

Surviving SAP Implementation in a Hospital

Case¹ prepared by **Juanita CAJIAO**² and **Enrique RAMÍREZ**³

Despite the potential benefits of electronic information management, including increased patient safety and more cost-effective health care delivery, few countries report the adoption of electronic systems for managing hospital information. On January 1, 2011, the Valle del Lili Foundation (VLF), a university hospital in Cali, Colombia, switched from paper to electronic documents to manage medical records (MR) and all related clinical and administrative procedures. The VLF, which reported revenues of US\$200 million in 2014, is ranked the third best hospital in Latin America and the best in Colombia. The hospital made the ambitious decision to simultaneously implement electronic medical records (EMR), computerized physician order entry (CPOE), and enterprise resource planning (ERP). The new system is now fully operational. Marcela Granados, chief medical director (CMD) at VLF, was tasked by the board of directors with analyzing the IT implementation process and documenting the main reasons for its success. While reflecting on this task, Granados concluded that one thing was certain: SAP implementation was a major turning point in VLF's history.

The Valle del Lili Foundation

The Valle del Lili Foundation is a private non-profit organization founded in 1982 to deliver tertiary medical care. The VLF was the brainchild of two cardiologists from Cali who identified the need for a regional healthcare institution to deliver specialized care to medically complex cases and critically ill patients. They were later joined by Vicente Borrero, a public health physician, who has been CEO since 1986. Bringing together regional civic and political leaders and donors, they collected the necessary funds to launch the project. Initially focused on cardiology cases, they gradually expanded their service offer. Today, VLF offers clinical care in more than sixty medical specialties (See Exhibits 1 and 2 for statistical highlights and staffing information) and serves as a teaching hospital, where ICESI University medical students receive training.

¹ Real case based on twenty-two interviews conducted by the authors over a four-month period in 2014. All interviewees were working at VLF at the time of data collection and represent various functions – clinical, assistive, and administrative – and hierarchical levels – directors, middle managers, process leaders – at the hospital.

² Juanita Cajiao is an assistant professor in the Facultad de Ciencias Administrativas y Económicas (School of business and economics studies) at Universidad ICESI in Cali, Colombia.

³ Enrique Ramírez is an assistant professor in the Facultad de Ciencias Administrativas y Económicas (School of business and economics studies) at Universidad ICESI in Cali, Colombia.

In December 2014, revenues totalled about US\$200 million (see Exhibit 3). The previous year, *America Economia* magazine had ranked VLF the fourth best hospital in Latin America and the best in Colombia based on clinical, administrative, and financial indicators. In 2014, VLF was ranked the third best hospital in Latin America and the best in Colombia. These awards confirmed VLF's long-standing commitment to delivering excellent health care services in a patient safety-centred environment.

In 2006, VLF embarked on an ambitious plan to expand its service offering by constructing new facilities to house additional beds, an emergency room (ER), and ambulatory care services. By December 2010, the number of beds had increased by almost 60%. This growth put tremendous pressure on all patient care delivery procedures.

Structure and Operation of Colombia's Healthcare Industry

The functional and financial structure of Colombia's health system is complex. Law 100 (1993) launched a major reform of the country's healthcare industry. This law identified the system's stakeholders and established their responsibilities. These included private health insurers, known as Health Promotion Organizations (HPO),¹ which are responsible for enrolling members and managing the system's available resources. Other important players are the Care Delivery Organizations (CDO), including hospitals, which are responsible for providing services to HPO members. Under this scheme, insurance companies contract services with hospitals (in this case VLF) through managed care agreements and decide which CDO will care for their members. This is an important feature of the Colombian system because it means that HPOs, not doctors, decide where patients are treated. By December 2013, 58% of VLF billing went to HPOs (see Exhibit 3); the rest went to prepaid medical organizations, other companies, and private patients. Law 100 also created the Obligatory Health Plan (OHP), which stipulates the health-care services, surgeries, procedures, hospital services, and medications that HPO members are entitled to. The OHP also provides a reference price list for the industry, used when negotiating health-care contracts between insurers and CDOs.

The VLF Medical Staff

VLF is a hierarchical, top-down hospital composed of medical units, each headed by a specialist physician. The CEO, the CMD, the chief nursing officer, the chief administrative officer, and the heads of the medical units form the physicians' medical council and are responsible for communicating all senior management decisions to their units.

