 months has had a noticeable impact, as the majority of technologist FTEs are female.
- The large proportion of female technologist staff has also been reported as a challenge in staffing additional shifts and overtime, as many of the female technologists are reported to be not as likely to work additional hours.
- Some of the smaller hospitals have also reported challenges in creating dedicated management positions for the DI departments, as managers typically have responsibilities for several departments
  - This is reported to have an impact on the depth and expertise that the DI managers are able to develop and apply for their departments.
- There has also been an introduction of unionized staff into some of the DI departments within SWO, so the results of this unionization have yet to be seen.
3.4.2.5 DI Management and Physician Survey – Technology and Equipment

**Strengths**

- Some hospitals have already implemented varying degrees of PACS, CR, and Teleradiography.
- A small number of hospitals report that preliminary use of Teleradiology for the Coordinated Stroke Strategy has already proven to be effective in enabling remote consults and call in select areas.
- Planned capital investment in technology, equipment, and physical renovations demonstrates the high profile that DI has within the SWO region hospitals.

**Challenges**

- The equipment used at SWO hospitals ranges in age and digital capability, but most hospitals with older analog equipment report plans to upgrade to digital equipment that will be able to interface with a PACS system.
- Smaller hospitals need PACS/Teleradiology technology while some of the larger hospitals already have this technology in place.
- Many of the hospitals without PACS plan to install this technology within the next 2-5 years.
- Overall, hospitals commented on the need to need to replace/expand/renovate the physical space available for their DI departments.
- Most hospitals are planning to replace or purchase additional CT, US, and X-Ray equipment in the next 2-5 years.
- Some are also considering the introduction of MRI services in the next 2-5 years.
- Funding shortages and operating deficits are impacting the ability of DI departments to purchase new equipment, and prevent increases in throughput efficiency that can be achieved through new technology.
3.4.2.6 DI Management and Physician Survey – Network Model

Strengths

- There is almost unanimous agreement that a regional service delivery model would be the most effective way to maximize imaging physician availability and minimize costs.
- The common view is that such a service delivery model should be fully integrated and share resources; linking a pool of imaging physicians that can service overloaded/all regions, using the latest technology.

Challenges

- All hospitals acknowledge that this will not be an easy undertaking and challenges such as staffing, payment and coordination or resources and technology will need to be planned carefully.
- There is some concern that not all hospitals would benefit equally from such a Network, with specific reference to how financial, staffing, and technology resources would be distributed between the ‘Haves’ and ‘Have-Not’s within the SWO region.
- Hospitals identified the need for DI services on-site for sites with an active ER and/or OR.
- A regional model that results in some hospitals not having DI on-site was noted as a distinct deterrent for other physicians to join those hospitals.
- Some on-call procedures may fall outside the scope of practice of residents who are on-call at the London hospitals - a challenge for a regional DI on-call service.

For consideration of the Network Model, several DI Managers and Physician Chiefs also provided insight into the critical success factors necessary for a Network model:

- People – accepting change and overcoming the feared loss of resources or employment.
- Defined and planned organizational structure.
- Technology & equipment – established and equitable funding and distribution.
- Buy-in and availability of imaging physicians and technologists.
- Consistent focus on patient care.

Additional ideas suggested through this component of the qualitative review that could contribute to a successful Network model also included the following:

- End the use of imaging physician FFS thresholds – to facilitate increased access to DI services.
- New imaging physician fee pools – to mitigate the existing FFS income cap issues and expectation of expanded role.
- Technologist pool – to decrease impact of staffing shortages; wage equity would be important.
- Teleradiology network and PACS – to decrease impact of imaging physician shortages.
- Sharing/allocation of equipment and funding – to improve use of limited resources across SWO.
- Designated/formal referral patterns between hospitals for CT and MRI - stepwise to LHSC.
- Voice dictation – to avoid challenges of where a report is typed relative to where it is read.
- Strategic sourcing options – to improve use of limited capital and operating resources throughout SWO.
3.4.3 CEO Interview Summary

3.4.3.1 Introduction

An important component of the qualitative assessment of the SWO Imaging Needs Assessment was a series of interviews with hospital CEOs throughout the region. Figure 21, below, presents the CEOs and other key individuals who were interviewed:

*Figure 21. SWO CEOs and Key DI Stakeholders Interviewed*

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Position</th>
<th>Hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natasu Veljovic</td>
<td>CEO</td>
<td>Woodstock</td>
</tr>
<tr>
<td>Diane Beattie</td>
<td>IVP &amp; CIO</td>
<td>London Hospitals (LHSC, SJHC, London)</td>
</tr>
<tr>
<td>Gary Byrne</td>
<td>IVP</td>
<td>London Hospitals (LHSC, SJHC, London)</td>
</tr>
<tr>
<td>Chris O’Callaghan</td>
<td>Manager</td>
<td>Regional Coordinated Stroke Strategy</td>
</tr>
<tr>
<td>Ken Deane</td>
<td>CEO</td>
<td>Hotel Dieu Grace, Windsor</td>
</tr>
<tr>
<td>Dr. Martin Girash</td>
<td>CEO</td>
<td>Windsor Regional Hospital</td>
</tr>
<tr>
<td>Bernie Blais</td>
<td>CEO</td>
<td>Chatham-Kent Health Alliance</td>
</tr>
<tr>
<td>Dave Vigar</td>
<td>CEO</td>
<td>Lambton Hospitals Group</td>
</tr>
<tr>
<td>John Sutherland</td>
<td>CEO</td>
<td>Huron Perth Hospitals Partnership</td>
</tr>
<tr>
<td>Pat Campbell</td>
<td>CEO</td>
<td>Grey Bruce Health Services</td>
</tr>
<tr>
<td>Warren Chant</td>
<td>CEO</td>
<td>Leamington District Memorial hospital</td>
</tr>
<tr>
<td>Andrew Williams</td>
<td>VP</td>
<td>Stratford General Hospital (HPHP)</td>
</tr>
</tbody>
</table>

The CEO interviews were based on the same five key areas of investigation as the DI Management and Physician Surveys (as per Figure 20, pg. 23):

1. Service Delivery
2. Finances
3. Staffing & Recruitment
4. Technology and Equipment
5. Network Model

For each area of investigation, key strengths are presented, followed by specifically noted challenges that are common across the interviewed stakeholders.
### 3.4.3.2 CEO Interviews – Service Delivery

**Strengths**
- CEOs understand and support the need for expanded and strengthened DI service delivery.
- CEOs are cognizant of the barriers/obstacles and challenges to DI service delivery, particularly those posed by human resources and funding; indeed, CEOs initiated discussions about regional service delivery (“Network”) approaches, driven, in large part, by human resource shortages.
- Smart Systems for Health is building the network infrastructure, without which a regional delivery system could not be supported.

**Challenges**
- There is an acknowledged critical shortage of key human resources, specifically imaging physicians and technologists, and a further acknowledgement that the shortages will likely become more severe before they get better.
- There is a huge issue pertaining to funding; quite simply, the Ministry does not fund IT investments such as PACS, and this is a major impediment to developing a regional approach/model.

### 3.4.3.3 CEO Interviews – Finance

**Strengths**
- Many hospitals have, or are in the throes of debating, a commitment to invest in PACS.
- Many hospitals have a vision for, and commitment to, an electronic health record and investing in technology to help them migrate toward an electronic record.

**Challenges**
- Many hospitals are operating at a deficit, and funding for DI equipment is simply not a high priority.
- Because the Ministry does not fund IT and most DI equipment needs, hospitals are left to their own to raise the necessary funds. The result is wide variability in the IT infrastructure necessary to support service delivery.
- The Ministry does not accept that IT is integral to DI service delivery.
- Caps on Radiology fee-for-service are seen as a major impediment to resolving/alleviating physician shortages.
### 3.4.3.4 CEO Interviews – Staffing & Recruitment

**Strengths**
- CEOs recognize that recruitment and retention is the primary reason for new approaches to service delivery, and is the driver in considering a regional model.

**Challenges**
- There is an overall shortage of available imaging physicians and technologists.
- An alternative to compensate for the existing shortage of imaging physicians is to raise/eliminate fee-for-service caps. This is seen as a fundamental impediment to moving to a Regional model.
- A Region-wide PACS system could very well attract technologists and imaging physicians by offering them state-of-the-art equipment. Without this in place, hospitals will be left on their own to attract technologists and imaging physicians.

### 3.4.3.5 CEO Interviews – Technology and Equipment

**Strengths**
- Some hospitals have already implemented varying degrees of PACS, CR, and Teleradiography.
- Planned capital investment in technology, equipment, and physical renovations demonstrates the high profile that DI has within the SWO region hospitals.

**Challenges**
- Funding is the biggest challenge; each hospital has to raise its own funds; therefore, investment decisions vary widely among hospitals, as does the state of their equipment and technology infrastructure.
- Hospitals use different vendors; some wonder if this will pose an additional challenge for developing a regional system.
3.4.3.6 CEO Interviews – Network Model

**Strengths**

- There is near unanimity that a regional service delivery model could be the most effective and efficient way to maximize the use of existing human resources.
- There is strong support for the notion that a regional delivery model could be a cost-effective way to utilize DI equipment.
- There is a firmly held belief that a regional model could significantly benefit patient care, both in terms of enhanced quality and improved access.

**Challenges**

- The wide variability that currently exists among hospitals, in terms of infrastructure, capabilities and capacity, and the priority of DI investments will not be easily resolved/overcome.
- There is a perception among some hospitals that the London hospitals will ‘dominate’ the regional Network.
- The distribution of key DI resources (human and equipment) will be a major issue to manage, in terms of balancing local needs and a regional model.
- Ministry policy with respect to fee-for-service caps, no funding for IT infrastructure and grossly inadequate funding for equipment are seen as major impediments.
- There is no financial business case for PACS.

For consideration of the Network Model, several CEOs also provided insight into the critical success factors necessary for a Network model:

- CEOs must be committed to the concept, supporting/promoting it, both internally and externally among colleagues/peers and with the Ministry.
- CEOs must ensure the alignment of local needs with a Network model/approach.
- The Network model must improve the effective and efficient use of resources (both human and equipment).

Additional ideas suggested through this component of the qualitative review that could contribute to a successful Network model also included the following:

- Remove imaging physician FFS cap.
- Technologist pool.
- Sharing/allocation of equipment and funding – to improve use of limited resources across SWO.
- Network-wide PACS system, migrating, over time, to standardized/common vendors.
- Network-wide scheduling system.
- Network-wide image routing system and on-call system.
3.4.4 DI Physician Chiefs Interview Summary

3.4.4.1 Introduction

In order to better understand the Radiologist and Nuclear Medicine physician perspective on the SWO regional imaging needs, a series of interviews with DI Physician Chiefs was conducted. Figure 22, below, presents the DI Chief Physicians that were included in the list of interviewees:

*Figure 22. SWO DI Physician Chiefs Interviewed*

<table>
<thead>
<tr>
<th>Physicians (Radiology/Nuclear Medicine)</th>
<th>Hospitals</th>
<th>Interviewed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Richard Rankin [R]</td>
<td>London Health Sciences Centre</td>
<td>Not Available</td>
</tr>
<tr>
<td>Dr. Lisa Thain [R]</td>
<td>London Health Sciences Centre</td>
<td>✓</td>
</tr>
<tr>
<td>Dr. Don Taves [R]</td>
<td>St. Joseph's Health Care, London</td>
<td>✓</td>
</tr>
<tr>
<td>Dr. Larry Nicholson [NM]</td>
<td>Chatham-Kent Health Alliance</td>
<td>✓</td>
</tr>
<tr>
<td>Dr. Colin McIver [R]</td>
<td>Grey Bruce Health Services</td>
<td>✓</td>
</tr>
<tr>
<td>Dr. Doug Mowbray [R]</td>
<td>South Bruce Grey Health Centre</td>
<td>✓</td>
</tr>
<tr>
<td>Dr. King Mahon [R]</td>
<td>Sarnia General Hospital site (LHG)</td>
<td>✓</td>
</tr>
<tr>
<td>Dr. Yale Erenberg [R]</td>
<td>Wingham, Kincardine, Durham</td>
<td>✓</td>
</tr>
<tr>
<td>Dr. Winston Ramsewak [R]</td>
<td>Windsor Regional Hospital</td>
<td>✓</td>
</tr>
<tr>
<td>Dr. Peter Tadros [R]</td>
<td>Hotel Dieu Grace Hospital, Windsor</td>
<td>✓</td>
</tr>
<tr>
<td>Dr. Kevin Tracey [NM]</td>
<td>Hotel Dieu Grace Hospital, Windsor</td>
<td>✓</td>
</tr>
</tbody>
</table>

* [R] = Radiologist, [NM] = Nuclear Medicine Physician

The DI Physician Chief interviews were based on the same five key areas of investigation as the DI Management and Physician Surveys, and CEO Interviews (as per Figure 20, pg. 23):

1. Service Delivery
2. Finances
3. Staffing & Recruitment
4. Technology and Equipment
5. Network Model

For each area of investigation, key strengths are presented, followed by specifically noted challenges that are common across the interviewed Physician Chiefs.
3.4.4.2 Physician Chief Interviews – Service Delivery

**Strengths**

- There is an increased recognition of the importance of DI and the need for more DI equipment approvals.
- DI departments across SWO are providing high quality patient care.
- PACS implementation and/or planning is underway in the majority of hospitals.
- DI has an excellent service reputation across the region.

**Challenges**

- Acute shortage of DI physicians in every SWO community.
- Major shortage of DI physicians across Ontario.
- Insufficient number of newly trained DI physicians and technologists to meet existing demand.
- No human resources strategy to cope with future needs.
- Recruitment and retention of DI physicians is becoming increasingly more difficult.
- FFS thresholds are limiting patient access to more physicians, including imaging physicians.
- Large amount of outdated DI equipment.
- Difficulty to obtain new radiology equipment approvals at hospital and MOH levels.
- Insufficient funding for DI services.
- Lack of trained technologists.
- Increased level of competition from U.S. border communities for DI human resources.
- Perception that Ontario government is hostile to medical technology investment, particularly DI equipment.
- Waiting lists that are too long for all DI modalities, all which continue to grow.
- Lack of collaboration among SWO sites to meet patient care needs.
3.4.4.3 Physician Chief Interviews – Finance

### Strengths
- 2001/02 federal funding resulted in replacement of some urgently required DI equipment.
- Improved perception that the new $1.5 billion of federal Health Accord funding will deal with other outdated equipment needs.
- Increased MOH funding to hospitals has relieved some of the immediate diagnostic pressures.

