Managing Health Information Delivery Processes for Better Medical Decision Making

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Abstract: Hospitals often retain inadequate systems because they are concerned about the organisational and financial cost of IT investments that do not clearly lead to increased revenue. Previous work has not carefully examined the health care, organisational and business process issues caused by widespread under-investment in Health Information Systems, leading to compromised decision making. Methods: This paper describes the processes involved in a common data management problem in hospitals by investigating the use of a legacy semi-integrated system. It combines a number of methods in a novel way - interviews, surveys and a simulation - to show how data loss affects the length of service time for patients. Findings: The paper finds that data delay or loss inclines medical consultants to make decisions about patient care without full access to all requested data, leading to repeat patient scanning, risks to patients and costs to the system. Contribution: It examines how the processes leading to unreliable data delivery influence the decision-making behaviour of actors in a system. It shows how problematic processes lead to doctors making decisions even if data is absent and illustrates how inertia in adopting integrated health IS, providing improved decision support, can have an impact on patient care.

Keywords: Decision- making; Delivery services; Effectiveness; Hospital; Data loss; simulation; IS implementation

Introduction

IT investment in the hospital sector worldwide sits at around 1.5 per cent of total budget compared to up to 15 per cent in other sectors, with an American Hospital Association report suggesting that 8 out of 10 American Hospitals further reduced spending on I.T. during the global economic downturn [1]. Since then there has been continued slow progress with respect to the adoption of health information technology [2]. This may partly be because while rapid computerisation has been shown to increase administrative costs [3] outcomes measures for improved health care as a result of computerization have been inconclusive [3].

Consequently, those seeking to justify increased technology funding in hospitals need to support their arguments with a detailed explanation of how the use of information systems will bring significant quality, safety and cost benefits to health organizations. Benefits may occur in many ways including through the support that IT can potentially provide to decision makers in terms of more readily available and more reliable patient information, but these need to be clearly demonstrated.

Lack of integration, a common problem identified in studies of hospital Information Systems [4, 5], is a frequent source of reduced benefit. At present, many information systems in major hospitals are best described as semi-integrated. The typical operation of PET (Positon Emission Tomography) and MRI (Magnetic Resonance Imaging) scanning procedures in neurology departments of large US and Western European hospitals are an example of this type of system. PET and MRI scanners produce digitized data which is often printed and stored in a central storage area for distribution, while the original digital file is archived at the scanning center. When medical staff request the scan, the print-out is collected and delivered by administrative staff [5-7]. A common reason why the digital copy is unable to be sent from the scanning center to the medical staff is that, even when both parties are physically co-located in the same building, the scanning centre network is completely separate from the main hospital network. This situation has evolved because hospitals budget separate divisions separately and do not often have budgets for computer implementations that span across divisions. Additionally, full implementation of integrated technologies, such as PACS (Picture Archiving and Communications Systems), is still years away at many otherwise modern centres, with particularly low rates of uptake in smaller hospitals. Recent industry reports also suggest that the current focus on the Electronic Health Record in the US and Australia (where the EHR was rolled out in 2012) has redirected funding away from other foci [8]. In Europe, financial shortcomings and capital expenditure freezes are predicted to delay the implementation of fully automated systems up until 2016 [9].

Consequently, hospitals are investing scarce resources in expensive network-enabled medical diagnostic technologies such as PET and MRI scanners but failing to maximize benefits because the data generated by each technology is trapped in an information silo. An added problem is the poor workflow management around the distribution of this information, leading to constant delays and losses in the delivery of data. Research indicates high levels of data loss in systems where data is transferred manually [7]. In an increasingly litigious environment, hospital administrators need to have a clear idea of the real health cost of delay in adopting data delivery improvements which might reduce the rate of missing data. Therefore, the aim of this paper is to quantify the impact of manual and semi-integrated systems on data distribution and to consider the consequence of the results that are found for doctor decision making and flow-on service quality and safety.

1. Background

1.1 Lack of System Integration

As described in the introduction, many hospital systems are only semi-integrated. That is, the data capture task is digitized and automated but is not integrated with the digital systems that deliver the data electronically throughout other parts of the hospital and the scanning machines are often not integrated with a hospital's communication infrastructure. As a result, the large digital file of each patient scan is printed at the scanning machine and this physical document is then distributed manually, while the scan is stored on a large data store either attached directly to the machine or within the scanning facility. Such practices may sound archaic in modern industry but are surprisingly common in Western hospitals.