Although physicians are not directly employed by VLF, they comply with the policies of the medical directorate and the physicians' executive council regarding quality and patient safety issues, the terms agreed to by VLF and insurers, and standard administrative procedures. Physicians are paid according to the number of patients they see, charging at the rates established by the insurance contracts; VLF takes a 20% cut to cover administrative expenses. Approximately 20%

¹ These organizations are similar to Health Maintenance Organizations (HMO) in the U.S., which limit coverage to care provided by contracted providers.

of total VLF billing is for medical fees. Additionally, all doctor-patient contact takes place within VLF facilities; full-time medical staff are not permitted to see patients or deliver clinical services outside VLF. Given the hospital's high occupancy rates, doctors don't need to go elsewhere to find patients.

Marcela Granados, a critical care physician who holds an MBA from ICESI University, has been head of the intensive care unit (ICU) since it opened at VLF in 1992 and CMD since 2012. She explained: "This type of relationship – with full-time doctors – is a cornerstone of the integrated medical care offered round the clock at VLF. Given the nature of the patients we serve, there are always medical specialists scheduled to be either on hand or on call. At VLF, doctors find everything they need to practise good medicine: technical resources, high standards, a group of highly skilled specialist physicians, nursing and assistive personnel, and many patients. They find it all here; there is no need to go anywhere else."

This governance structure is not common in Colombia, where physicians usually work as independent contractors at hospitals – often at several institutions simultaneously. This limits the influence that hospital administration can have over medical staff since it has no official authority over them.

Patient Care Delivery before IT Implementation

A patient can enter VLF in one of four ways: ER, outpatient services, ambulatory procedures (diagnostic or other), or surgery. A patient may be admitted through the ER, be referred for surgery, be sent to recovery, be transferred to the ICU, be sent to a hospital floor unit, and finally be discharged. While in the hospital, the patient may have been treated by a group of specialists in medicine or other disciplines such as nursing, respiratory therapy, nutrition, physiotherapy, and pharmacy. The patient may have been given various diagnostic tests and received specialized medical treatment such as chemotherapy, radiation therapy, and cardiac rehabilitation. Patients generally pass through many hands during their stay at VLF, requiring close coordination between administrative and patient care personnel. This coordination is based on medical records (MR) containing the record of every medical and clinical procedure performed and all supplies¹ and medicines used.

An example of one patient's journey will help put this in perspective. By December 2010, there was an average of 1,000 surgical cases per month. Each case required the coordination of many steps prior to, during, and after surgery with a schedule made up of three shifts. High quality standards were met at all times, but it was not easy to coordinate the work of everyone involved: surgeons, anesthesiologists, medical equipment preparers, assistants, operating room (OR) supply store staff, and clerical staff such as those in charge of detailed billing reports. First, the surgeon issued a medical order with a specific surgical procedure to be approved by the patient's insurer and another medical order to schedule an appointment for the pre-anesthesia evaluation. Once the insurer had authorized the procedure, the patient met with an anesthesiologist, whose consent for the surgery was required. The surgeon then asked the operating rooms to schedule the surgery and drew up a list of the instruments and supplies required for that specific procedure. These requests

¹ Non-reusable items used in surgical procedures such as sutures, gauze, and gloves.

were handwritten on a form sent to the chief OR nurse, who added the case to an Excel spreadsheet and informed the OR supply store and sterilization centre of the items needed to prepare the case cart.

On the day of the surgery, the operating room clerk would admit the patient, ensuring that all administrative documents were in order, especially the insurer authorization. A nurse would then assist the patient and check their paper chart, particularly the signed informed consent form and the pre-anesthesia evaluation. When the patient was ready, they would be sent to the operating room with the results of diagnostic tests attached to their chart. Once the surgical procedure was over, in addition to the notes made by the surgeon, four forms had to be completed and attached to the patient's chart. One was the anesthesiologist's report sheet: on one side was the pre-anesthesia evaluation and, on the other, the patient's vital signs during surgery. Another was the report of the case cart technician, recording the equipment and supplies used. Third was the report of the instrument technician. Fourth was the log of supplies and medicines used, which was sent to the operating room supply store to be entered in the inventory system and charged to the patient's bill. Supplies and medicines that were not used during the surgery had to be restocked by operating room clerks.