### Challenges
- MOH funding cuts have impeded the ability of DI physicians to provide outpatient services using modern radiology infrastructure.
- Lack of technical fee funding to support the operation and maintenance of new digital radiology equipment.
- Funding CT and PET services remains a serious challenge to hospitals.
- Hospital deficits are used by the MOH to withhold approvals for new DI services or equipment.
- Hospital foundations are expected to fund more equipment purchases.

3.4.4.4 Physician Chief Interviews – Staffing & Recruitment

### Strengths
- Well-trained DI physicians and technologists are committed to their hospitals and communities.
- Access to sub-specialized DI physicians is available in London.
- There is a critical mass of sub-specialty DI resources in specific SWO centres.
- There is an increased number of threshold exemptions for imaging physicians.
- There are improved recruitment efforts by hospitals to address shortages.

### Challenges
- Acute shortages of DI physicians and technologists across the region.
- Major shortage of Radiologists/Nuclear Medicine physicians in Ontario aggravates ability to attract imaging specialists to the SWO region.
- Small towns and rural areas are facing decreased attractiveness to DI and other physicians, without ability to offer full array of DI services.
- Increased number of DI physicians over the FFS threshold.
- Increased training period for technologists has caused an interruption in the supply of technical staff; especially in Nuclear Medicine.
- Lack of new equipment and key modalities like CT and MRI to attract DI physicians and other referring physicians.
- Aging physician population and increased feminization of medical profession have added pressures to the availability of physicians.
- Growing workload caused by aging population and announcement of new health care initiatives not matched with incentives.
### 3.4.4.5 Physician Chief Interviews – Technology and Equipment

**Strengths**
- Widespread recognition that modern DI equipment and modalities are essential to health care delivery.
- Some important improvement to certain key DI modalities and outdated services.
- Greater presence of PACS.
- Stronger commitment from hospitals to fund equipment investment.

**Challenges**
- Large disparity in age of DI equipment and availability in key modalities such as CT, MRI, PET.
- Ontario government cutbacks have hurt hospitals’ capability to replace equipment.
- Inability to move from film-based environment to PACS, due to funding shortfall.
- Lack of equipment inventory management and planning.
- Increased risk of medical liability and legal exposure to hospitals due to outdated equipment and inability to provide the most appropriate examination.
- Lack of modern diagnostic infrastructure has:
  - Hurt recruitment and retention efforts.
  - Failed to optimize DI physicians’ training and skills.
  - Impacted DI physicians’ ability to provide the required level of service to referring physicians.

### 3.4.4.6 Physician Chief Interviews – Network Model

**Strengths**
- Opportunity to improve access for some patients for specific examinations.
- Could support small town hospital radiology groups to provide after-hours patient care services.
- Increased ability to bring sub-specialized skills to smaller and mid-sized communities.
- Introduction of “night hawk” services for the region’s after-hours needs.

**Challenges**
- Lack of DI physician resources to provide a regional service.
- Hospital restructuring has been a negative experience for many DI physicians.
- There is currently no PACS infrastructure to support a regional model.
- Huge investment is required to introduce new DI equipment that would operate in a PACS environment.
- Constantly changing health care environment and lack of funding stability.
- Perception that MOH is unreceptive to the introduction of new medical technologies and DI funding, especially for newer modalities.
- Lack of a financial incentive to ‘take on another headache’.
With respect to the Network Model, several Physician Chiefs also provided insights into the critical success factors necessary for a Network model:

- Major funding investment in new imaging equipment and PACS.
- Increased number of DI training positions in London to train Radiologists and Nuclear Medicine physicians who will continue to work in the region.
- Creation of a broadband Wide Area Network dedicated to a mission critical imaging service.
- Support from DI physicians.
- Increase number of DI technologists to handle the growing workload.

### 3.5 Literature Review and Best Practice Findings

#### 3.5.1 Introduction

A review of DI literature and best practices was undertaken to complement the qualitative findings, and was one of the key components of the Needs Assessment. In an attempt to capture and integrate best practices into the option development phase of the project, a review was completed of DI literature published in the past 5 years in Canada, U.S, U.K., and Australia. In addition to this literature review, a high-level review of best practice models currently underway in Canada was also conducted. The purpose of this review of best practices, as well as current network models of diagnostic imaging, was to identify key lessons that will aid SWO in the consideration of its Network imaging options.

The literature review and best practice findings were consistent with the information provided through the participant surveys and interviews, and as such have been collected into the same five key areas of investigation (as per Figure 20, pg. 23):

1. Service Delivery  
2. Finances  
3. Staffing and Recruitment  
4. Technology and Equipment  
5. Network Model

For the purpose of reporting, a high level summary of information is presented in each of the five key areas. More detailed information is provided about three specific examples of organizations that have already moved towards a network model, in the ‘Lessons from the Field’ subsection. The review of best practices concludes with an additional internal review of current DI best practices that can be leveraged from organizations within SWO.

For a complete listing of the primary references used for input into this summary, please refer to Appendix C.
3.5.2 High-Level Literature Review and Best Practice Findings

3.5.2.1 Literature Review and Best Practice Findings – Service Delivery

Findings from the literature suggest that service delivery can be improved through a network model, assuming that a network-wide DI information system is established. Specific elements of service delivery that are highlighted in the literature as areas for improvement include:

- Increased DI service availability after-hours through remote physician on-call coverage.
- Improved patient access to DI services through remote consultation.
- Improved patient satisfaction in DI services due to faster report turnaround and reduction in duplicate testing/film transportation.
- Improved service to referring community physicians.

3.5.2.2 Literature Review and Best Practice Findings – Finances

Findings from the literature related to finances focused on technology-based financial drivers. Specifically, findings from the literature indicate that implementation of PACS and Voice Recognition can provide a financial savings, but requires a varying degree of investment, depending on the network model selected. A network model can reduce costs through achieving economies of scale in the following:

- Maximizing use of limited financial resources.
- Sharing costs of technology (network infrastructure, PACS, etc.).
- Reduction in costs associated with duplicate testing.

3.5.2.3 Literature Review and Best Practice Findings – Staffing and Recruitment

Findings from the literature suggest that adoption of a network model can aid staffing and recruitment through several channels:

- Maximization of DI physician resources, through shared after-hours call coverage, and sharing of expertise.
- Technologist pools to maximize staff resources –particularly with respect to part-time staff, and after-hours service delivery.
- Provision of in-services by technologists from sub-specialized areas of DI to promote cost-effective inter-organization staff education and upskilling.
- Coordinated DI physician staffing can provide improved coverage for CME and vacations.
3.5.2.4 Literature Review and Best Practice Findings – Technology and Equipment

Five key technology enablers were consistently identified as critical to a regional DI model:

1. RIS
2. PACS
3. Voice Recognition
4. WAN/Broadband Networks
5. Teleradiology

Further, the literature suggests that given appropriate investment and planning, the technological linkage between hospitals within a network should be seamless and an enabler, not a source of challenge to the task of delivering DI services. The digital imaging system must meet the needs of the DI users with respect to: immediacy of image transmission, appropriate image resolution, and flexibility to match the system expertise of the user. Digital imaging is also noted to be an excellent enabler of shared DI call and consultation coverage, enabling a network to maximize the use of scarce DI physician resources, especially during off-hours.

3.5.2.5 Literature Review and Best Practice Findings – Network Model

Several key factors for success were identified as critical in the transition to a regional model. These include the following:

- Making a shift from the hospital to a regional paradigm.
- Having equity in ownership, governance and financing of the regional model.
- Having clear roles and responsibilities at all levels of the region.
- 100% implementation of RIS, PACS, Voice Recognition and a WAN will maximize the benefit of a regional model.
- Making investments in education and upskilling for new technologies and processes across the region for physicians and technologists.
- Having a high level of communication throughout the transition with all stakeholders.

3.5.3 Lessons from the Field

In addition to the high-level review of DI literature and best practices, a review of the key lessons learned from other organizations that have implemented intra- and inter-facility DI systems was undertaken. These lessons provide helpful guidance in implementation planning, as well as offer examples of organizations that may be available for further consultation, during the SWO implementation.

Although several examples and lessons exist, three initiatives are highlighted here, along with the organizations that generated them:

- Inter-hospital PACS Financing Agreements: NORad Network 13 initiative (Cochrane District, Ontario).
- Physician Recruitment and Retention: Tele-i4 initiative (Atlantic Canada).
- Master Patient Index: TelePACS 2.0 initiative (Crete, Greece).
Examples of other external organizations that have undertaken (or are undertaking) the development of similar inter-facility diagnostic imaging networks include:

- Capital Health Authority, BC
- Fraser Valley Health Authority, BC
- Calgary Health Region, AB
- University Health Network, ON
- McGill University Health Centre, QC
- Department of Defence, U.S.A.

Lessons learned by SWO member organizations that have already undertaken the development of a PACS network across multiple facilities, such as the Lambton Hospitals Group and the Chatham-Kent Health Alliance, will also be highlighted.

### 3.5.3.1 Lessons from the Field: Inter-Hospital Financing Agreements - NORrad

*NORrad* is a diagnostic imaging collaboration by nine hospitals in northern Ontario, in the catchment area between Timmins and James Bay, serving a population of 150,000 residents. This project has been spearheaded by Dr. Claude Vezina (Chief of Diagnostic Imaging, Timmins & District Hospital).

In order to ensure the financial viability of the project, it was important to develop an inter-hospital agreement that focused both on operating and capital funding for the implementation of a PACS network among the participating hospitals.

- Capital funding for *NORrad* came from a combination of hospital investments from the nine hospitals, in addition to federal (Medical Equipment Fund I) and provincial funds.
- The project is designed to operate on a cost-recovery basis that will be realized almost annually, after the first year (based on reduction of film and associated costs, and not inclusive of depreciation costs).

The key lesson learned from this practical example from the field is that, whereas financing may be considered a substantial barrier to further DI collaboration among SWO hospitals, NORad presents a clear ‘best practice’ of Ontario hospitals coming together in an inter-hospital financing agreement to facilitate improved DI service delivery in their area.

### 3.5.3.2 Lessons from the Field: Physician Recruitment and Retention – Tele-i4

*Tele-i4* is a joint health information sharing effort funded by the four governments of Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland. Included in the *Tele-i4* project was the target of implementing an inter-connected PACS across Atlantic Canada by the end of 2002. The majority of this implementation has been achieved according to plan.

As this project was implemented, improvements in system and physician efficiency were noted. Of key importance is the observation by one of the key stakeholders of the project, Dr. Paul LeBrun (Chief of Diagnostic Imaging, Queen Elizabeth II Health Sciences Centre, Halifax), about the impact on physician recruitment and retention in rural areas:
Dr. LeBrun is reported to have found that having a PACS networked through rural and urban areas helped to make solo physician and radiology practices more attractive by making central specialist support immediately available.

In addition the *Tele-i4* project is expecting to improve physician retention, because “it can also put outlying physicians in touch with continuing medical education, which may make rural practices somewhat less professionally isolated.”

The key lesson learned from this practical example from the field is that the establishment of a DI network across a series of organizations created an improved forum for physician continuing medical education (CME), and for improved physician recruitment and retention.

### 3.5.3.3 Lessons from the Field: Master Patient Index – TelePACS 2.0

The *TelePACS 2.0* initiative was undertaken by the region of Crete, in Greece, to establish an ‘integrated health telematics network’ that would provide diagnostic imaging image and information sharing capabilities across more than 30 facilities. In developing the framework for this network, a critical component that was identified was the concept of a master patient index. It was seen as one of the central elements of the inter-facility PACS network.

By developing standard and common patient data elements across the patient records in local vendor and information systems, multiple autonomous diagnostic imaging systems can be integrated to share patient information and images.

Further it was found that developing a master patient index facilitates the intelligent management of patient data in diagnostic imaging, such that comparable functionality and services can be established within each hospital of the network.

The key lesson learned from this practical example from the field is that the development of a DI master patient index across all organizations within the network facilitated the sharing and management of patient information. This will also contribute to more effective and efficient patient care delivery within DI, as duplication of DI tests across multiple organizations can be reduced/eliminated within the network.

### 3.5.4 Current SWO Hospital Initiatives

From the preliminary stages of the Situational Assessment, it was determined that some SWO hospitals already have, or are well underway to having, PACS fully implemented. This includes:

- Chatham-Kent Health Alliance
- Hanover & District Hospital
- Lambton Hospitals Group
- Listowel Memorial Hospital and Wingham & District Hospital
- St. Joseph’s Health Care, London
In addition to this group, several other hospitals have already identified plans to implement a full PACS in the next 1-2 years. This includes:

- Alexandra Marine & General Hospital, Clinton Public Hospital, and South Huron Hospital
- Grey Bruce Health Services
- South Bruce Grey Health Centre
- Thames Valley Hospital Planning Partnership
- Hotel Dieu Grace Hospital, Windsor
- Windsor Regional Hospital

The current level of PACS and RIS implementation will be an important factor in the implementation of the SWO model, especially with respect to the following:

- **Timing**, and feasibility of beginning to implement the model.
- **Funding**, and how/if hospitals with PACS and RIS already implemented will receive ‘credit’ for their efforts in moving the SWO DI agenda forward.
- **Leadership**, and how internal lessons learned can be leveraged to ease implementation of the SWO imaging model.

Another key area for determination of where current SWO hospital initiatives can be leveraged is human resources. Where human resources strategies exist that improve recruitment and retention, investigation should be conducted to determine if these strategies can be expanded throughout the SWO Network.

Incorporation of current SWO hospital, provincial and national initiatives into a Network model will be a critical success factor and will provide an excellent platform from which to leverage further SWO DI collaboration.