The lack of integration seems to have often evolved not by specific intent, but because there has been funding for a network capable diagnostic device but no funding to build the communication infrastructure needed to make full use of the device (or there may be perceptions that some manual tasks are performed effectively as is). In other systems problems have occurred in interfacing manual and automated systems [10] and attempts have been discontinued. Overall, however, while semi-integrated systems are common, our understanding of the impact of leaving systems semi-integrated is still incomplete.

Additionally, there is limited consensus about the benefits of full integration. Research into the implementation of fully integrated image data delivery systems such as PACS suggests that hospitals are reluctant to move forward because benefits are unproven (Martin, Mariani et al, 2007) implementation is costly [11-13], non-IT staff are reluctant to learn new skills or unable to commit to the time required for implementation [14-18] or have received adverse reports about other implementations [19]. As a result, many large hospitals worldwide have continued to operate with fragmented, non-integrated systems and, in many cases, with significant processes performed manually.

2.2 How Doctors Make Decisions to Prescribe Treatment

These systemic problems mean that doctors in hospitals often find that the patient information they order is delayed. To date, work in the medical informatics field has tried to suggest technical solutions to such problems [20]. However, while these may exist, in the information Systems field it is considered important to also examine the theories, often from multiple disciplines, about how users and information intersect, and the impact on organisational problems [20].

Behavioral theory suggests that doctors will sometimes feel compelled to act in treating a patient regardless of delays in the delivery of information. The Theory of Planned Behavior [21] proposes a strong association between intentions and behaviors. It holds that behavioral norms are strong predictors of action; on this basis it follows that if there is a norm for a doctor to treat a patient at a consultation he or she will most likely attempt to do so. Research suggest that patient expectations that there be an outcome to a consultation, such as a prescription being issued, create such norms [22]. Thus in situations where there are long queues for service in a hospital it may be anticipated that once a patient has begun a face-to-face consultation, the doctor will be disinclined to move the patent further down the queue by postponing a decision about treatment, even if the amount of information for decision making that is available under a semi-integrated system is not optimal.

Additionally, information processing theories such as the Elaboration Likelihood Model [23] suggest that when an individual is highly motivated they are inclined to scrutinise all relevant information that they have in an attempt to make an accurate judgement (referred to as the systematic route). When motivation is low or the ability to process is low (because of insufficient information) they can be inclined to take a heuristic route or satisficing approach. Generally doctors will be motivated to make the best possible decision but in the complex hospital environment multiple time and economic pressures exist [24] that may affect a doctors motivation to seek out additional information if experience shows it may be difficult to attain .

Further, decision making about patient treatment by clinicians has been shown to entail consideration of many factors. These include “application of biomedical knowledge, rigorous problem-analysis, weighing of probabilities and usefulness of various outcomes, and acceptance of risk”[25 p.957]. Thus a doctor may be concerned about the outcomes of delay in treatment in a system where there is no assurance that the requested information will be available quickly. This may further encourage an action to treat the patient even where patient information is incomplete. Thus the consequences of retaining systems which do not deliver the data required for effective decision making may be greater than is currently apparent.

Related studies over many decades, have shown the improved patient benefits that can result when information flow and workflow are better aligned to support timely decision making. Studies claim a focus on workflow “will enable (hospitals) to better co-ordinate the use of resources for diagnosis, treatment or clinical management, allowing (hospitals) to preserve quality [26]. Studies that examine the digital distribution of medical images have also found “higher workflow efficiency leading to better patient care” [27] Other work has found just over a 30% reduction in time before a treatment action took place when a digitized database was used rather than a hard copy film process [28]. More recent studies, including an indepth examination of current trends in Health IS [29], suggest that that the impact of unreliable data delivery on health care is not being studied, despite identification of continuing problems of integration and penetration of the IT artefact. Other recent work suggests that a patient centred approach, rather than one that supports individual clinician tasks is needed [30]. No previous work that we have identified has examined the impact of delayed data on patient care as a consequence of how this delay effects doctor decision making.

Research Question

In light of these issues this paper addresses the following novel research questions: **How do semi-integrated data delivery processes affect the delivery of patient data to doctors? What impact does this have on the decision making of doctors?**

In this paper we describe interviews and a survey conducted among hospital medical consultants. Using the data from these instruments we simulate a hospital process to analyze the impact of delayed data delivery. We conclude that problems in the continuing use of semi-integrated systems are significant in delaying the timely delivery of data to doctors and may impact on their decision process. These findings warrant consideration in any argument for using IS to increase the quality provision of service.