After surgery, the patient was taken to a recovery room and nurses began reviewing the relevant information. Another form was then completed, recording the patient's progress during recovery. This was also attached to the paper chart. When authorized by the surgeon, the patient was either hospitalized or discharged. This system worked in the surgical wards, but with so many forms to be completed and so many preliminary steps, confusion sometimes led to delays, making it necessary to reschedule cases. Inefficient procedures created extra work, and delays negatively impacted efficient room turnover and the surgeons' schedule.

María del Carmen Valencia, chief OR nurse, who has worked at VLF since 1994, explained: "In some cases, the pre-anesthesia evaluation or informed consent was not attached to the patient's chart, or necessary supplies were not provided, sometimes because the surgeon's or anesthesiologist's instruments and supplies list was incomplete. This was a drain on everyone, because surgery could not begin until everything was in order."

Medical Records and Medical Orders

MR are clinical documents containing information about patients and their clinical course; they are created by healthcare staff while patients are under their care. MR thus contain information essential to both patient care and administrative procedures and must be managed and stored in such a way as to ensure the confidentiality of information and the physical integrity of the records. In Colombia, medical records are legal documents.

In the case of VLF, all professionals who dealt with a patient made a note of the procedures done. All these notes were made on paper or, in the case of the epicrisis,¹ dictated by the attending physician into a recording machine and then transcribed by one of a pool of secretaries. The transcription was then printed out and attached to the patient's chart. This procedure had several

¹ Epicrisis is the final report of a physician summing up the medical case when a patient is discharged.

implications for the quality and availability of the information contained in the MR. Doctors aren't known for their legible handwriting, secretaries can make transcription errors, and documents can be lost, mislaid, or filed with the wrong MR. Sometimes a patient's chart is required by different departments at the same time, affecting its availability. A critical care physician who has worked in the adult ICU since 2007 explained this situation: "In the ICU, there was this paper form on which different team members of the unit worked – doctors, anesthesiologists, nurses, physiotherapists; and sometimes we all needed that paper form at the same time. In addition, it was possible that the chart was in another unit, or that it was being audited by the insurance company."

An ER physician who has worked at VLF for five years added: "Sometimes a patient arriving in the ER could not remember what their physician had said, or what medications he was taking. In the case of a VLF patient, all of that was written on the patient's MR, but it took some time for us to get the patient's chart and review the necessary information."

Medical orders provide additional information to that found in medical records. These are the instructions from attending or consulting physicians on the course of action to be taken. Physicians use medical orders to request diagnostic tests, stipulate outpatient procedures, prescribe drugs, order surgery or hospitalization, and terminate the treatment and discharge the patient. Various health professionals then carry out the physician's orders. Doctors would handwrite orders either directly on the patient's chart or on a separate form, and the professionals who carried them out needed to see the physical chart. An order could involve several people, as in the case of medicines, for example, which involved the pharmacy that dispensed the drugs, the nurses who administered them, and the billing clerk who invoiced customers.

Betty Gomez, nurse and chief nursing officer, has worked for VLF since 1987. She explained: "When a nurse administered the medications ordered by an attending physician, she would make a note on the pink nursing form. In the case of inpatients, they would use blue ink in the morning, green ink in the afternoon, and red ink on the night shift. These sheets were then attached to the charts. We wanted traceability of pharmacy-related procedures, but this was time consuming and not always reliable."

Although there are no official statistics on preventable medical errors in Colombia, studies of this subject have been conducted in the United States. The results are disturbing: a 2000 study by the Institute of Medicine concluded that, in the United States, more people die from human error in hospitals than in car accidents. Among the problems that commonly occur during the course of providing healthcare are adverse drug events: preventable injuries resulting from improper order processing, dispensing, or administration of drugs.

Jaime Garcia, a physician who has worked at VLF since 2010, explained: "Illegible handwriting on medical orders was one cause of adverse drug events, but it was not the only one. The person transmitting the order might confuse the names of similar medications, or trailing zeros might make the dosage unclear. But one of the biggest risks was drug-drug interactions. With the kind of patients we handle, and the involvement of several specialists, unforeseen or unwanted reactions could take place between the drugs prescribed by different specialists."

There was also the possibility of duplicate orders for diagnostic tests, which could impact patient safety – in addition to the needless discomfort of undergoing them and the extra costs for insurers.

Back-Office Procedures

Parallel to medical care are administrative procedures, which are governed by regulations.