### 3.6 Situational Assessment Conclusion

A summary of the findings from the Situational Assessment has been incorporated into the SWOT Analysis in section 4.0. Following this analysis, an integrated summary of the Situational Assessment and SWOT Analyses is provided (Section 5.0).
4.0 SWOT Analysis

4.1 INTRODUCTION

The SWOT Analysis integrates the findings from the quantitative, qualitative and literature/best practice information that was reviewed. A number of key elements that will contribute to option development have been identified. They are grouped into four categories:

1. **Strengths**
2. **Weaknesses**
3. **Opportunities**
4. **Threats**

The SWOT Analysis is based on the same five key areas of investigation as Situational Assessment (as per Figure 20, pg. 23):

1. Service Delivery
2. Finances
3. Staffing & Recruitment
4. Technology and Equipment
5. Network Model

4.2 SWOT ANALYSIS – SERVICE DELIVERY

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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</thead>
<tbody>
<tr>
<td>- Loyalty/Commitment of Radiologists</td>
<td>- Availability of Capital Funds</td>
</tr>
<tr>
<td>- Loyalty/Commitment of Technologists</td>
<td>- Radiologist Shortages</td>
</tr>
<tr>
<td>- CEO Support for DI</td>
<td>- Technologist Shortages (FT and PT)</td>
</tr>
<tr>
<td>- Breadth and Depth of DI Physician Expertise</td>
<td>- Proportion of Outdated/Analog Equipment</td>
</tr>
<tr>
<td>- Expected Growth in DI Services</td>
<td>- Low Level of PACS Implemented</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Sharing of Best Practices</td>
<td>- Hospital Deficits</td>
</tr>
<tr>
<td>- Formal Referral Relationships between Hospitals</td>
<td>- Lack of MOH Funding Support for SWO Network-level Initiatives</td>
</tr>
<tr>
<td>- Patient and Physician Education about DI</td>
<td>- Lack of MOH Funding Support for DI Technology</td>
</tr>
<tr>
<td>- IHFs and Potential for Increase in Private DI</td>
<td>- U.S. Technologist Recruitment Efforts</td>
</tr>
<tr>
<td>- New Roles for DI Including Disease Screening</td>
<td>- Radiologist and Technologist Shortages</td>
</tr>
</tbody>
</table>

- Radiologist FFS Cap
- Increasing Demand on DI from New Physicians
- Increasing Patient Demand
- IHFs and Potential for Increase in Private DI
- Competition with Subspecialists for Equipment/Turf
- Increased Demand on Foundations for Funding
### 4.3 SWOT Analysis – Finances

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ CEO Support for DI</td>
<td>▪ Availability of Capital Funds</td>
</tr>
<tr>
<td>▪ Strong DI Capital Support in Face of Limited Funds</td>
<td>▪ Radiologist Shortages</td>
</tr>
<tr>
<td>▪ Expected Growth in DI Services</td>
<td>▪ Technologist Shortages (FT and PT)</td>
</tr>
<tr>
<td></td>
<td>▪ Proportion of Outdated/Analog Equipment</td>
</tr>
<tr>
<td></td>
<td>▪ Proximity to the U.S.</td>
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<td></td>
<td>▪ Prospect of Increased On-Call Payments to Radiologists</td>
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<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Special Retention Initiative</td>
<td>▪ Hospital Deficits</td>
</tr>
<tr>
<td>▪ Equipment and Resources Management</td>
<td>▪ Lack of MOH Funding Support for SWO Network-level Initiatives</td>
</tr>
<tr>
<td>▪ Formal Referral Relationships between Hospitals</td>
<td>▪ Lack of MOH Funding Support for DI Technology</td>
</tr>
<tr>
<td>▪ IHFs and Potential for Increase in Private DI</td>
<td>▪ U.S. Technologist Recruitment Efforts</td>
</tr>
<tr>
<td>▪ Shared Strategic Sourcing Arrangements</td>
<td>▪ Radiologist and Technologist Shortages</td>
</tr>
<tr>
<td>▪ Position the Needs of Referring Physicians to Advocate for Additional DI Funding Resources</td>
<td>▪ Radiologist FFS Cap</td>
</tr>
<tr>
<td></td>
<td>▪ Increasing Demand on DI from New Physicians</td>
</tr>
<tr>
<td></td>
<td>▪ Increasing Patient Demand</td>
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<tr>
<td></td>
<td>▪ IHFs and Potential for Increase in Private DI</td>
</tr>
<tr>
<td></td>
<td>▪ Competition with Subspecialists for Equipment/Turf</td>
</tr>
<tr>
<td></td>
<td>▪ Globalization of Outpatient Technical Fees (HIAC)</td>
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</tbody>
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### 4.4 SWOT Analysis – Staffing and Recruitment

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Loyalty/Commitment of Radiologists</td>
<td>▪ Radiologist Shortages</td>
</tr>
<tr>
<td>▪ Loyalty/Commitment of Technologists</td>
<td>▪ Technologist Shortages (FT and PT)</td>
</tr>
<tr>
<td>▪ CEO Support for DI</td>
<td>▪ Proportion of Outdated/Analog Equipment</td>
</tr>
<tr>
<td>▪ Breadth and Depth of DI Physician Expertise</td>
<td>▪ Low Level of PACS Implemented</td>
</tr>
<tr>
<td>▪ Degree of PACS and Teleradiology Implementation</td>
<td>▪ Proximity to the U.S.</td>
</tr>
<tr>
<td>▪ Expected Growth in DI Services</td>
<td>▪ Increased Professional Fee Cost</td>
</tr>
<tr>
<td></td>
<td>▪ Mixed Support by Radiologists for Regional Model</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Radiologist Fee Pool and Remote Call Coverage</td>
<td>▪ Hospital Deficits</td>
</tr>
<tr>
<td>▪ Special Retention Initiative</td>
<td>▪ Lack of MOH Funding Support for SWO Network-level Initiatives</td>
</tr>
<tr>
<td>▪ Technologist Pool</td>
<td>▪ Lack of MOH Funding Support for DI Technology</td>
</tr>
<tr>
<td>▪ Sharing of Best Practices</td>
<td>▪ U.S. Technologist Recruitment Efforts</td>
</tr>
<tr>
<td>▪ Formal Referral Relationships between Hospitals</td>
<td>▪ Radiologist Shortages</td>
</tr>
<tr>
<td></td>
<td>▪ Radiologist FFS Cap</td>
</tr>
<tr>
<td></td>
<td>▪ Technologist Shortages (FT and PT)</td>
</tr>
<tr>
<td></td>
<td>▪ Increasing Demand on DI from New Physicians</td>
</tr>
<tr>
<td></td>
<td>▪ Increasing Patient Demand</td>
</tr>
<tr>
<td></td>
<td>▪ IHFs and Potential for Increase in Private DI</td>
</tr>
<tr>
<td></td>
<td>▪ Private clinic MRI and CT approvals</td>
</tr>
</tbody>
</table>
### 4.5 SWOT Analysis – Technology and Equipment

#### Strengths
- CEO Support for DI
- Strong DI Capital Support in Face of Limited Funds
- Degree of PACS and Teleradiology Implementation
- Expected Growth in DI Services

#### Weaknesses
- Availability of Capital Funds
- Proportion of Outdated/Analog Equipment
- Low Level of PACS Implemented

#### Opportunities
- PACS, Teleradiology, and Voice Dictation
- Sharing of Best Practices
- Equipment and Resources Management
- IHFs and Potential for Increase in Private DI
- Shared Strategic Sourcing Arrangements

#### Threats
- Hospital Deficits
- Lack of MOH Funding Support for SWO Network-level Initiatives
- Lack of MOH Funding Support for DI Technology
- Increasing Demand on DI from New Physicians
- Increasing Patient Demand
- IHFs and Potential for Increase in Private DI
- Competition with Subspecialists for Equipment/Turf

#### Weaknesses
- Availability of Capital Funds
- Radiologist Shortages
- Technologist Shortages (FT and PT)
- Proportion of Outdated/Analog Equipment
- Low Level of PACS Implemented
- Proximity to the U.S.
- Lack of Direct Control Over Referrals to DI
- Lack of SWO Decision-Making Body
- Geography – Distance and Weather

### 4.6 SWOT Analysis – Network Model

#### Strengths
- Loyalty/Commitment of Radiologists
- Loyalty/Commitment of Technologists
- CEO Support for DI
- Breadth and Depth of DI Physician Expertise
- Strong DI Capital Support in Face of Limited Funds
- Degree of PACS and Teleradiology Implementation
- Overall Support for Regional Model/Approach
- Expected Growth in DI Services

#### Weaknesses
- Availability of Capital Funds
- Radiologist Shortages
- Technologist Shortages (FT and PT)
- Proportion of Outdated/Analog Equipment
- Proximity to the U.S.
- Lack of Direct Control Over Referrals to DI
- Lack of SWO Decision-Making Body
- Geography – Distance and Weather

#### Opportunities
- PACS, Teleradiology, and Voice Dictation
- Radiologist Fee Pool and Remote Call Coverage
- Special Retention Initiative
- Technologist Resource and Education Pool
- Sharing of Best Practices
- Equipment and Resources Management
- Formal Referral Relationships between Hospitals
- Patient and Physician Education about DI
- IHFs and Potential for Increase in Private DI
- New Roles for DI Including Disease Screening
- Shared Strategic Sourcing Arrangements
- Link with Regional Electronic Health Record

#### Threats
- Hospital Deficits
- Lack of MOH Funding Support for SWO Network-level Initiatives
- Lack of MOH Funding Support for DI Technology
- U.S. Technologist Recruitment Efforts
- Radiologist Shortages
- Radiologist FFS Cap
- Technologist Shortages (FT and PT)
- Increasing Demand on DI from New Physicians
- Increasing Patient Demand
- IHFs and Potential for Increase in Private DI
- Competition with Subspecialists for Equipment/Turf
- Patient Privacy/Confidentiality
5.0 Summary of Findings

5.1 FINDINGS SUMMARY: DRIVERS OF OPTION DEVELOPMENT

The Situational Assessment and SWOT Analysis revealed ten factors as the primary drivers for change:

1. DI finances are impacted by technical fee clawbacks, hospital deficits, increasing patient needs, physician FFS caps, high demand on hospital foundations for capital funding, and the potential globalization of technical fees (HIAC).

2. Lack of MOH funding for SWO activities and DI technology means that SWO hospitals will have to self-fund, or find alternative funding sources (e.g. MEF2, foundations, etc.).

3. The current shortage of Imaging Physicians and Technologists is expected to increase over the next several years.

4. There is a large amount of outdated equipment throughout SWO, which is impacting the level of patient care and service delivery that can be achieved.

5. There is a low level of PACS currently implemented, and a lack of a SWO-wide WAN – all of which create a challenge in the sharing of images and reports for improved patient care and access.

6. Imaging Physicians note difficulty with increasing service demands, outdated imaging equipment, and current physician shortage, especially with respect to on-call after-hours coverage.

7. The demand for DI services is increasing through both referring physician and patient demand, as well as an expansion of the scope and role of DI services (e.g. disease screening and interventional work). An example of this is observed in the expansion of major clinical programs, such as cancer care, which are highly dependent on DI to deliver their patient care services.

8. There is a desire and need for increased continuing medical education time and funding for physicians and technologists.

9. Physician and technologist staffing, recruitment and retention are impacted by physician FFS caps, discrepancies in technologist salaries, SWO geography, and hospital deficits.

10. SWO geography includes weather and distance challenges – which will impact potential sharing and/or distribution of resources.

These key drivers for change were considered as part of the preferred model selection process for Diagnostic Imaging in SWO.
6.0 Option Development and Value Analysis

6.1 Option Development and Value Analysis Overview

The findings from the Situational Assessment and SWOT Analysis revealed several opportunities for improving DI service delivery that could be achieved through a Network-wide collaboration across SWO. In order to consider the different service delivery and collaboration models/options that would be both appropriate and feasible for the SWO DI Network to consider, the following 6-step process was undertaken:

1. Identify Purpose and Scope of Strategic Options.
2. Identify Principles for Strategic Option Development.
4. Develop Preliminary Strategic Options.
5. Validate Strategic Options with the Operational Coordinating Team.
6. Conduct Value Analysis Workshop with Oversight Committee to Select Preferred Strategic Option(s).

This process involved significant stakeholder input, from both the Operational Coordinating Team and the Project Oversight Committee. A series of meetings and workshops were held to solicit feedback, build consensus, and determine the optimal service delivery model for DI across SWO. A consolidation of this process is presented in this Final Report.

The first stage in the option development and value analysis process has been iterated throughout the Situational Assessment and SWOT Analysis, and is captured here as a summary of the primary objective of this Needs Assessment: to develop a SWO DI Network model to improve DI service delivery across the Network, with specific attention to alleviating the impact of human resources and capital funding shortages on patient care delivery and access to DI services.

6.2 Principles and Criteria for Option Development

The following guiding principles for option development were selected:

- Increased coordination of service delivery.
- Improved patient care and equitable access to DI services across SWO (at SWO and local levels).
- Improved overall distribution of funding, staffing, and DI physicians relative to reported shortages.
- Improved linkages between hospitals within SWO.
- 100% interoperable PACS and WAN implementation across all modalities and hospitals (DICOM and HL7 compliant, regardless of vendor).
- Enabling of remote access to images, call coverage, and consultation.
- A coordinated approach to SWO training and education of imaging physicians and technologists.
Findings from the Situation Assessment also suggest the following additional assumptions and guidelines:

- Each participating organization will continue to be separately and distinctly governed.
- PACS technical solutions will be determined locally and will be compliant with existing technical standards (DICOM and HL7, regardless of vendor).
- Improved linkages to referring physicians (web-based access of images and reports).
- Ongoing commitment to maintaining current DI technology.
- Equitable distribution of additional non-organization-specific costs throughout the SWO participants.
- SWO would collaboratively lobby the MOHLTC for additional SRI approvals to remove physician FFS caps, increased DI funding, and coordinated efforts to increase MEF2 funding for DI.
- IHFs would be invited to work collaboratively with the Network.

6.2 Introduction to the Options

There are six options for DI service delivery and coordination that were considered with the Oversight Committee, which fall along a continuum from a more to less coordinated infrastructure, as per Figure 23, below.

*Figure 23. SWO DI Service Delivery Option Continuum*

Common to all of the options was a set of integration considerations that were identified as having potential application to the selected SWO service delivery option. These integration considerations were:

- SWO training and education of imaging physicians and technologists.
- ‘Nighthawk’ physician call coverage.
- Human resources strategy on recruitment and retention.
- Equipment purchasing and maintenance.
- Modality-specific scheduling.
- Modality-specific funding distribution.
- Inter-hospital agreements.
A high-level description of each option is presented in Appendix C. In the following section, a summary table is presented. It was used by the Project Oversight Committee to select a service delivery option for further detail and review.