2. Methodology

2.1. Research Setting

The research was conducted in a 700-bed public hospital. The specific process under examination involves a patient entering a hospital Neurology out-patient center for treatment. A neurology department was selected because neurologists traditionally request large numbers of image based scans which are more subject to data delivery problems than text based data. Consultants in this center conduct a three-hour consultancy with outpatients each week, seeing approximately fourteen patients over this time.

Imaging modalities available at the hospital include x-ray, magnetic resonance imaging (MRI) and positron emission tomography (PET). The management of these image processes is semi-integrated in the sense that the scans are digitized and stored on disk in digitized archives with the potential for networked electronic transmission, but once removed from the imaging centers, scans are transported manually around the hospital.

2.2. Methods

Interviews and surveys were conducted with 5 doctors (consultant neurologists) in an out-patient unit. These 5 consultants were selected based on their number of weekly requests for image based data sitting around the mode for the unit.

The consultant neurologists were each involved in half-hour open ended interviews where they were asked to describe the data delivery process through the various service nodes in the hospital and were questioned about processes used to locate data, problems relating to lost data and their ability to make treatment decisions in the absence of data.

The interview data was systematically transcribed, coded and analysed to uncover emergent themes. This was done independently by multiple reviewers. Because there were no a priori hypotheses guiding experience of how the neurologists dealt with data in the system, accepted theory building approaches to data analysis were used. These recommend a multiple parses of the data with different levels of coding and the development of theoretical notes and memos as the data was progressively analysed. Three coding cycles [31,32] were used to code the audio-recorded interviews using the software NVivo, version 9. The open and axial coding cycles were used to induce propositional statements [27] from which the themes were developed.

The consultants were also asked to fill in a survey questionnaire (see Appendix A) immediately after each patient consultation over a two week period. Where data was unavailable and the questionnaire could not be immediately completed, doctors were asked to revisit the questionnaire after 3, 7 and 14 days until it was completed. Consultants' secretaries supported this aspect of the task. Nearly 400 questionnaires were collected. Of these 332 were completed in full. Results from the survey presented in this paper are deduced from these 332 surveys. The survey produced simple Yes/No or numeric results which were quantified using Excel software.

The Survey and interview results were used to create a simulation of the hospital system. Using the software, "Micro Saint" (Rapid Data, UK) it was possible to estimate the impact on 1000 patients of delayed data delivery, which would have been unfeasible to study in the real world. Survey and interview results were used to work out which tasks were required when a consultant sought two separate pieces of data, and to ascertain where the significant points of activity in the process occurred.

Evidence gathered from the surveys and interviews with hospital staff suggested the possible pathways and search times for a data request through the repositories listed in Table 1. At each data repository in the search there is a given probability of finding data and returning it to the consultant. If data is not found the search continues. These search times and probabilities were implemented in the simulation.

3. Results

3.1. 3.1 Interview results

The interview data established a number of themes relating to hospital business processes:

Theme One: There is an ideal route through the hospital process from initial consultation to final treatment. Interviewees concurred that this ideal route followed 8 steps:

Step 1: the patient enters the system;

Step 2: the patient undergoes a scan process such as a PET or an MRI and a hard-copy scan is transferred to a central file area;

Step 3: the patient makes an appointment to see a consultant where the scan will be reviewed;

Step 4: the Consultant requests relevant patient scans to be found and delivered to the consultation;

Step 5: the relevant data repository is searched and scans are retrieved and delivered to the consultant;

Step 6: the patient is seen by the consultant and the scans (which have been delivered in a timely fashion) are reviewed;

Step 7: diagnosis and treatment decision are made;

Step 8: the patient continues to subsequent stages of treatment or cessation of treatment.

Theme Two: Lost and delayed data often prevents the ideal route being followed. For example, if information cannot be retrieved from the central file area (or other data repository) in step 5 the consultant will not have the information required for diagnosis and treatment (at steps 6 and 7). At this point the patient may continue to move back to step 3 until the doctor is satisfied with the amount of information available. This may not occur until the

MRI or PET archives have been searched (step 5). If step 7 cannot be completed, queues will begin to develop at the earlier steps as the patient re-enters the service loop (step 2) for re-scanning.