Insurance contract guidelines and billing. Under Colombia's health funding system, insurers have agreements with CDOs (such as VLF) for the healthcare of their members. The hospital's Insurance contract department was in charge of negotiating and managing contracts with insurance companies. Because it handled some 70,000 billing items, tracking them manually was an enormous challenge. The department knew there could be problems with allocating the costs of services delivered and thus negotiating reimbursement terms with insurers. "We were not always certain whether VLF was profiting or losing with some procedures," explained Danny Moreano, head of insurance contract management and chief operating room physician.

The terms of managed care contracts sometimes differ, making it difficult to standardize patient admission procedures and charges for clinical procedures and supplies and medicines used while providing services. Billing clerks thus had to memorize the contract terms or look them up in hard-copy manuals.

More than half of VLF billing is to HPOs, which must comply with conditions laid out in the OHP manual. Any procedures not included in the OHP manual require prior authorization from the insurer along with a report from the treating physician explaining the need for the procedure and/or medication. In addition, any contact with the patient must be recorded in detail in the MR. Any failure to comply with these conditions endangers the reimbursement and timely payment to VLF.

All fees charged to patients, whether they be for supplies, drugs, procedures, equipment use, room fees, or doctors' fees, had to be typed into the billing system. But this did not always happen. Valencia, chief OR nurse, explains: "Although the required supplies and medications were pre-ordered, the surgeon or anesthesiologist would sometimes request additional supplies during the surgery. The nurse assistant would go to the operating room supply store, request what was needed, and say, 'I'll get you the written form in a minute.' But with over 1,000 surgeries per month, emergencies, and the pressure for rapid room turnover, some charges may not have been entered into the system for billing purposes." The billing manager explained the impact of this situation: "Billing clerks were never sure whether they could close the patient's account or if there were still pending charges to be entered. They would try to contact people by telephone, but those people were not always available; after the account had been closed, they sometimes got calls telling them there were still pending charges; all this delayed the process even further."

Insurers had bills reviewed by medical auditors and required documentation of all fees charged to patients' accounts. This meant that documents had to be manually collected, organized, and attached to invoices. In addition to requiring physical space to organize an average of 43,000 monthly hard-copy bills, this manual procedure affected the timing of invoicing, which had a major impact on VLF's cash flow. The head of billing and accounts receivable explained: "It was time consuming to track bills to know whether they had been finalized, were in the billing department for prior medical auditing, or had already been sent to insurers. Invoice processing was equally difficult – tracking every invoice to establish whether they had annotations, had been returned, had debit notes, or had already been paid."

Supply chain management. Colombia is no stranger to the pressures to cut healthcare costs experienced by many countries around the world. The efficient management of supply and drug inventories is critical, and the hospital strived to maintain just enough stock for day-to-day operations while avoiding out-of-stock situations. The complexity of the billing process created frequent inconsistencies in the information required for efficient supply chain management.

Medical fees. Doctors are not employed by VLF; they charge fees for their work based on rates agreed upon by insurers. Every time a doctor delivered a service – an outpatient consultation, surgery, a procedure, or an inter-consultation – they would give the billing clerk a paper form with a collection note that was attached to the patient’s bill. The head of billing and accounts receivable explained: “This procedure meant that every doctor had to keep track of their own billing – how much had been billed in a given period and whether or not they had been paid. Since several clinical procedures could be done in a single day, the necessary information was scattered, and the whole process was demanding and time consuming. Some physicians were fairly organized, but most did not keep careful track of their billing.”

Archives. Until December 31, 2010, VLF’s medical records were on paper. Back then, an average of 50,000 hard copy charts had to be moved back and forth between the archives and the medical units. This had significant logistical implications and created a growing demand for physical storage space. All units were affected by these logistical problems. Walk-in patients might arrive at a doctor’s office before their chart did, for example. If patients asked for copies of the information in their charts, a manual search had to be done and the requested documents photocopied.

As they struggled to gain control of their physical space, the archives developed a spreadsheet system for keeping track of medical records; missing charts were becoming a problem. “Given the number of charts we were dealing with, plus the projected growth in service delivery, we knew we would continue to have major problems managing records efficiently,” explained the head of inpatient registration and archives.