6.3 **OPTION SUMMARY**

Figure 24, below, presents a summary of the 6 SWO DI service delivery options, by five key attributes:

1. Organizational Structure.
2. Recruitment and Retention.
3. PACS and WAN.
4. Data Repository.
5. Finances.

![Figure 24. Summary of SWO DI Service Delivery Options](image)

<table>
<thead>
<tr>
<th>Options</th>
<th>Organizational Structure</th>
<th>Recruitment and Retention</th>
<th>PACS and WAN</th>
<th>Data Repository</th>
<th>Finances</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Option 1: Status Quo</strong></td>
<td>Status Quo</td>
<td>Status Quo</td>
<td>Status Quo</td>
<td>Status Quo</td>
<td>Status Quo</td>
</tr>
<tr>
<td><strong>Option 2: Status Quo + WAN</strong></td>
<td>Status Quo</td>
<td>Status Quo</td>
<td>SWO WAN with film digitizers, and Status Quo for PACS</td>
<td>Status Quo</td>
<td>Local cost sharing for maintenance of SWO WAN</td>
</tr>
<tr>
<td><strong>Option 3: Sub-Clusters</strong></td>
<td>Hospitals organized into flat sub-clusters</td>
<td>Efforts focused on greater coordination within sub-clusters</td>
<td>Sub-cluster WANs and PACS administration</td>
<td>Independent decision for each sub-cluster</td>
<td>Independent decision for each sub-cluster</td>
</tr>
<tr>
<td><strong>Option 4: Flat Network</strong></td>
<td>All hospitals connected and coordinated in a flat Network structure</td>
<td>Hospitals would collaborate within Network clusters</td>
<td>WAN and PACS across SWO, collaboratively administered by each Network cluster</td>
<td>Independent decision for each Network cluster</td>
<td>Cost sharing for maintenance of SWO WAN</td>
</tr>
</tbody>
</table>
### 6.4 Option Selection

After careful consideration of all of the DI service delivery options, the Project Oversight Committee reached a clear consensus and decided to select a blend of two service delivery models for further development and evaluation – ‘Option 4: Flat Network’ and ‘Option 5: Primary Node Network’.

At this stage in the project, the Project Oversight Committee learned that Canada Health Infoway had announced that it planned to fund certain elements of a network-wide DI service delivery model. High-level modelling of the ‘blended’ model (Options 4 and 5), and how the Canada Health Infoway initiative will be integrated into this blended model, is presented in the following section of the Final Report.
7.0 SWO DI Service Delivery Model

7.1 SWO DI SERVICE DELIVERY MODEL INTRODUCTION

In this section, a full description of the selected SWO DI Service Delivery Model is presented. This will provide a more detailed overview of this blended Service Delivery Model for diagnostic imaging in Southwestern Ontario, with specific attention to:

- Service delivery coordination.
- Technology and equipment infrastructure.
- Human resources approach.
- Financial considerations.

In addition, an overview of the process to select the primary nodes for the SWO DI Service Delivery Model is presented. It was used at a workshop conducted with the Project Oversight Committee. Further consideration will also be given to current SWO hospital initiatives, and how they will integrate into the proposed SWO DI Service Delivery Model.

And finally, a description of some of the key considerations for integration of the Canada Health Infoway initiative with the SWO DI Service Delivery Model will also be presented, to provide a complete picture of the future of DI services in Southwestern Ontario. It should be noted that the high-level description of the SWO DI Service Delivery Model provided on the following pages will need to be refined/modified to incorporate the ongoing design and implementation of the Canada Health Infoway initiative.

7.2 SWO DI SERVICE DELIVERY MODEL OVERVIEW

This next section will outline the recommended SWO DI model and key components, including:

- Model Description.
- Functional Objectives.
- General Functional Requirements.
- Specific Functional Requirements.
  - Shared Services Agreement.
  - Funding, Financial and Budget Management.
  - Service Delivery Coordination.
  - Human Resources and Professional Education.
  - Technology and Equipment Infrastructure.
  - Stakeholder Engagement.
7.2.1 SWO DI Service Delivery Model Description

At a high-level, the SWO Service Delivery Model will be built upon a small number of interconnected Primary Node hospitals, each of which will, in turn, be connected with geographically clustered ‘Secondary Node’ hospitals. These hospitals will be linked together to serve the diagnostic imaging needs of the population around them. The Primary Node hospitals will have a lead coordinating role within each cluster.

Overall, the direction of the Project Oversight Committee was that the SWO hospitals should be asked to form a SWO DI Network to coordinate and serve the diagnostic imaging needs of the population of Southwestern Ontario.

7.2.2 Functional Objectives

Critical to the development of a SWO DI Network are the functional objectives for delivering DI services. These include the following:

- Coordinating DI services within Network nodes, and across SWO.
- Minimizing additional DI overhead in SWO.
- Having fair and equitable participation and representation from all hospital organizations.
- Recognizing local responsibility for patient care, service delivery, management, staffing, technology, and financing.

In order to achieve these objectives, both general and specific functional requirements have been identified to support implementation planning.

7.2.3 SWO DI General Functional Requirements

Key to the success of the SWO DI model will be an oversight or steering committee function that has representation from all participating hospitals, either directly or through local hospital networks. This oversight function would oversee the coordination of DI services across SWO, including the complete implementation, and ongoing maintenance, financing and promotion of the DI Network.

There is also the need for a Medical/Technical team to support the design, implementation and maintenance of a PACS and WAN across SWO, the role of which should include the following:

- Ensuring inter-operability and system stability.
- Maintaining central data repository back-ups.
- Coordinating local PACS and WAN implementation and maintenance across the Primary Node clusters.
- Providing support to local Medical/Technical teams.
- Providing on-site troubleshooting and maintenance (as needed).
- Providing local administrative support for the coordination of DI services within the Primary Node cluster, as well as delivering DI services locally.
7.2.4 SWO DI Specific Functional Requirements

In support of the general DI functional requirements, several specific functional requirements and considerations have been identified for SWO, including the following:

- Shared Services Agreement.
- Funding, Financial and Budget Management.
- Service Delivery Coordination.
- Human Resources and Professional Education.
- Equipment Acquisition and Asset Management.
- Technology and Equipment Integration.
- Stakeholder Engagement.

These specific functional requirements and considerations should be supported, coordinated and directed by a SWO steering committee or oversight function, whose structure can be designed to best meet the needs of the SWO DI model.

7.2.4.1 SWO DI Shared Services Agreement

Establishing a shared services agreement across all of the SWO DI Network participants, which identifies the scope and level of DI services provided throughout SWO, and by individual hospitals, will be an important step in defining the SWO DI Service Delivery Model. This is underscored by the need to engage all SWO DI Network members at once. This is especially true in the promotion of the Network to internal and external stakeholders. Some of the key elements for consideration in a shared services agreement include the following:

- Functional and organizational structure for the SWO DI Network.
- Financial and budgeting for the SWO DI Network (e.g. a SWO DI inter-hospital agreement).
- Definition of the relationship and level of service delivery between the SWO DI Network and SWO hospital organizations (including hospital inter-relationships, primary node cluster arrangements, commitment towards patients, etc.). It will be important to incorporate different levels and types of agreements, and to revisit these agreements throughout the evolution of the Network.
- Definition of the relationship and level of service delivery between the SWO DI Network and SWO imaging physicians.

7.2.4.2 Funding, Financial and Budget Management

Securing funding for the SWO DI Service Delivery Model will be a critical success factor for its implementation. Integration of financing and funding approaches with the Canada Health Infoway initiative will be an important first step for these efforts. Specifically, activities could include the following:

- Determining the financial cost of implementation, once the detailed implementation plan is completed.
- Working with all SWO hospital organizations to establish an inter-hospital funding agreement, which identifies the financial operating and capital resources that each organization will contribute.
Investigating the viability of different funding models, and how/if the SWO DI Network can be developed to be self-supporting.

Identifying an equitable compensation model with OHIP for referring DI physicians who complete the initial DI examination, and second-read physicians, to encourage physician collaboration, and improve patient care and access.

In consideration of these financing requirements, it is clear that the SWO DI Network will need to establish a strong funding base for the further design and implementation of Network-wide DI service delivery model. Establishing such funding will require, at a minimum:

- identification of the level of external funding required to develop and maintain the SWO DI Service Delivery Model; and
- collaboration with the SWO hospitals’ foundation, MOHLTC, MEF2, Canada Health Infoway, and other external funding sources to establish secure sources of external funding.

### 7.2.4.3 Service Delivery Coordination

Coordinating DI services among the hospitals will be a pivotal undertaking prior to, throughout and after implementation. The scope of coordination will be dependent on a variety of factors to be determined through detailed implementation planning. It but could include:

- Analysis of formalized referral patterns between DI physicians, to serve as a guideline to facilitate consult patterns.
- Development of local hospital modality wait lists using consistent identifiers and metrics across SWO, which are available to SWO’s imaging physicians and ordering physicians.
- Feasibility assessment of establishing a ‘nighthawk’ DI physician on-call service that coordinates physician after-hour call coverage across SWO, with appropriate after-hours physician funding.

Additional components that will be important in the development of coordinated DI service delivery include:

- A standardized confidentiality agreement and process for enabling the secure and legal transfer of patient images across the SWO WAN.
- A series of performance indicators to assist in monitoring overall patient access and financial viability within the SWO DI Service Delivery Model.
- Cross-hospital privileges for imaging physicians providing ‘nighthawk’ services in multiple SWO hospitals.

### 7.2.4.4 Human Resources Management and Professional Education

Human resources management and professional education will be activities essential to the success of the SWO DI Service Delivery Model. Activities could include the following:

- Establishing DI technologist recruitment and retention strategies for SWO.
- Establishing PACS and WAN administrators recruitment and retention strategies for SWO.
- Working with physicians to develop DI physician recruitment and retention strategies, and to improve work/life balance for physicians.
Developing SWO-wide DI CME and training programs for physicians and technologists that leverages internal SWO education resources.

The key to a SWO-wide approach to human resources management and professional education will be that all Network participants work together in recruitment and retention efforts for SWO. An example of these efforts could include the development of a coordinated human resources strategy for all new technologist staff, who would be distributed throughout the Network based on technologist preference, and geographical need.

7.2.4.5 Technology and Equipment Infrastructure

The technology and equipment infrastructure of the SWO DI Network will need to be managed collaboratively through the oversight function, Medical/Technical teams, key imaging physicians, DI managers, and PACS/IT experts throughout the Network. Key responsibilities for a collaborative infrastructure management should include the establishment of the following:

- Technology and equipment requirements to achieve the SWO DI model (new DI equipment, PACS brokers, film digitizers, etc.), and the corresponding financial and education investments required.
- A dedicated high speed SWO DI WAN that connects all SWO hospitals, and also extends to provide in-home connectivity and image viewing for referring and DI physicians.
- Standards for all DI equipment, PACS and HIS/RIS components that interface with the SWO WAN, to ensure inter-compatibilities (e.g. HL7, DICOM).
- A task force of IT, DI and PACS professionals to assist in PACS interface challenges with local HIS and RIS networks, and vendor incompatibilities.
- A standardized set of key patient information elements to facilitate information and image sharing, including a DI Master Patient Index.

The implementation and ongoing operation of the SWO WAN and interconnected PACS should be managed by local and Primary Node-level PACS and WAN support teams. Further, DI data will need to be stored in accordance with the optimal storage solutions available at the time of implementation, including local storage capability, and data redundancy across SWO. On-line access to diagnostic images/reports would also need to be compatible with leading practices at other comparably sized health organizations, in order to maximize the SWO benefit received through increased digital imaging.

7.2.4.5.1 Technology and Equipment Infrastructure: High-Level Estimate of Financial Investment

From the information gathered through the Situational Assessment, an investment of $75M was identified to replace outdated equipment. Several additional technology investments will also be required to make the SWO DI Service Delivery Model a reality (estimates provided):

- Implementation of PACS across all non-PACS facilities > $60M
- Implementation of a SWO WAN > $10M
- Implementation of a DI Master Patient Index with HIS interfaces > $5M
- Staff and Physician technology training > $5M

Total: > $80M
These estimates have been generated through the past experience of the Deloitte team members. They suggest that a minimum budgetary investment of over $80 million will be required to purchase and implement the technology and equipment required to support the SWO DI Model, although this estimate will be influenced by a variety of factors during implementation planning.

7.2.4.6 Stakeholder Engagement

The need for a high level of stakeholder engagement throughout the planning and implementation of a SWO DI Network will comprise a cornerstone of the change management strategy. Critical to the development of the SWO DI Network will be participation and involvement of the following key internal stakeholder groups:

- Hospital CEOs and Senior Management.
- DI Managers and Directors.
- Imaging Physicians.
- PACS/WAN and IT Experts.
- DI Staff.
- Referring Physicians.

Equally important will be the involvement of the key external stakeholders of the SWO DI Network, including:

- Province of Ontario Ministry of Health and Long-Term Care.
- Canada Health Infoway.
- District Health Councils.
- Other Health Care Organizations in SWO.

7.3 PROCESS FOR IDENTIFYING THE PRIMARY NODE SELECTION FACTORS

In order to streamline the process of identifying the key Primary Node selection factors, Deloitte compiled the information that was received through the Situational Assessment, and from meetings with the Project Oversight Committee members. Using this information, Deloitte identified three key selection factors, and completed an initial value analysis (evaluating the appropriateness and feasibility of each selection factor).

The selection factors and corresponding value analysis were then circulated through the Project Oversight Committee for validation and feedback. This process proved very effective in that it identified the most appropriate Primary Node selection factors, and incorporated feedback from the key DI stakeholders throughout SWO.

The Primary Node selection factors that were identified through this process, and the corresponding value analysis of each of these selection factors, are presented in the following pages. Before this is presented, however, an overview of the process used to evaluate the Primary Node Selection factors is first introduced.
7.3.1 Primary Node Selection Process: Value Analysis

The Deloitte Value Analysis Methodology employs two sets of criteria to evaluate key dimensions of each Primary Node Selection Factor: appropriateness and feasibility. In conjunction with the Project Oversight Committee, four criteria were identified to define appropriateness, and an additional four criteria were identified to define feasibility. Criteria are rated on a scale of 1-10, where 1 = low appropriateness or feasibility. Through the Value Analysis Methodology, an evaluation of each Primary Node Selection Factor is completed, and the relative score of each Factor is compared, to determine which Factor will be the primary driver of the Primary Node selection. In this comparison, a higher relative score suggests a more ‘value-added’ Primary Node Selection Factor.

An overview of these two dimensions, and their respective criteria, is presented in Figure 25 below, with a graphic depiction of how the two dimensions intercept to evaluate each Primary Node Selection Factor. Following this, in Figure 26, is a detailed description of the specific criteria used to define appropriateness and feasibility for this exercise.

Figure 25. SWO DI Dimensions and Criteria for Primary Node Selection Factor Value Analysis

![Figure 25](image)

1. Improvement to Patient Care and Access
2. Improvement in Service for Referring MDs
3. Operating Efficiencies
4. Recruitment and Retention

This approach was used to evaluate the 3 Primary Node selection factors. The value analysis approach was used to weight the importance of the selection factors. All of the selection factors were still considered in identifying the Primary Nodes of the SWO network, relative to their respective weighting.
7.4 PRIMARY NODE SELECTION FACTORS

Three key factors were identified throughout the consultation process, and by the Project Oversight Committee, which served as the basis for selecting the location of the Primary Nodes. These include the following:

1. Geography.
2. Existing hospital structures/alliances.
3. Imaging and External Physician referral patterns.

Although technology and funding also served as key drivers for the service delivery model, they were integrated into the model, regardless of the model’s design, and so have not been used as Primary Node selection factors. A value analysis review was undertaken to examine if one or more of these three factors is preferred in selecting the Primary Nodes. This value analysis was first conducted by Deloitte, and then validated by the Project Oversight Committee, through a working session in which each Primary Node selection factor was evaluated against the criteria for appropriateness and feasibility.