Theme Three: Scans are only ordered when presumed valuable to treatment as they are expensive and intrusive.

Theme Four: Medical staff regard the system as "untrustworthy" and do not presume that data will be available in a timely fashion. (A timely fashion is generally regarded as 7 days in the neurology ward, as the quick detection of tumours requiring treatment is vital and should not extend beyond this timeframe where possible).

Theme Five: Medical and administrative staff commonly spend time searching for missing data.

Theme Six: Doctors acknowledge the patient expectation that consultations (which have often been preceded by a significant wait time) will generally produce some sort of action recommendation.

3.2. 3.2 Results for Searching the Data Repositories

As well as the six general themes that emerged from the interviews, the interviews combined with question 3 of the survey data (see Appendix A) also provided some specific timing information for how long it took, on average, to search the data repositories for patient data that had been ordered.

Table 1 describes the average time taken to move through the 4 repository searches (Central file, Pet Centre, Pet Archive, Rescan (if not found). In this scenario there is a choice of Radiology (PET) or MRI at step 5 of the treatment route and an expected 100 searches a day. Every search request in the table arrives at the Central File Area (100 out of 100) and if the file cannot be found there, searching continues through the other repositories.

Table 1: Rates of Delay and Probabilities of Data Being Found for 100 Searches

Search Process	Expected Delay in days	Expected rate of a search request arriving at this component	Probability (interview or survey based) of data being found at this point
Search Central File (CF)	3.5	100	0.8
Search MRI Center or Radiology (CT) Center *	3	20	0.7
Search MRI Archive or Radiology (CT) Archive *	2	6	0.95
Rescan (File routed back to CF)	20	.3	0.8

* A search will be conducted in either the MRI Center/Archive or the Radiology Center/Archive depending on whether a MRI or a CT scan is sought

3.3. Survey Results

The survey (see Appendix A) was also used to measure the impact of the data loss on a doctors ability to make a treatment decision. Making a treatment decision is defined as providing a drug or other course of remedial treatment or a conscious decision not to change current treatment. Measurement of this impact is important as lost data only adds to the service queue if it causes doctors to reschedule appointments, or reorder scans.

[1] **Table 2 :** Questions and percentage responses from the survey

Survey Question	Response	
	Yes	No
2b) Where the consultation took place with requested data items missing, were you able to make a treatment decision?	82%	18%
2 c) If the missing data items had been present, would the data have made it easier to make a treatment decision?	9%	91%
2 d) If you answered no to 2b, Was it possible to delay making a treatment decision until the missing item(s) was (were) found?	66%	34%

Table 2 illustrates the problems of decision making in the absence of data. We see that in a significant number of cases absent data is associated with a lack of decision making or difficulty in decision making. Additionally, a particularly interesting result from the survey was the finding derived from question 3b that doctors worked hard to find missing date. They spent on average 13 minutes of their own time locating files that were missing, both liaising with clerical staff, and on occasion going down to the PET and MRI centers to search out the scans themselves, which took over an hour.

3.4. Simulation Results

The simulation modeled a request covering two data modalities, MRI and PET, demonstrating the spread of times for returning the information sought. In many cases the simulation shows that the two scans would have followed different paths and would have arrived at different times.

Although a doctor requesting two scan results for a patient, such as PET and MRI, compounds the possibility of delay, it is common hospital practice in the neurology outpatients' center. A request for a single data mode (PET alone) carries with it a given probability of being delayed at all the points along the search process (Table 1). When a request for multiple-modality data (both PET and MRI) is made, all scans will need to travel along their independent paths back to the consultant, and may suffer their own separate degrees of delay. Therefore if a consultant is waiting for two scans and needs both scans to make a treatment decision, the wait will be equal to the time it takes for the longest delayed scan to be returned.

In the simulation created, a generator representing the individual requesting the file, sends a request for two different scans – an MRI and a PET – to the central file area. There the file divides in two and the two scan types follow a combination of possible paths. At the conclusion, the two scans are found and can be delivered to the person who requested them.

Data requests in the simulation follow a particular path or route, defined at each point in the network, based on probabilities determined through the interviews with consultants. For example, it was determined that there was a probability of 0.95 that a file would be found in the PET archive and would move straight back to the consultant. This data was input into the simulation. Similarly, using the information gathered from consultants, the mean time that it took to complete each search was defined (Table 1).