IT architecture

By December 2010, there were at least thirty information systems working somewhat independently at VLF; they provided partial solutions to the needs of some users but did not allow for information integration. There were electronic systems for laboratory and diagnostic imaging and some software developed in-house for support processes such as a scheduling module. In addition, some doctors had developed software tailored to their specific needs. Generally speaking, software developments were aimed at administrative and support processes rather than clinical procedures directly related to patient care. Until 2010, the hospital had software to handle back-office procedures, accounting, billing, accounts receivable, supply management, and medical fee management. Given the many disadvantages of its inventory module, it developed its own system. All this software was connected via interfaces. The opening of new beds and the resulting increase in related clinical services – e.g., surgery and outpatient care – placed additional pressure on procedures related to healthcare delivery.

The problems with medical fee management had become critical, as Hernando Garcia, head of information technology, recalled: “We had developed an application for managing medical fees,

but it was causing problems. The interface could bog down for a day, even two days!” In addition, the information was sometimes inaccurate. An anesthesiologist and anesthesia group coordinator explained: “There were times when your numbers didn’t match the payments you received; you could always recheck your bills, but it was a drain on everyone. It was time consuming, and, as a doctor, you prefer to spend that time with your patients.”

A comprehensive IT project would enable VLF to improve patient safety, make healthcare services more efficient and cost-effective, and increase revenues in the medium term. The productivity of medical staff would also benefit from the streamlining of healthcare delivery, since it was expected to improve patient flow/throughput.

Searching for an Integrated Enterprise-Wide Solution: ERP, CPOE, EMR¹

In late 2008, an interdisciplinary team led by a cardiologist familiar with state-of-the-art technology began looking for an application that would provide an integrated hospital-wide solution for patient care and administrative procedures. This was the launch of the Synapsis project. The initial team was made up of the cardiologist, the chief medical director, the chief nursing officer, the chief administrative officer, and the head of insurance contract management. It was important that those using the macro-processes that would be affected by systematization – both clinical and administrative – had a voice in the project. Any option would have to include complete electronic health records. The team began by visiting other hospitals in Colombia to see firsthand what electronic devices they were using to manage their medical records.

When an organization implements an Enterprise Resource Planning (ERP) system, it undergoes major changes because a single database must be shared by the entire organization to achieve centralized management and integrated information processing. The implementation and adoption by end users of ERP affects the ways people work and disrupts organizational routines. But VLF was even more ambitious: along with ERP, it wanted to integrate all core business processes by implementing a comprehensive healthcare solution that, in addition to back-office procedures such as billing and accounts receivable, included electronic medical records (EMR), CPOE,² and pharmacy management. With this in mind, they began their search.

Choosing SAP

SAP was known as a powerful ERP system for administrative and operational support processes. However, its healthcare solution was developed for less clinically complex environments and health systems that differed greatly from Colombia’s. The healthcare-specific functions of SAP ERP were based on a German business model, German culture, and healthcare regulations quite different from those in place in Colombia. All this created significant gaps at every level between what SAP offered and what VLF believed it needed: 1) at the level of VLF itself, given the complexity of its cases, e.g., pharmacy management of patients undergoing chemotherapy, 2) at

¹ Acronyms for Enterprise Resource Planning (ERP); Computerized Physician Order Entry (CPOE), Electronic Medical Records (EMR).

² Computerized Physician Order Entry. This is the electronic entry of instructions given by the treating physician to the medical assistant personnel in charge of executing those instructions (diagnostic tests, therapies, medicines, etc.).

the level of the healthcare industry, e.g., reimbursement terms, and 3) at the legislative level, e.g., OHP conditions.

At the end of the vendor selection process, they had two top offers. One proposed to make over 1,000 software developments; the other, Compunet – a local SAP partner firm – proposed just 350. Hernando Garcia, head of IT, explained: “That was a key factor in our decision. Anyone who knows SAP knows that it can be parameterized. Someone who does not know it well makes software developments not knowing that those options already exist in SAP. With SAP, it’s better to integrate than to develop. When you integrate, you are adjusting to what the program offers, to what is there already, and when upgrading to a new version, you have no trouble. That is not the case for software you develop yourself.”

The general manager of Compunet added: “VLF was looking to integrate the hospital’s entire operations, both clinical and back-office, and to organize all related information around the patient’s MR; we knew SAP’s ERP and IS-H MED applications could do this. We could do further developments based on the program standards and certify them with SAP.”¹

On October 1, 2009, VLF decided to hire Compunet to implement SAP and develop the applications needed to carry out the Synapsis project. It proposed an ambitious schedule: the project roll-out would occur over thirteen months and include some 2,200 end users.