Following this selection, the Primary Nodes are identified, as selected and validated by the Project Oversight Committee.
7.4.1 Primary Node Selection Factor #1: Geography

Geography was a key selection factor because it is often the primary driver for patients in their selection of where to receive their care. Further, given the distances within SWO, geography will likely be a deciding factor on how to structure the PACS and WAN administration staff, who will likely need to travel between sites. Aligning the DI service delivery model along geographical lines should achieve the greatest operating efficiencies with respect to PACS and WAN. Finally, geography is currently the basis for many of the SWO hospital alliances and physician referral patterns, and hence is a natural basis for further coordination of DI services.

Consideration of these points was incorporated into the value analysis of Geography as a Primary Node Selection Factor. The evaluation of Geography resulted in the following scores for each of the criteria of the appropriateness and feasibility dimensions (Figures 27 and 28, respectively).

<table>
<thead>
<tr>
<th>Geography</th>
<th>Improvement to Patient Care</th>
<th>Improvement in Service to Referring MDs</th>
<th>Operating Efficiencies</th>
<th>Recruitment and Retention</th>
<th>Overall Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriateness</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>8</td>
<td>8.25</td>
</tr>
</tbody>
</table>

Figure 27. Evaluation of the Appropriateness of Geography as a Primary Node Selection Factor

<table>
<thead>
<tr>
<th>Geography</th>
<th>Cost of Implementation</th>
<th>Cost of PACS and WAN</th>
<th>Stakeholder Buy-in</th>
<th>Ease of Implementation</th>
<th>Overall Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feasibility</td>
<td>8</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>8.5</td>
</tr>
</tbody>
</table>

Figure 28. Evaluation of the Feasibility of Geography as a Primary Node Selection Factor

7.4.2 Primary Node Selection Factors: Hospital Structures/Alliances

There are several established hospital alliances that have been formed within SWO. Further DI coordination along these lines can build on existing stakeholder buy-in for these hospital alliances. Aligning DI services with these alliances will likely facilitate the administration and coordination of service, and thereby achieve greater operating efficiencies. It is expected that this would be a ‘behind-the-scenes’ alignment, with respect to patient awareness, referring physicians, and overall impact on patient care.

Consideration of these points was incorporated into the value analysis of Hospital Structures/Alliances as a Primary Node Selection Factor. The evaluation of Hospital Structures/Alliances resulted in the following scores for each of the criteria of the appropriateness and feasibility dimensions (Figures 29 and 30, respectively).
7.4.3 Primary Node Selection Factors: Imaging and External Physician Referral Patterns

Referring physicians determine the level and mix of DI activity, and as such, developing a DI service delivery model on referral patterns should maximize service to imaging and referring physicians, and provide good improvements to patient care. Because referral patterns will likely cross organizational and geographical boundaries, it is unlikely that this approach can be leveraged to contribute to greater operating efficiencies. Integration of these referral patterns, however, will still be critical in the overall model for DI service delivery.

Recruitment and retention strategies will also be difficult to establish, if based on physician referral patterns, rather than geography and existing hospital alliances, especially as the referring physicians change over time. Further, a model based primarily on physician referral patterns will likely serve to deepen the current issue of most SWO imaging physicians exceeding their FFS thresholds.

Consideration of these factors was incorporated into the value analysis of Imaging and External Physician Referral Patterns as a Primary Node Selection Factor. The evaluation of Imaging and External Physician Referral Patterns resulted in the following scores for each of the criteria of the appropriateness and feasibility dimensions (Figures 31 and 32, respectively).
Figure 32. Evaluation of the Feasibility of Imaging and External Physician Referral Patterns as a Primary Node Selection Factor

<table>
<thead>
<tr>
<th>Geography</th>
<th>Cost of Implementation</th>
<th>Cost of PACS and WAN</th>
<th>Stakeholder Buy-in</th>
<th>Ease of Implementation</th>
<th>Overall Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feasibility</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>5.0</td>
</tr>
</tbody>
</table>

7.4.4 Primary Node Selection Factor Value Analysis Summary

A compilation of the three separate evaluations of each Primary Node Selection Factor was undertaken to compare their relative value-add to selecting the Primary Nodes for the SWO DI Service Delivery Model. Figure 33, below, presents a graphic depiction of this comparison.

From this value analysis summary, Geography is identified as the primary driving factor for selection of the Primary Nodes. This said, although not selected as the primary driver for identifying the Primary Nodes, Hospital Structures/Alliances and Physician Referral Patterns were also taken into account.
### 7.5 Primary Node Identification

The value analysis reinforced the position that the existing geographic networks within SWO would serve as the basis for Primary Nodes in the SWO DI Network. In consideration of the value analysis, as well as the current SWO geography and hospital alliances, it is recommended that these six geographic areas serve as the coordinating units for the SWO DI Network.

Although only three Primary Nodes (London, Windsor and Owen Sound) were provided in the original DI Service Delivery Options (section 6.2), these were provided simply as an example of how the Network may be coordinated. In further discussion with the Project Oversight Committee, it was deemed that the six geographic areas within SWO would serve as a more appropriate basis for coordination of the SWO DI Network. The result of these discussions was that the Project Oversight Committee selected a total of six Primary Nodes for the Network, as identified in Figure 34, below.

#### Figure 34. SWO DI Service Delivery Model Primary Nodes

<table>
<thead>
<tr>
<th>Geographic Area/Hospital Alliance</th>
<th>Primary Node Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windsor-Essex</td>
<td>Windsor</td>
</tr>
<tr>
<td>Chatham-Kent Health Alliance</td>
<td>Chatham</td>
</tr>
<tr>
<td>Lambton Hospitals Group</td>
<td>Sarnia</td>
</tr>
<tr>
<td>Thames Valley Hospital Planning Partnership</td>
<td>London</td>
</tr>
<tr>
<td>Huron-Perth</td>
<td>Stratford</td>
</tr>
<tr>
<td>Grey Bruce Health Network</td>
<td>Owen Sound</td>
</tr>
</tbody>
</table>

Incorporating these six Primary Nodes into the service delivery model for DI in SWO, the SWO DI Service Delivery Model Network is presented in Figure 35, below.

#### Figure 35. SWO DI Service Delivery Model Network
7.6. **INTEGRATION WITH CANADA HEALTH INFOWAY INITIATIVE**

### 7.6.1 Canada Health Infoway Initiative Background

In December 2002, the Southwest region was invited to respond to a Request For Information (RFI) from Canada Health Infoway (Infoway). This RFI asked the region to submit information on current resources and to propose how the region would use a shared services model to develop digital imaging services in the region. A proposal was submitted in late January 2003.

SWO was approved for funding through this RFI, under the project title ‘Southwest Ontario Digital Imaging Network Project’. This Project provides the opportunity to begin building a SWO DI Service Delivery Model that is supported by significant financial resources, through Canada Health Infoway. The initial implementation is planned to take place among the eight hospitals in Thames Valley, which will be followed by additional implementation phases throughout Southwestern Ontario.

Specifically, Infoway is interested in supporting the development of a shared services digital imaging model. That is, technology and information systems will be shared across participating organizations. Infoway sees this approach as being more affordable, supporting expanded radiology coverage; reducing storage, technology and patient transfer costs; supporting faster turnaround on results; increasing productivity; and eliminating film duplication. The financial model that is being proposed to sustain this Network on an on-going basis is a transactional model, in which both operating and capital costs will be addressed through payment of transaction fees by participating organizations.

### 7.6.2 Integration with the Canada Health Infoway Initiative

The SWO Imaging Needs Assessment Project has established a vision and model for DI in SWO that provides a basis for service delivery that is consistent and compatible with a model of regional shared services among a large group of hospitals. It identifies key principles to ensure broad geographic and constituency involvement in decision-making. It identifies key components such as human resources, infrastructure and communications that need to be addressed. Further, the vision builds on and strengthens the fabric of the local SWO geography, referral patterns and hospital alliances, and incorporates functional requirements that promote a shared services model for DI delivery.

These key characteristics indicate that the SWO vision and model are consistent and compatible with the approach proposed by Canada Health Infoway for fostering and supporting DI service delivery in Ontario. This is particularly relevant in light of the fact that Ontario does not have a regional health care structure, and that all hospitals in SWO have come together under the DI Network to explore a regional service delivery model. Indeed, the SWO DI Network concept/approach, whose vision and model have emerged through the Needs Assessment, is among the first of its kind in Ontario, wherein an entire group of hospitals have come together on a voluntary basis to develop a DI service delivery model on a scale comparable to the largest health regions in Canada.

In summary, the SWO vision and model provide the basis for the integration and consolidation of the SWO DI Network with the Canada Health Infoway initiative, as this model is consistent with the Infoway emphasis on shared services in Ontario.
8.0 Summary and Next Steps

A general vision and service delivery model has been developed that provides a set of guidelines and parameters for moving towards the system-wide coordination of DI services in SWO, over the next 5-10 years. It will be critical to obtain buy-in to this framework and model from all stakeholders within SWO, through extensive communication and consultation.

Key immediate next steps for SWO include the following (1-3 month timeline):

- Obtain buy-in to vision and model from all key SWO hospital stakeholders.
- Coordination with Canada Health Infoway to integrate efforts into one consolidated initiative that reinforces the complementary nature of the SWO vision and model, and Canada Health Infoway’s approach to shared services.
- Establish an appropriate structure/vehicle to continue the efforts of the Project Oversight Committee, and provide leadership and direction in coordinating the evolution of the SWO DI Network.

Key short- to mid-term next steps for SWO include the following (1 - 6 month timeline):

- Development of an inter-hospital agreement that addresses funding, human resources, technology, and distribution of resources across SWO.
- Development and positioning of a business case that promotes SWO to external funding sources such as the Medical Equipment Fund 2, and the MOHLTC.
- Implementation planning to determine key tasks, timelines, accountabilities, and milestones.
Appendices

APPENDIX A: HOSPITAL CORPORATIONS OF SOUTHWESTERN ONTARIO

All hospitals within Southwestern Ontario participated in this SWO Network Imaging Needs Assessment. A listing of the hospital corporations, and the geographic county/area that they are located in, is provided below. Due to the current change in governance structure of the Huron Perth Hospitals Partnership, the individual hospital organizations are also listed.

<table>
<thead>
<tr>
<th>SWO Hospital Corporations</th>
<th>Geographic County/Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chatham-Kent Health Alliance</td>
<td>Chatham-Kent</td>
</tr>
<tr>
<td>Grey Bruce Health Services</td>
<td>Grey-Bruce</td>
</tr>
<tr>
<td>Hanover &amp; District Hospital</td>
<td>Grey-Bruce</td>
</tr>
<tr>
<td>South Bruce Grey Health Centre</td>
<td>Grey-Bruce</td>
</tr>
<tr>
<td>Huron Perth Hospitals Partnership</td>
<td>Huron-Perth</td>
</tr>
<tr>
<td>Alexandra &amp; Marine Hospital</td>
<td>Huron-Perth</td>
</tr>
<tr>
<td>Clinton Public Hospital</td>
<td>Huron-Perth</td>
</tr>
<tr>
<td>Listowel Memorial Hospital</td>
<td>Huron-Perth</td>
</tr>
<tr>
<td>Seaforth Huron Hospital</td>
<td>Huron-Perth</td>
</tr>
<tr>
<td>South Huron Hospital</td>
<td>Huron-Perth</td>
</tr>
<tr>
<td>St. Marys General Hospital</td>
<td>Huron-Perth</td>
</tr>
<tr>
<td>Stratford General Hospital</td>
<td>Huron-Perth</td>
</tr>
<tr>
<td>Wingham &amp; District Hospital</td>
<td>Huron-Perth</td>
</tr>
<tr>
<td>Lambton Hospitals Group</td>
<td>Sarnia-Lambton</td>
</tr>
<tr>
<td>Alexandra Hospital (Ingersoll)</td>
<td>Thames Valley (Middlesex, Oxford and Elgin)</td>
</tr>
<tr>
<td>Four Counties Health Services</td>
<td>Thames Valley (Middlesex, Oxford and Elgin)</td>
</tr>
<tr>
<td>London Health Sciences Centre</td>
<td>Thames Valley (Middlesex, Oxford and Elgin)</td>
</tr>
<tr>
<td>Woodstock General Hospital</td>
<td>Thames Valley (Middlesex, Oxford and Elgin)</td>
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<tr>
<td>St. Joseph’s Health Care, London</td>
<td>Thames Valley (Middlesex, Oxford and Elgin)</td>
</tr>
<tr>
<td>St. Thomas-Elgin General Hospital</td>
<td>Thames Valley (Middlesex, Oxford and Elgin)</td>
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<td>Strathroy Middlesex General Hospital</td>
<td>Thames Valley (Middlesex, Oxford and Elgin)</td>
</tr>
<tr>
<td>Tillsonburg District Memorial Hospital</td>
<td>Thames Valley (Middlesex, Oxford and Elgin)</td>
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<tr>
<td>Windsor Regional Hospital</td>
<td>Windsor-Essex</td>
</tr>
<tr>
<td>Hotel-Dieu Grace Hospital, Windsor</td>
<td>Windsor-Essex</td>
</tr>
<tr>
<td>Leamington District Memorial Hospital</td>
<td>Windsor-Essex</td>
</tr>
</tbody>
</table>
APPENDIX B: PROJECT OVERSIGHT COMMITTEE AND OPERATING COORDINATING TEAM MEMBERSHIP

The Project Oversight Committee consisted of 38 representative stakeholders from across the SWO hospitals. Specifically, membership included the following list of stakeholders. Individuals marked with an asterisk (*), are also members of the Operating Coordinating Team, and individuals whose names are bolded are also a part of the Project Leadership Team.