The percentage of files likely to have been returned to a consultant by the end of one week and two weeks is shown in Tables 3 and 4. In a small number of cases one file was still not available after 18 days, with a small percentage of patients being rescanned up to 40 day.

[2] **Table 3:** The percentage of files returned to a consultant after one week when two were ordered

One week elapsed	Percentage of files returned to consultant
Percentage of cases where one data item was returned to the doctor	93.78
Percentage of cases where both items of data were returned to the doctor	68.26

[3]

[4] **Table 4 :** The percentage of files returned to a consultant after two weeks

[5] when two were ordered.

Two weeks elapsed	Percentage of files returned to consultant

Percentage of cases where one data item was returned to the doctor	98.20
Percentage of cases where both items of data were returned to the doctor	86.53

4. Discussion and Analysis

The survey and interviews suggested that more than 70 per cent (where P = 0.7) of files will likely be found by the time the search moves to the PET or radiology centers (Table 1). At this stage, for an individual file, only six and a half days should have elapsed: one day to go to the central filing area, two days to search the central filing area, two days to search the PET Center. But, in the simulation, after seven days nearly 32 per cent of requests for a second data item are unfulfilled when the search is simulated for 1000 data requests. As suggested in the interview theme 4, more than 7 days is considered problematic. As data requests rejoin the queue for processing from the beginning, the time it takes to fulfill a data request increases disproportionately as more repositories are searched and in extreme cases, a rescan is done. Thus two weeks elapsing does not return double the number of scans as one week elapsing. Each data item that is not found after the first week, takes longer to look for in the second week. Thus the relatively low instance of a re-scan being required (see Table 1) disproportionally blows out the service time for the whole queue as the rescanning of one patient inevitably moves other patients back in the queue and delays the whole system. This problem is over and above the health issues that may arise from being scanned twice unnecessarily [7].

In a large proportion of cases, one data item in a request for two is delivered after the benchmark consultation time. This complicates decision-making for consultants and could result in treatment being delayed or being implemented without full information. While the latter option is reported as a clearly undesirable event, survey data suggested that in the busy public hospital setting this approach was sometimes necessary. In nine percent of cases consultants answered "yes" to "If the missing data items had been present, would the data have made it easier to make a treatment decision?" While consultants use extensive professional judgment in taking this course, they would clearly prefer to have access to full information.

The Theory of Planned Behavior may explain why doctors will still make decisions even if data is absent. The theory suggests that behavioral norms and consideration of the usefulness of outcomes incline consultants to take action of some kind. This may be particularly the case because, as evidenced in the interviews, doctors regarded the data delivery system as untrustworthy and did not presume that data would become available. The Elaboration Liklihood model further explains why doctors may be inclined to make do with the information available despite its incompleteness. Where information is difficult to attain a heuristic route may be taken to fill the gaps.

Despite doctors claiming that in 18% of cases they were unable to make a decision, in only 66% (of the 18%) did they actually claim they had delayed decision making. Where doctors are inclined to treat and reported that there was often some urgency to treat placing further pressure on doctors, doctors relied on other test results or other symptoms. Given that doctors do not order expensive tests like MRI and PET frivolously, this is clearly problematic for patient health where one would presume that each patient result contributes in some way to the data required when a treatment program is designed.

Because consultants in neurology departments in public hospitals often order multiple-modality data, the delay in the receipt of one data item can prevent the fully effective use of the others: when one data item arrives much later than the other, the first item's role in decision support is devalued. Consultants expressed concern about the impact of data delay on their own decision-making and the flow-on impact on patients' health care when every element of a request for more than one data item does not arrive in reasonable time.

The result in question 3b of the survey that doctors spend an average of 13 minutes looking for a lost scan also raises important issues. Doctor time is a limited resource and time spent on data search is at least to some extent, taken from patient care time. Additionally, the time required to search may be prohibitive for doctors in implementing a search and have an impact on a doctor's inclination to make a treatment decision despite the absence of the data.

In sum, this research shows that the late arrival of even one item can wreak process havoc. It can cause patient appointments to be cancelled, patient timeslots to go unfilled, and treatment to be delayed. Additionally it can push doctors into a situation where they are making treatment decisions "in the dark" in the absence of all the information that they had, in their professional judgment, ordered and considered necessary for treatment. This can negatively impact health care as well as incurring additional costs, extending far beyond repeating a scan or consultation.