Communicating the decision

Synapsis was seen as a strategic imperative to meet the growing demand for services facing VLF; its main objective was not to cut jobs but to improve service delivery and efficiency. Communicating the rationale for the change to all stakeholders – with varying interests and incentive structures – was a major challenge. (See Exhibit 4.) It was decided that each department head should ensure that their members fully understood the project and its benefits. Moreano, head of insurance contract management and chief operating room physician, recalled those days: “I have a vivid memory of the meeting of the physicians’ medical council when Dr. Borrero told us about the IT project. The message came through loud and clear: SAP was not a systems-driven initiative; it was a strategic decision to support VLF’s growth while ensuring patient safety. His support for the project was impressive, and we were held accountable for communicating the project rationale to our doctors.”

In addition to stressing the reasons for paperless care delivery, the department heads were to stress that the system’s implementation would lead to major workflow changes at all levels. The role and workload of physicians would be greatly affected, in fact, since the new system would upgrade the medical order process, making order entry the responsibility of physicians. There would no longer be an intermediary – be it a nurse, a pharmacist, or a clerk – implementing verbal orders from doctors. Additionally, medical notes would be typed by doctors in SAP. Granados explained: “For us it was clear that one of the most critical issues throughout this project was that doctors understand its benefits. We did not want them thinking this was an administrative project and that suddenly they would be doing clerical work, typing into a computer what had previously been done

¹ Throughout the case, references to SAP include the ERP and all healthcare applications developed on SAP’s platform to meet VLF’s IT needs.

with pen and paper or dictated to a secretary. If they did not see the benefits for the patient, for VLF, and for themselves, there was a good chance they would be reluctant to use SAP.” It was stressed that doctors would benefit from decision-support processes that would help reduce medical errors and that patient flow would improve. They would be able to access MR anywhere, anytime, and view on-line information about lab tests and other diagnostic procedures before seeing patients, significantly improving the quality and efficiency of care delivery. As healthcare needs grew, these improvements were expected to positively impact patient care.

When informing administrative staff about the need for change, managers were to relieve their anxiety about the possibility of losing their jobs. The head of inpatient registration and archives explained: “For the dictaphone secretaries, it was clear that their jobs would disappear when the doctors begin typing clinical notes themselves. We assured them that since the demand for services kept growing, most of them would be assigned to different units. And that is what ended up happening.” As the head of billing and accounts receivable explained, it was also important to lower expectations about the system’s benefits: “Some employees, particularly billing clerks, thought the new system would provide a tailor-made solution to all their problems by handling all the same processes electronically; we knew that would not be the case and tried to communicate a more realistic view. Long-held routines and practices would also change.”

Gomez explained her approach with her subordinates: “We had many meetings with assistive personnel to inform them about the decision to have paperless care delivery processes, which would significantly improve safety and quality of care. We wanted to be sure they understood why the change was necessary; but most of all we wanted to assure them we would be offering the necessary training and support to smooth the transition.”

Health insurers would also be affected by the systematization and had to be informed about the project. They would benefit from improved care delivery safety for their members as well as potentially decreased/better use of tests and medications. The billing process would be more efficient, and audit procedures could be dramatically improved. Several meetings were held to communicate the scope of the project.

System configuration decisions

VLF had an ambitious objective. More than just electronic medical records, it wanted an information system that would integrate all clinical and administrative procedures, providing a unified picture of the entire care delivery process. VLF rose to this challenge by first establishing the project governance. Compunet’s manager joined the Synapsis team, the executive committee responsible for all final decisions. There were also design teams, charged with identifying end-user requirements.

To ensure a successful transition, it was important to involve a wide range of stakeholders in the design teams: those in charge of the back office and service delivery and administrative procedures. Gomez recalled how those teams were selected: “I remember I appointed my best nurses, those familiar with care delivery procedures, both clinical and administrative – the top OR, ER, and hospital nurses. In all, I assigned eight nurses full time to the project.” Those key users were made accountable for workflow design and system specifications for their procedures.

Compunet suggested the formation of cross-functional design teams composed of VLF subject-matter experts and Compunet consultants. Each team was led by a consultant, known as an integrator, who was responsible for the entire process. Questions on which the design groups failed to agree were referred to the project's Synapsis committee. The CEO met regularly with the Synapsis committee to assess the project's progress and resolve impasses between Compunet consultants and the design teams. The process leaders worked with a consultant, explaining how things were done and figuring out how they could be done more efficiently in the future. The consultant then determined the SAP parameters and the software developments that would be required.