(Note: Physician member organizations are not representative of all of the hospital organizations in which the Physicians work)

<table>
<thead>
<tr>
<th>Project Oversight Committee Members</th>
<th>Member Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steve Elson* (Co-Chair)</td>
<td>Integrated Strategic Alliances &amp; Networks (ISAN), London Health Sciences Centre/St Joseph's Health Care</td>
</tr>
<tr>
<td>Jim Whaley* (Co-Chair)</td>
<td>Grey-Bruce Huron-Perth District Health Council</td>
</tr>
<tr>
<td>Mark Britnell* (Project Coordinator)</td>
<td>Ontario Ministry of Health and Long Term Care</td>
</tr>
<tr>
<td>Anne Robertson*</td>
<td>Grey-Bruce Health Services</td>
</tr>
<tr>
<td>Barb Mylemans*</td>
<td>London Health Sciences Centre</td>
</tr>
<tr>
<td>Dawn Cleland</td>
<td>Huron Perth Hospitals Partnership</td>
</tr>
<tr>
<td>Des Morrow*</td>
<td>Lambton Hospitals Group</td>
</tr>
<tr>
<td>Dianne Beattie</td>
<td>London Health Sciences Centre and St. Joseph's Health Care, London (London Hospitals Group)</td>
</tr>
<tr>
<td>Don Ewert</td>
<td>Huron Perth Hospitals Partnership</td>
</tr>
<tr>
<td>Dr. Chris O'Brien</td>
<td>Stratford General Hospital</td>
</tr>
<tr>
<td>Dr. Colin McIver</td>
<td>Grey-Bruce Health Services</td>
</tr>
<tr>
<td>Dr. Don Taves*</td>
<td>St. Joseph's Health Care, London</td>
</tr>
<tr>
<td>Dr. Doug Mowbray*</td>
<td>Huron Perth Hospitals Partnership</td>
</tr>
<tr>
<td>Dr. Kevin Harding</td>
<td>St. Thomas Elgin General Hospital</td>
</tr>
<tr>
<td>Dr. Kevin Tracey*</td>
<td>Hotel-Dieu Grace Hospital, Windsor</td>
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<tr>
<td>Dr. Larry Nicholson</td>
<td>St. Joseph's Health Care, London</td>
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<tr>
<td>Dr. Lynda Harker</td>
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<tr>
<td>Dr. Martha Leadman</td>
<td>Leamington District Memorial Hospital</td>
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<tr>
<td>Dr. Main Yee</td>
<td>Chatham-Kent Health Alliance</td>
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<tr>
<td>Dr. Maurice Levin</td>
<td>St. Thomas Elgin General Hospital</td>
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<tr>
<td>Dr. Peter Tadros</td>
<td>Hotel-Dieu Grace Hospital, Windsor</td>
</tr>
<tr>
<td>Dr. Richard Rankin</td>
<td>London Health Sciences Centre</td>
</tr>
<tr>
<td>Project Oversight Committee Members</td>
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</tr>
<tr>
<td>-----------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>Dr. Robert Vinson</td>
<td>Woodstock General Hospital</td>
</tr>
<tr>
<td>Dr. W. Ramsewak</td>
<td>Windsor Regional Hospital</td>
</tr>
<tr>
<td>Harold Corbett</td>
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</tr>
<tr>
<td>Jim Herbert</td>
<td>St. Thomas Elgin General Hospital</td>
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<tr>
<td>Karen Palmer*</td>
<td>Woodstock General Hospital</td>
</tr>
<tr>
<td>Kathy Wilkins</td>
<td>St. Joseph's Health Care, London</td>
</tr>
<tr>
<td>Kristen Grisenthwaite</td>
<td>Strathroy Middlesex General Hospital</td>
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<tr>
<td>Larry Creeden</td>
<td>South Bruce Grey Health Centre</td>
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<tr>
<td>Linda Fitzpatrick</td>
<td>Thames Valley District Health Council</td>
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<td>Marty Klein</td>
<td>Tillsonburg District Memorial Hospital</td>
</tr>
<tr>
<td>Mary Alice Benetanau</td>
<td>Hotel-Dieu Grace Hospital, Windsor</td>
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<tr>
<td>Mary Anne Brown</td>
<td>Chatham-Kent Health Alliance</td>
</tr>
<tr>
<td>Paul Davies</td>
<td>South Bruce Grey Health Centre</td>
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<tr>
<td>Rita downhill</td>
<td>Chatham-Kent Health Alliance</td>
</tr>
<tr>
<td>Rob Vandoninck</td>
<td>Tillsonburg District Memorial Hospital</td>
</tr>
<tr>
<td>Rose Costa</td>
<td>Leamington District Memorial Hospital</td>
</tr>
<tr>
<td>Hy Eliasoph</td>
<td>Deloitte &amp; Touche LLP</td>
</tr>
<tr>
<td>Mark Fam</td>
<td>Deloitte &amp; Touche LLP</td>
</tr>
<tr>
<td>Ray Foley</td>
<td>The Public Sector Corporation (in association with Deloitte &amp; Touche LLP)</td>
</tr>
</tbody>
</table>
APPENDIX C: LITERATURE SEARCH BIBLIOGRAPHY WITH ABSTRACTS

The following bibliography presents the primary article references used to populate the Literature and Best Practice Review component of the Imaging Need Assessment. Where available, the abstract for each article is also provided.

Technological Changes


Since the acquisition of high-resolution three-dimensional patient images has become widespread, medical volumetric datasets (CT or MR) larger than 100 MB and encompassing more than 250 slices are common. It is important to make this patient-specific data quickly available and usable to many specialists at different geographical sites. Web-based systems have been developed to provide volume or surface rendering of medical data over networks with low fidelity, but these cannot adequately handle stereoscopic visualization or huge datasets. State-of-the-art virtual reality techniques and high speed networks have made it possible to create an environment for clinicians geographically distributed to immersively share these massive datasets in real-time. An object-oriented method for instantaneously importing medical volumetric data into Tele-Immersive environments has been developed at the Virtual Reality in Medicine Laboratory (VRMedLab) at the University of Illinois at Chicago (UIC). This networked-VR setup is based on LIMBO, an application framework or template that provides the basic capabilities of Tele-Immersion. We have developed a modular general purpose Tele-Immersive program that automatically combines 3D medical data with the methods for handling the data. For this purpose a DICOM loader for IRIS Performer has been developed. The loader was designed for SGI machines as a shared object, which is executed at LIMBO's runtime. The loader loads not only the selected DICOM dataset, but also methods for rendering, handling, and interacting with the data, bringing networked, real-time, stereoscopic interaction with radiological data to reality. Collaborative, interactive methods currently implemented in the loader include cutting planes and windowing. The Tele-Immersive environment has been tested on the UIC campus over an ATM network. We tested the environment with 3 nodes; one ImmersaDesk at the VRMedLab, one CAVE at the Electronic Visualization Laboratory (EVL) on east campus, and a CT scan machine in UIC Hospital. CT data was pulled directly from the scan machine to the Tele-Immersion server in our Laboratory, and then the data was synchronously distributed by our Onyx2 Rack server to all the VR setups. Instead of permitting medical volume visualization at one VR device, by combining teleconferencing, tele-presence, and virtual reality, the Tele-Immersive environment will enable geographically distributed clinicians to intuitively interact with the same medical volumetric models, point, gesture, converse, and see each other. This environment will bring together clinicians at different geographic locations to participate in Tele-Immersive consultation and collaboration.


The acquisition of a picture archiving and communications system (PACS) is an opportunity to reengineer business practices and should optimally consider the entire process from image acquisition to communication of results. The purpose of this presentation is to describe the PACS planning methodology used by the Department of Defense (DOD) Joint Imaging Technology Project Office (JITPO), outline the critical procedures for each phase, and review the military experience using this
model. The methodology is segmented into four phases: strategic planning, clinical scenario planning, installation planning, and implementation planning. Each is further subdivided based on the specific tasks that need to be accomplished within that phase. By using this method, an institution will have clearly defined program goals, objectives, and PACS requirements before vendors are contacted. The development of an institution-specific PACS requirement should direct the process of proposal comparisons to be based on functionality and exclude unnecessary equipment. This PACS planning methodology is being used at more than eight DOD medical treatment facilities. When properly executed, this methodology facilitates a seamless transition to the electronic environment and contributes to the successful integration of the healthcare enterprise. A crucial component of this methodology is the development of a local PACS planning team to manage all aspects of the process. A plan formulated by the local team is based on input from each department that will be integrating with the PACS. Involving all users in the planning process is paramount for successful implementation.


The Department of Defense (DoD) undertook a major systems specification, acquisition, and implementation project of multivendor picture archiving and communications system (PACS) and teleradiology systems during 1997 with deployment of the first systems in 1998. These systems differ from their DoD predecessor system in being multivendor in origin, specifying adherence to the developing Digital Imaging and Communications in Medicine (DICOM) 3.0 standard and all of its service classes, emphasizing open architecture, using personal computer (PC) and web-based image viewing access, having radiologic telepresence over large geographic areas as a primary focus of implementation, and requiring bidirectional interfacing with the DoD hospital information system (HIS). The benefits and advantages to the military health-care system accrue through the enabling of a seamless implementation of a virtual radiology operational environment throughout this vast healthcare organization providing efficient general and subspecialty radiologic interpretive and consultative services for our medical beneficiaries to any healthcare provider, anywhere and at any time of the night or day.


During the 20th century, the field of radiology experienced extraordinary growth and became an essential component of the practice of clinical medicine. In the 21st century, it is likely that radiology will continue to grow by interfacing with new and important domains such as information technology and molecular biology and by playing a more central role in general medical education, biomedical research, and non-invasive therapeutic interventions. To sustain such wide-ranging growth and yet remain intact as a medical specialty, the profession will require many radiologists who can provide leadership to bridge the many gaps between the various frontiers and the traditional core of radiology. These radiologists will need skills and background in two critical management areas: leadership and strategy. This article approaches the broad topic of strategy in several ways. First, it provides the radiologist with a basic framework for strategy development. Second, it summarizes central ideas from the evolving field of strategic thinking. Finally, it outlines a strategy-based method for dealing with uncertainty about the future and identifies situations where specific strategic tools and techniques are likely to be helpful.

The digital imaging network-picture-archiving and communications system (DIN-PACS) will be implemented in ten sites within the Great Plains Regional Medical Command (GPRMC). This network of PACS and teleradiology technology over a shared T1 network has opened the door for round the clock radiology coverage of all sites. However, the concept of a virtual radiology environment poses new issues for military medicine. A new workflow management system must be developed. This workflow management system will allow us to efficiently resolve these issues including quality of care, availability, severe capitation, and quality of the workforce. The design process of this management system must employ existing technology, operate over various telecommunication networks and protocols, be independent of platform operating systems, be flexible and scaleable, and involve the end user at the outset in the design process for which it is developed. Using the unified modeling language (UML), the specifications for this new business management system were created in concert between the University of Arizona and the GPRMC.


The purpose of this literature review is to present the concepts surrounding the issue of communication between imaging systems and information systems in radiology and the literature about them. Picture archiving and communication systems (PACS) were developed to combine viewing of modality images, archiving, and distribution of images. When PACS is integrated/interfaced with radiology information systems (RIS) or hospital information systems (HIS), it can merge patient demographics, medical records, and images. To address several issues surrounding communication between PACS and HIS/RIS and to make interface development easier and faster, various organizations have developed standards for the formatting and transfer of clinical data. Additional work continues to better handle these issues. Communication protocol Health Level 7 (HL7) is a standard application protocol used for electronic text data exchange in health care by most HIS/RIS. The imaging communication protocol for PACS is the Digital Imaging and Communications in Medicine (DICOM) standard specification protocol that describes the means of formatting and exchanging images and associated information.


This presentation describes our experience and lessons learned over the first 3 years of developing and operating a filmless picture archiving and communications system (PACS) for all computed tomography (CT), magnetic resonance (MR), ultrasound, and nuclear medicine studies in our hospital. The PACS conforms to the Digital Imaging and Communications in Medicine (DICOM) standard and includes a sophisticated Worldwide Web (WWW)-based interface to complement the regular DICOM services. The PACS has undergone many design modifications from its inception, which have addressed performance, functionality, support, and maintenance issues. The lessons we have learned through making these modifications are described here and may prove to be helpful to anyone planning to deploy a PACS of their own.

Prior to June 1997, military picture archiving and communications systems (PACS) were planned, procured, and installed with key decisions on the system, equipment, and even funding sources made through a research and development office called Medical Diagnostic Imaging Systems (MDIS). Beginning in June 1997, the Joint Imaging Technology Project Office (JITPO) initiated a collaborative and consultative process for planning and implementing PACS into military treatment facilities through a new Department of Defense (DoD) contract vehicle called digital imaging networks (DIN)-PACS. The JITPO reengineered this process incorporating multiple organizations and politics. The reengineered PACS process administered through the JITPO transformed the decision process and accountability from a single office to a consultative method that increased end-user knowledge, responsibility, and ownership in PACS. The JITPO continues to provide information and services that assist multiple groups and users in rendering PACS planning and implementation decisions. Local site project managers are involved from the outset and this end-user collaboration has made the sometimes difficult transition to PACS an easier and more acceptable process for all involved. Corporately, this process saved DoD sites millions by having PACS plans developed within the government and proposed to vendors second, and then having vendors respond specifically to those plans. The integrity and efficiency of the process have reduced the opportunity for implementing non-standard systems while sharing resources and reducing wasted government dollars. This presentation will describe the chronology of changes, encountered obstacles, and lessons learned within the reengineering of the PACS process for DIN-PACS.


No other generation has witnessed the volume and frequency of technological change that has taken place over the past decade. In medical imaging today, vendors are harnessing Internet and communication technology to deliver innovative solutions that are efficient and productive and reduce costs. Many economic and technological trends are behind these innovations, including:

- consolidation of healthcare providers;
- growth of imaging procedures;
- increased bandwidth and speeds for networks and the Internet;
- lower costs of desktop PCs;
- rapid advances in inkjet printing; and
- conversion from analog to digital technologies.

These trends have all played a critical role in the creation of a new model for the delivery of radiologic information.

Healthcare enterprises often "acquire and install" picture archiving and communications systems (PACS) without examining many of the care delivery processes and information flows that will be affected. Many times these unexamined factors can delay or be the cause of failure of the PACS project. This article presents issues that were worked through as part of a PACS clinical services assessment and reengineering analysis for several US military medical treatment facilities.


We constructed an inter-hospital network system using the worldwide web (WWW) and the Common Gateway Interface (CGI). Original clinical images are digitized and stored as a database for educational and research purposes. Personal computers (PCs) are available for data treatment and browsing. Our system is simple, as digitized images are stored into a Unix server machine. Images of important and interesting clinical cases are selected and registered into the image database using CGI. The main image format is 8- or 12-bit Joint Photographic Experts Group (JPEG) image. Original clinical images are finally stored in CD-ROM using a CD recorder. The image viewer can browse all of the images for one case at once as thumbnail pictures; image quality can be selected depending on the user's purpose. Using the network system, clinical images of interesting cases can be rapidly transmitted and discussed with other related hospitals. Data transmission from relational hospitals takes 1 to 2 minutes per 500 Kbyte of data. More distant hospitals (e.g., Rakusai Hospital, Kyoto) takes 1 minute more. The mean number of accesses our image database in a recent 3-month period was 470. There is a total about 200 cases in our image database, acquired over the past 2 years. Our system is useful for communication and image treatment between hospitals and we will describe the elements of our system and image database.