Administrators need to rethink the relevance of factors that have previously worked against hospitals commitment to fully integrated systems. For example, wireless solutions now provide opportunities within PACS implementation which are significantly less expensive and less disruptive to ongoing operations.

This paper does not however, attempt to make a case for fully integrated solutions, such as PACS. In fact recent research suggests that there may be no large reductions in duplicate imaging after PACS [33] and that PACS may contribute their own novel set of system delays such as lengthening ward rounds. However, when hospitals spend millions of dollars on PET scanners and MRI machines they need to seriously consider the broad implications, both in healthcare and resource terms, of the inefficient distribution of the data generated by these machines.

5. Conclusion

This paper makes an important contribution to the discussion about how and why IT funds for the support of decision making should be allocated in public organizations. It also raises issues about the role of systemic factors in data loss and delay. It makes much clearer the disadvantages of hospitals' continued use of these semi-integrated systems and highlights the value of investigating the technological alternatives as well as the specific process and procedural factors that make these systems problematic. It also contributes to the wider discussion on how poor systems can impact broadly on organizational effectiveness.

This paper has shown how IT analyses need to look at not just the possible benefits of implementing new systems but the unexpected effects of retaining problematic legacy systems. It has answered the research question by measuring the extent to which data that is ordered fails to be available to doctors when requested. It has shown how this missing data puts doctors in the unenviable position of having to decide how patients should be treated without having full and timely access to all the information which they ideally need and have requested. This creates a legal and ethical minefield which needs to be considered in any systems implementation program that does not prioritize the replacement of poor data delivery systems.

Aside from the direct impact on doctor decision making, if all the impacts mentioned are considered, such as the amount of doctor time spent searching for data, the poor use of equipment for rescans, ancillary staff time assisting doctors in searching for data and badly used waiting space, the resource wastage that results from the delays in current systems must have an inevitable effect on the quality and timeliness of care.

5.1. Limitations of the Study

This research is limited by the generalizability of the findings based on one site, the effects of using one specialty within the hospital (neurology), and the limitations of simulating data as opposed to measuring it. Nonetheless, the study still provides valuable insights for IT implementation decision models in hospitals. It provides useful data for consideration for hospital administrator's faced with the difficult decision of how and where to expend limited funds to support hospital decision making.

5.2. Recommendations

Replacing systems is not always financially feasible or practical in the short term, and the best way ahead is not always fully clear. However, hospitals need to:

- commence the very significant task of mapping workflows and current processes
- reflect on how these work flows and processes support or reduce decision making
- consider the decision support benefits that could accrue from improved processes and the implications for future information systems redesign.
- Employ clinically astute systems analysts with a full understanding of the impact of data delay on decision making in the clinical setting.

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Appendix: 1

[6] Patient Data Survey for Consultant

1 a) Which of the following data items were sought and available in the present patient consultation?

	SOUGHT	AVAILABLE
MRI	YES/NO	YES/NO
PET	YES/NO	YES/NO

Answer YES or NO to Questions 1 b) to 2f)

1 b) If all the data that was sought was available were you able to make a treatment decision?

2 a) Where requested data was unavailable, was it necessary to reschedule the patient consultation?

If the answer to 2 a) is YES you can go to question 2 e). (You do not need to complete the next 3 questions (2 b)–d)).

If the answer to 2 a) is NO, answer 2 b)–d), and leave out 2 e) and 2f).

2 b) Where the consultation took place with requested data items missing, were you able to make a treatment decision?

2 c) If the missing data items had been present, would the data have made it easier to make a treatment decision?

2 d) Was it possible to delay making a treatment decision until the missing item(s) was (were) found?

2 e) Where it was necessary to reschedule the patient consultation was another patient available to fill the consultation time slot?

2 f) If no other patient was available, were you able to use your time for patient care?

You will need to answer the following question, when the information becomes available.

3) Where a data item was unavailable

a) How long was it until the missing data item subsequently became available?

   ______ Hours _______Days

b) How much of your own time do you estimate was spent attempting to locate and retrieve the missing data? _____ Hours ________Days

c) When the data was finally located was it in the

   i) PET/MRI Center

   ii) PET/MRI Archive

d) Was a Re-scan necessary? Yes…….No……

   i) If Yes ,, how many days did it take for the rescanned data to be returned to you? Days