We developed an off-the-shelf system to transfer DICOM-compliant ultrasound images from a small rural hospital in northern Alberta to an urban radiology clinic in Calgary. The transfer time was less than 30 s per image. The radiologist could then review the case and release the patient. The radiologist could also switch to realtime videoconferencing mode and direct the rural ultrasound technician to obtain additional images of the patient.


Exponential advances in the technology sector and computer industry have benefited the science and practice of radiology. Modalities such as digital radiography, computed radiography, computed tomography, magnetic resonance imaging, ultrasound, digital angiography, and gamma cameras are all capable of producing DICOM compliant images. Text can likewise be acquired using voice recognition technology (VRT) and efficiently rendered into a digital format. All of these digital data sets can subsequently be transferred over a network between machines for display and further manipulation on workstations. Large capacity archiving units are required to store these voluminous data sets. The
enterprise components of radiology departments and imaging centers--radiology information systems (RIS) and picture archiving and communications systems (PACS)--have thus undergone a transition from hardcopy to softcopy. When preparing to make transition to a digital environment, the first step is introspective. A detailed SWOT (strengths, weaknesses, opportunities and threats) analysis, with a focus on the status of "electronic preparedness," ensues. The next step in the strategic planning process is to formulate responses to the following questions: Will this technology acquisition provide sufficient value to my organization to justify the expense? Is there a true need for the new technology? What issues or problems does this technology address? What customer needs will this technology satisfy today and tomorrow? How will the organization's shareholders benefit from this technology? The answers to these questions and the questions that they in turn generate will stimulate the strategic planning process to define demands, investigate technology and investment options, identify resources and set goals. The mission of your radiology center will determine what you will demand from the electronic environment. All radiology practices must address the demand of clinical service. Additional demands based on your mission may include education and research. The investigation of options is probably the most time consuming portion of the analysis. It is in this stage where the system architecture is drafted. Important contributions must be solicited from your information technology division, radiologists and other physicians, hospital administration and any other service where the use of imaging technology information is required and beneficial. Vendors and consultants can be extremely valuable in generating workflow diagrams, which include imaging acquisition components and imaging display components. A request for proposal (RFP) may facilitate this step. A detailed inventory of imaging equipment, imaging equipment locations and use, imaging equipment DICOM compatibility, imaging equipment upgrade requirements, reading locations and user locations must be obtained and confirmed. It is a good idea to take a careful inventory of your resources during the process of investigating system architecture and financial options. An often-ignored issue is the human resource allocation that is required to implement, maintain and upgrade the system. These costs must be estimated and included in the financial analysis. Further, to predict the finances of your operation in the future, a solid understanding of your center's historical financial data is required. This will enable you to make legitimate and reasonable financial calculations using incremental volumes. The radiology center must formulate and articulate discrete clinical and business goals for the transition to a digital environment that are consistent with the institutional or enterprise mission. Once goals are set, it is possible to generate a strategic plan. It is necessary to establish individual accountability for all aspects of the planning and implementation process. A realistic timetable should be implemented. Keep in mind that this is a dynamic process; technology is rapidly changing, as are clinical service demands and regulatory initiatives. It is therefore prudent to monitor the process, make appropriate revisions when necessary and address contingencies as they arise.


Data networks are a basic technology with regard to an appropriate design of the information technology (IT) infrastructure for the hospital. Due to the distributed workflow within the hospital, an integrated Hospital Information System (HIS) is based mostly on a set of network applications facing specific items. Medical communication standards, i.e., HL 7, DICOM, and in the near future the migration towards XML, support the interoperability between the IT subsystems and pave the way to patient information systems with access to unified and complete electronic medical records (EMR). Furthermore, with standardized communication techniques, such as CORBAmed, an object-oriented design of Healthcare applications will be possible in the near future. The intent of this paper is to give an overview of which basic technologies are suitable for building comprehensive, flexible, and reliable hospital networks and which also meet the special demands of the radiology department.

A wireless system for radiological subspecialist consultation based on a portable personal computer and a GSM cellular phone was tested. A link with secure access to the hospital image network was built. A total of 68 emergency computerized tomography (CT) examinations were transmitted. Transmission time via GSM for a single CT image was 1 min and for a complete head scan was 18 min. The transmitted images were acceptable for final diagnosis in 72% of the cases, the rest being acceptable for preliminary diagnosis. The diagnosis from the transmitted images did not change after a later review of the original images in 97% of cases. The wireless link saved a hospital visit by the senior radiologist in 24% of cases. The results show that a remote consultation link can be built with readily available technology and that the technique is useful in radiological subspecialist consultations for CT images.


The company offers radiology services and has taken advantage of the growth of the Internet to create a business model that offers essential services for various levels of healthcare professionals. All medical care centres, from large hospitals to small private practitioners, often need experienced and qualified radiologists to work with essential technologies such as X-rays, ultrasound, computed axial tomography (CAT), medical resonance imaging (MRI) and nuclear medicine. Specialists in this area are expensive and some of the smaller organisations find it expensive to hire full-time radiologists. Apex has created a solution to this problem by offering the services of trained and qualified radiologists as and when necessary, bringing down the costs of providing this service while maintaining the high quality demanded in the medical profession. The company provides Mac workstations to clients that can range from hospitals to diagnostic centres, clinics and individual private practitioners. These Mac computers capture the images of the X-rays and other technologies and transmit them to Apex's centre.

In urgent cases, the Apex radiologist could just dictate the report to his Mac which will use a voice recognition system to convert the dictation to text that will be sent out immediately. However, in cases where the need for the report is less urgent, it is sent to transcriptionists at a remote location who will retype the report and check for errors. The incoming images at Apex are quickly processed by a PowerMac G4 farm which uses specially-designed AppleScript software to spread the load across several G4s for efficient processing. Copyright Financial Times Information Limited Jul 5, 2001


The technical and management considerations necessary for the establishment of a network link between computed tomography (CT) and magnetic resonance imaging (MRI) networks of two geographically separated teaching hospitals are presented. The University of Texas Medical School at Houston Department of Radiology provides radiology residency training at its primary teaching hospital and at a second county-run hospital located approximately 12 miles away. A direct network link between the two hospitals was desired to permit timely consultative services to residents and professional colleagues. The network link was established by integrating the county hospital free-standing imaging network into the network infrastructure of the Medical School and the main teaching hospital. Technical issues involved in the integration were reassignment of internet protocol (IP) addresses, determination of data transmission
protocol compatibilities, proof of connectivity and image transmission, transmission speeds and network loading, and management of the new network. These issues were resolved in a planned stepwise fashion and despite the fact that the system has a rate-limiting T1 segment between the county hospital and the teaching hospital the transmission speed was deemed suitable. The project has proven successful and can provide a guide for planning similar projects elsewhere. It has in fact made possible several new services for the teaching and research activities of the department's faculty and residents, which were not envisaged before the implementation of this connection.


The transition from conventional film-based to filmless operation at the Baltimore Veterans Affairs (VA) Medical Center has resulted in a large number of clinical and economic benefits. The integration of the Department of VA hospitals in Maryland into the VA Maryland Health Care System has resulted in the opportunity to establish a "virtual" radiology and nuclear medicine department. This integrated department is based on a wide area network in which outlying medical centers use a central hospital information system/radiology information system (HIS/RIS) and a central commercial picture archiving and communication system (PACS), as well as a VA-developed image management and communication system. The creation of this virtual radiology/nuclear medicine department has resulted in additional savings and improvements in clinical care. The benefits of the PACS are made possible, to a large extent, by the high level of integration of the PACS and medical modalities with the hospital information and transcription systems. Our experience suggests that it is absolutely essential to integrate the PACS into the patient's electronic medical record to maximize efficiency and clinical effectiveness of the system.


We were commissioned by the West Midlands NHS Regional Specialized Services Group (RSSG) to formulate a strategic plan for the management of Magnetic Resonance Imaging (MRI) within the West Midlands, UK. We needed to establish whether an increase in MRI provision was required, and if so to develop criteria to shape both the nature and location of MRI provision. We found that the UK had relatively low MRI provision per capita by international standards, and that the West Midlands region of the UK had less than the UK average level of MRI provision per capita. Within the region there was a 'mixed economy' of MRI provision involving fixed site scanners owned by the NHS and private companies, and private sector mobile MRI provision. There was little evidence of inappropriate MRI use, but considerable evidence of under-provision. Most MRI scanners in the region were heavily utilized, and average waiting times for MRI frequently exceeded guidelines (of a maximum 13-week wait for non-urgent MRI scans). Projections from NHS Trusts, MRI suppliers, and experts in the MRI field, led us to the conclusion that demand for MRI was likely to grow by between 12.5 and 18.5% per annum. This implies that 8-14 additional MRI scanners might be required within the West Midlands over the next 5 years, to meet existing, and rising demand for MRI. We therefore developed criteria (outlined in the paper) to enhance the productive and allocative efficiency of the deployment of MRI provision, whilst improving the configuration of MRI with reference to geographical equality of access to MRI.

The strategic development and deployment of a health management information technology infrastructure is discussed from two perspectives for radiologists and for other medical technologists: the integrated delivery system (IDS) perspective and a total quality-management (TQM) perspective. On the one hand, an IDS perspective is important because of the need to prepare radiologists and other medical practitioners to thrive within rapidly changing health organizational models and evolving health service delivery partnership systems.

On the other, a TQM perspective is important due to the need to realize an appropriate, efficient, and cost-effective health information infrastructure for developing seamless, integrated radiological and other medical imaging services. Apart from intelligently pursuing an aligned organizational business strategy with the organizational information system strategy, senior radiological managers and medical technologists of health organizations need to pay particular attention to key quality principles for effecting changes in organizational structures and processes to fit changes in information technological requirements, implementations, and innovations.

**Regionalization**


In 1994 the Alberta government acted to reduce to a decade-long deficit in the provincial budget with draconian reductions in the health, education and welfare expenditures. As a result, funding to Alberta clinical laboratories was to be reduced by approximately 40%. In response, the private and public laboratories in metropolitan Edmonton formed a unique alliance to provide laboratory testing in a more coordinated and efficient manner. Of the five metropolitan hospitals, only University of Alberta Hospital preserved its full service laboratory and its specialty reference testing. The other hospital laboratories were converted to rapid response laboratories with a merged private reference laboratory providing routine testing and support to the four hospitals, and far fewer outpatient collection facilities. This paper describes the steps in the laboratory restructuring from inception to execution.


An emergency neurosurgical teleradiology system was initially installed in two referring hospitals in Ireland to transmit images to the neurosurgical department in Cork. It was subsequently expanded to six major referring hospitals transmitting to both neurosurgical departments in Ireland serving the entire population of 3.5 million people, effectively becoming a national teleradiology system. The system was based on PCs interconnected by leased data circuits and ISDN. The network was operational 24 hours a day. Over 750 emergency computerized tomography scans were transmitted and transmission failures occurred in only 6% of cases. We conclude that current PC technology can be used to form a peer-to-peer wide-area network upon which a robust emergency teleradiology system can be based.

Multicenter clinical trials for therapy evaluation of rare diseases are necessary. A digital imaging network improves the ability to share information between collaborating institutions for adrenoleukodystrophy. The DICOM 3.0 standard is used to move images over the Internet from contributing sites to the central clinical database and on to the reviewing physicians' workstations. Patient confidentiality and data integrity are ensured during transmission using virtual private network technology. Fifteen sites are participating in the network. Of these sites, 6 use the proposed protocol. The other 9 sites have either security policy issues or technical considerations that dictate alternative protocols. Network infrastructure, Internet access, image management practices, and security policies vary significantly between sites. Successful implementation of a multicenter digital imaging network requires flexibility in the implementation of network connectivity. Flexibility increases participation as well as complexity of the network.


Six pediatric hospitals were interviewed at length about the status of PACS in their facilities. Children's Hospital Medical Center in Cincinnati, Ohio entered electronic imaging communications in 1993. Several nearby clinics were connected through telediagnosis and by 1998, the radiology department had developed a business plan for the implementation of PACS. Two hospitals in Atlanta, Egleston Hospital and Scottish Rite Children's Medical Center, merged in 1998 to become one entity with two medical campuses. They now treat 60 percent of Atlanta's pediatric patients. Merging incompatible systems has been the administrator's most immediate problem. One director of imaging services is responsible for the recently merged Mary Bridge Children's Hospital and Tacoma General Hospital, plus a network of clinics and medical facilities scattered throughout Tacoma and the South Puget Sound area in Washington state. A state-of-the-art mini-PACS and telediagnosis system were implemented at Primary Children's Medical Center, Salt Lake City, in 1991. Over the years, it has added modalities into an electronic system that now results in significantly improved use of physicians' time and patient relations. St. Louis Children's Hospital, with both a director of radiology and a PACS administrator, has implemented telediagnosis and an ultrasound mini-PACS, and has plans for an enterprise-wide PACS. Children's Hospital in Birmingham, Ala., a major trauma center, provides specialized pediatric care to nearly all 67 counties in Alabama. With a 20-year history of online computerization, it is now reengineering its emergency department and will implement CR there first.


An organized delivery system is a network of organizations that provides or arranges to provide a coordinated continuum of services to a defined population and is willing to be held clinically and fiscally accountable for the outcomes and the health status of the population served. As such, organized delivery systems are at the center of efforts to implement health care reform. Based on analysis of 12 such systems, this article identifies key characteristics that influence what organized delivery systems are able to do, outlines the major obstacles or challenges to achieving greater levels of integration, and then discusses a number of approaches for effectively dealing with these obstacles.
Examples (Successes and failures)


This article discusses a project undertaken at the Atlantic Health Sciences Corporation to fund improvements around radiology services and equipment through a partnership with AGFA.


Scientists at 2 NASA centers and 4 medical facilities have demonstrated the possibilities of collaborative medicine, using the Internet to enable doctors and scientists at different sites to view 3-D medical images simultaneously. Unlike traditional telemedicine, in which 2 parties pass information and images back and forth, last month's demonstration involved Internet-based multicasting, with images being shared among multiple parties. Copyright Federal Computer Week Jun 7, 1999 (PQD)


E-commerce, e-mail, e-greeting, e-this, and e-that everywhere you turn there is a new "e" word for an internet or Web application. We, at the Cleveland Clinic Foundation, have been "e-nlightened" and will discuss in this report the implementation of a web-based radiology information system (RIS) in our radiology division or "e-radiology" division. The application, IDXRad Version 10.0 from IDX Corp, Burlington, VT, is in use at the Cleveland Clinic Foundation and has both intranet (for use in Radiology) and internet (referring physician viewing) modules. We will concentrate on the features of using a web browser for the application's front-end, including easy prototyping for screen review, easier mock-ups of demonstrations by vendors and developers, and easier training as more people become web-addicted. Project communication can be facilitated with an internal project web page, and use of the web browser can accommodate quicker turnaround of software upgrades as the software code is centrally located. Compared with other technologies, including client/server, there is a smaller roll out cost when using a standard web browser. However, the new technology requires a change and changes are never implemented without challenges. A seasoned technologist using a legacy system can enter data quicker using function keys than using a graphical user interface and pointing and clicking through a series of pop-up windows. Also, effective use of a web browser depends on intuitive design for it to be easily implemented and accepted by the user. Some software packages will not work on both of the popular web browsers and then are tailored to specific release levels. As computer-based patient records become a standard, patient confidentiality must be enforced. The technical design and application security features that support the web-based software package will be discussed. Also web technologies have their own implementation issues.


This presentation provides ideas for designing and upgrading radiology departments.

Electronic imaging clinical implementation strategies and principles need to be developed as we move toward replacement of film-based radiology practices. During an 8-month period (1998 to 1999), an Electronic Imaging Clinical Implementation Work Group (EICIWG) was formed from sections of our department: Informatics Lab, Finance Committee, Management Section, Regional Practice Group, as well as several organ and image modality sections of the Department of Diagnostic Radiology. This group was formed to study and implement policies and strategies regarding implementation of electronic imaging into our practice. The following clinical practice issues were identified as key focus areas: (1) optimal electronic worklist organization; (2) how and when to link images with reports; (3) how to redistribute technical and professional relative value units (RVU); (4) how to facilitate future practice changes within our department regarding physical location and work redistribution; and (5) how to integrate off-campus imaging into on-campus workflow. The EICIWG divided their efforts into two phases. Phase I consisted of fact finding and review of current practice patterns and current economic models, as well as radiology consulting needs. Phase II involved the development of recommendations, policies, and strategies for reengineering the radiology department to maintain current practice goals and use electronic imaging to improve practice patterns. The EICIWG concluded that electronic images should only be released with a formal report, except in emergent situations. Electronic worklists should support and maintain the physical presence of radiologists in critical areas and direct imaging to targeted subspecialists when possible. Case tools should be developed and used in radiology and hospital information systems (RIS/HIS) to monitor a number of parameters, including professional and technical RVU data. As communication standards improve, proper staffing models must be developed to facilitate electronic on-campus and off-campus consultation.


The county organization, including health care, is reorganized in the province of Scania in southern Sweden. As part of the restructuring of health care, a program for digitalization of the departments of diagnostic imaging, as well as for teleradiology, has been set up. Standards for network, radiology information systems, and workstations have been settled, and teleradiology links both for on-call consultations and for on-line consultations day-time have been implemented, mainly running at 10 Mb/s. Further digitalization and implementation of teleradiology is planned for the nearest years. Parallel to this, a videoconference system including several disciplines, hospitals and health care levels in the whole of southern Sweden has been implemented. The links are now also used for education, both in the province and internationally.


This article examines the driving forces for redesign in radiology departments, planning for implementation and describes the dream department for the St. Paul Medical Center in Dallas, Texas. Leadership chose a phased implementation to help with expenses.

In this article the authors describe the Management Informatique de la Radiologie et de l'Imagerie Medicale (MIRIAM) major picture archiving and communication system (PACS) project in Paris, France. The Assistance Publique of Paris, France is a healthcare provider and took the initiative to start the largest PACS program in Europe to date. The MIRIAM project will start in 1997 and will be used in different, consecutive phases. A consortium of several companies is in charge of the implementation. Thirty-three hospitals with 54 imaging departments will be integrated in one system.


Although picture archiving and communications systems (PACS) network is only a few months old, it is making life much easier for the radiologists. PACS also is better medicine. Now if physicians have a consultative radiology question in the middle of the night, about something they ordinarily would not ask a radiologist to come in and look at, they can call the radiologist who is on call and he can bring it right up on his home computer. PACS implementation at the Dallas VA Medical Center is discussed. Copyright Intertec Publishing Apr 1998 (PQD)


OBJECTIVE: To obtain users' views of the new picture archiving and communication system (PACS) from clinical and radiological staff at Hammersmith Hospital, UK. METHODS: Semi-structured interviews were used to ascertain the views of staff, following an interview schedule which covered aspects of: (1) their use of PACS, (2) facilities available, (3) the perceived quality of images, (4) reporting, (5) image availability, (6) image accessibility, (7) training, and (8) ease of use of PACS. RESULTS: Interviews were carried out with 34 key users and providers of the radiological service at Hammersmith Hospital. Overall, staff were very satisfied with PACS particularly in terms of image availability. All staff said that they preferred PACS to the previous, conventional radiology service. CONCLUSIONS: The key implications of issues raised by staff were: the impact of 'down-time' and the importance of an efficient back-up system, the requirement for sufficient short-term storage to prevent images being off-line during clinical situations, the usefulness of the folder system for management of the images, the need to access images for teaching purposes, the advantage of having a default display protocol to facilitate radiological reporting, and the requirement for flexible, yet effective, training to ensure that the system is utilised to its full potential by users.


The James Paton Memorial Hospital in Gander has scored a technological coup by installing the first Picture Archiving and Communication System (PACS) in Newfoundland. PACS technology makes use of computers and electronic networks to store and transmit diagnostic images. At the same time, the centre has also launched an ambitious teleradiology network that will connect three rural hospitals to the medical centre, dramatically speeding up access to medical specialists for doctors and patients in the outlying areas.

Abstract unavailable.
APPENDIX D: SWO DI SERVICE DELIVERY OPTIONS

In the option development phase of the project, six distinct service delivery options were identified for DI in SWO (refer to section 6.0). A high-level description of these options is presented below, from which a preferred option was selected by the Project Oversight Committee (refer to section 7.0 for a detailed description of the preferred option).

For each service delivery option, the following 4 key elements are presented:

1. Option Model (with graphic depiction*).
2. Option Description.
3. Integration Considerations.
4. Additional Key Issues.

*Note: The graphic depiction in the following DI service delivery option pages are not intended to represent the actual Network design, but rather are intended to serve as a relative guide to differentiate between service delivery options.

Option 1: Status Quo

**Option 1 Model:**
Local DI Service Delivery Models

Option 1: Description

- Hospitals are organized into sub-SWO clusters, where a mix of formal and informal relationships exists.
- No SWO WAN exists, and there is a mixed degree of PACS implementation across SWO.
- No coordinated SWO approach to improve Imaging Physician or technologist shortages.
- Organizations are still working independently, with no coordinated HR strategy on recruitment and retention of technologists.
- Overall patient care and service to referring physicians remains at current levels.

Option 1: Integration Considerations

- SWO training and education of imaging physicians and technologists.
- ‘Nighthawk’ physician call coverage.
- Human resources strategy on recruitment and retention.
- Equipment purchasing and maintenance.
- Modality-specific scheduling.
- Modality-specific funding distribution.
- Inter-hospital agreement.

**Option 1: Additional Key Issues**

- Lack of SWO WAN and full PACS across all hospitals will make image sharing across SWO difficult.
- Imaging Physician and technologist shortages continue to challenge SWO.
- After hours call coverage cannot be coordinated due to a lack of WAN/PACS.
- Lack of coordinated SWO HR approach to recruitment and retention means that hospitals continue to compete for technologists.
- It will be difficult for SWO to lobby MOHLTC for additional SWO DI funding, additional SRI approvals, collective pooling of MEF2 funding, etc.

**Option 2: Status Quo + WAN**

**Option 2 Model:**

Independent Organizations
Linked Through a WAN

**Option 2: Description**

- No further coordination of hospitals within SWO is included in this model.
- SWO would collaboratively lobby the MOHLTC for funding to implement a WAN and PACS across SWO, to enable image sharing and improve access to services.
- The SWO WAN will be set-up to allow individual hospitals to use the associated image-sharing services on a pay-per-use basis, for physician consults, after-hours call coverage, etc.
- Each hospital organization would independently make further technology decisions, on such issues as level and timing of PACS implementation, providing in-home access to images for physician call coverage, equipment replacement schedules, etc.
- Each hospital organization would establish and maintain its own data repository, independent of other SWO participants.
Option 2: Integration Considerations

- SWO training and education of imaging physicians and technologists.
- ‘Nighthawk’ physician call coverage.
- Human resources strategy on recruitment and retention.
- Equipment purchasing and maintenance.
- Modality-specific scheduling.
- Modality-specific funding distribution.
- Inter-hospital agreement.

Option 2: Additional Key Issues

- Lack of full PACS across all hospitals will make image sharing across SWO difficult.
- Standardization of key patient information elements will be required to facilitate information sharing, and confidentiality agreements will need to be established.
- Imaging Physician and technologist shortages continue to challenge SWO.
- Lack of coordinated SWO HR approach to recruitment and retention means that hospitals continue to compete for technologists.
- It will still be difficult for SWO to lobby MOHLTC for additional SWO DI funding, additional SRI approvals, collective pooling of MEF2 funding, etc. – given the lack of formal coordination.
- Competition for technical fee revenue may possibly exist between hospitals, in the absence of the globalization of technical fees (via the recommendations of HIAC).

Option 3: SWO Sub-Clusters

Option 3 Model

Series of Independent Sub-clusters

Option 3: Description

- Current formal and informal organization relationships will be formalized into ‘sub-clusters’, which will serve a loose coordinating function to improve overall access to DI services.
- A WAN will be implemented within sub-clusters, and where possible, WAN connections will be developed between sub-clusters. Each sub-cluster will be responsible for its own PACS and WAN administration.
- Each sub-cluster would determine how best to manage coordinated or independent data repositories within its hospitals.
In-home access to images would be provided for call coverage to all imaging physicians within each sub-cluster.

Modality waiting lists would be maintained by each sub-cluster.

Sub-cluster hospitals will work together in recruitment and retention efforts.

Option 3: Integration Considerations

- SWO training and education of imaging physicians and technologists.
- ‘Nighthawk’ physician call coverage.
- Human resources strategy on recruitment and retention.
- Equipment purchasing and maintenance.
- Modality-specific scheduling.
- Modality-specific funding distribution.
- Inter-hospital agreement.

Option 3: Additional Key Issues

- Lack of full WAN across all hospitals will make image sharing across SWO difficult.
- Standardization of key patient information elements will be required to facilitate information sharing, and confidentiality agreements will need to be established.
- Additional efforts towards population health management with respect to DI services may be coordinated at the sub-cluster level.

Option 4: Flat Network

Option 4 Model:
Coordinated Approach Across a Network of Sub-clusters

Option 4: Description

- Major SWO centres such as London, Windsor and Owen Sound will serve as coordinating centres for the Network, which will be linked together, and will coordinate with the hospitals closest to them, to form a Network of ‘clusters’.
- The coordinating centres will not necessarily have a lead role within each cluster.
A WAN will be implemented, where there may be lead PACS and WAN administrators located in one of the hospitals within each cluster, to serve a coordination function, or there may only be local PACS and RIS staff in each hospital of the cluster.

- Data repositories may be established in each hospital, or in a single hospital within each cluster, to serve each cluster.
- In-home access to images would be provided for call coverage.
- Formalized referral patterns would be established between DI physicians, to facilitate consults, and would be based (where possible) within each Network cluster.
- Modality waiting lists would be maintained by each cluster.
- Network participants will work together in recruitment and retention efforts for SWO, focused within each Network cluster.

**Option 4: Integration Considerations**

- SWO training and education of imaging physicians and technologists.
- ‘Nighthawk’ physician call coverage.
- Human resources strategy on recruitment and retention.
- Equipment purchasing and maintenance.
- Modality-specific scheduling.
- Modality-specific funding distribution.
- Inter-hospital agreement.

**Option 4: Additional Key Issues**

- Standardization of key patient information elements will be required to facilitate information sharing, and confidentiality agreements will need to be established.
- Additional efforts towards population health management with respect to DI services may be coordinated within each cluster, and across neighbouring clusters.

**Option 5: Primary Node Network**
**Option 5: Description**

- Major SWO centres such as London, Windsor and Owen Sound will serve as coordinating centres for the Network (primary nodes), which will be linked together, and will serve the hospitals closest to them (secondary nodes), to form a Network of ‘node clusters’.

- The coordinating primary node centres will have a lead role within each cluster.

- A WAN will be implemented, where the primary PACS and WAN administrators would be located in the primary nodes, and would serve a coordination function for local PACS and RIS staff.

- Data repositories would be established in each of the primary node centres, to serve each node cluster.

- In-home access to images would be provided for call coverage.

- Formalized referral patterns would be established between DI physicians, to facilitate consults, and would be based (where possible) on the primary and secondary node relationships.

- Modality waiting lists would be maintained by each primary node.

- Network participants will work together in recruitment and retention efforts for SWO, focused within each node cluster.

**Option 5: Integration Considerations**

- SWO training and education of imaging physicians and technologists.

- ‘Nighthawk’ physician call coverage.

- Human resources strategy on recruitment and retention.

- Equipment purchasing and maintenance.

- Modality-specific scheduling.

- Modality-specific funding distribution.

- Inter-hospital agreement.

**Option 5: Additional Key Issues**

- Standardization of key patient information elements will be required to facilitate information sharing, and confidentiality agreements will need to be established.

- Additional efforts towards population health management with respect to DI services may be coordinated within each primary node, and across SWO through the primary nodes.
Option 6: Hub-and-Spoke

Option 6: Description

- A central site would serve as the hub for a SWO Network of separately governed organizations, in relation to staffing, financing, major capital acquisitions and patient care.
- A WAN will be implemented, where the primary PACS and WAN administrators would be in the central site, and would serve a coordination function for local PACS and RIS administrators.
- A centralized data repository would be established and managed for all of SWO DI.
- Each Network participant would be focused on improving patient care at both the local and SWO level.
- In-home access to images would be provided for call coverage.
- Formalized referral patterns would be established between DI physicians to facilitate consults.
- A centralized waiting list for all modalities would be developed and maintained.
- Network participants will work together in recruitment and retention efforts for SWO.

Option 6: Integration Considerations

- SWO training and education of imaging physicians and technologists.
- ‘Nighthawk’ physician call coverage.
- Human resources strategy on recruitment and retention.
- Equipment purchasing and maintenance.
- Modality-specific scheduling.
- Modality-specific funding distribution.
- Inter-hospital agreement.

Option 6: Additional Key Issues

- Standardization of key patient information elements will be required to facilitate information sharing, and confidentiality agreements will need to be established.
- Additional efforts towards population health management with respect to DI services may be coordinated within each primary node, and across SWO through the primary nodes.