Eighteen VLF leaders and fourteen Compunet consultants participated in the work of the design teams. VLF assigned the most qualified people to spearhead their respective processes. Their regular duties were assigned to someone else to ensure they could devote 100% of their attention to the project. It was critical to have people who fully understood how VLF operated and the specific needs of their own processes. These leaders, in turn, worked with Compunet consultants who knew SAP functionality and what the application could offer. In total, approximately 100 people worked full-time on the project for twenty-two months during the design, training, and system roll-out phases.

For some processes, mapping out what they wanted to achieve was a more expeditious approach; this was the case with supply chain management, maintenance, accounting, and human resources, whose business processes were generally in line with SAP functionality. The Compunet consultant who later joined VLF as manager of its new projects department remembered this critical stage of the project: "Meetings with the leaders of the supply-chain-related processes went quite smoothly; the leaders I worked with had a good understanding of their processes and understood how the business operated. This made it easy for them to communicate their needs, which were easily adapted to what SAP offered."

With clinical processes, the road was rockier. Gomez explained: "We started with the basic SAP healthcare application and, from there, tried to determine what we needed; for example, what was available for nursing care versus what we really needed. It was a difficult stage: we didn't know what was possible, or what we could ask for. Some modules, such as pharmacy administration, were not available in SAP and had to be developed from scratch. The relationship with Compunet was not easy; in the beginning, we argued a lot. There were meeting minutes where we said, 'We need it this way,' and they answered, 'It can't be done.' In the end, both sides had to yield a little. I think these are the things that get adjusted along the way."

The leader of the billing process recalled those meetings: "At first, we felt the message from Compunet was that we had to adjust to what the system could give us, while we expected the system to conform to what we thought we needed. This caused many clashes because it meant big changes in the way we were working; we had to understand how billing was handled by SAP, which was very different from the way we did it."

Compunet's general manager offered another perspective: "Sometimes end users imagine many things they want to have, and the consultant's job is to keep their feet on the ground, because if the user wants something highly customized, the project will take too long. Our advice to VLF was to adapt to the best practices offered by SAP for different types of industry, and not try to adapt the

software to the processes they already had. VLF made the right decision to adapt to SAP standards. We can say there was a change in their expectations.”

Since the project’s success depended on the medical staff’s acceptance of IT use, this point was given special attention. The team began by approaching Jaime Garcia, a physician working at the Medellin General Hospital, who was overseeing SAP implementation there. In late September 2009, Garcia was hired by VLF to work full-time on its project. “I headed the design team in charge of patient care delivery modules; my job was to clarify needs with the various clinical units and medical specialties and communicate those needs to Compunet consultants and the leaders of administrative processes.” VLF wanted doctors to have a voice in the process redesign, including their input and active participation in workflow mapping and system specifications for clinical processes. Encouraging their involvement in the project was a way to ensure their buy-in and support.

Dr. Garcia’s expertise in SAP implementation made him the perfect intermediary between the IT experts and the physicians. As a result of those meetings, medical fee functionality was added to SAP enabling doctors to check the payment status of their invoices on-line. They would no longer need to hand collection notes to the billing clerk; instead, when they entered a clinical procedure – surgery, inpatient visit, etc. – the system would automatically calculate the medical fee associated with that procedure and add it to the doctor’s personal medical fees account.

While some specialists were fairly receptive to the changes, others were more hesitant. Those who had developed their own systems tailored to their specialized functionality had strong opinions about the negative impact of using IT in patient-related processes and saw little or no reason to becoming more integrated with the others. It became a matter of balancing the needs and interests of the clinical units and of some individuals with those of VLF as an institution. The time spent with each group differed depending on their attitude to the project, but the message was clear; paperless care delivery was on its way. Granados gave an example: “There was one doctor who told the CEO that he wouldn’t use SAP, that he would leave VLF if he was forced to do so. Well, SAP is still here, and so is the doctor, and he is using SAP!”

Granados assumed leadership of the Synapsis project in 2010; she summarized her thoughts about the project this way: “We knew that SAP had very specific standards, which in theory could not be altered. Some end users explained what they saw as their needs, and a Compunet consultant, who tried to respond to the needs expressed by users but often fell short, said it was not possible to comply with those requests. There were moments of strong polarity, and I think my contribution to the process was to mediate between the parties, always with the understanding that we at VLF should feel confident about the application in terms of both patient safety and VLF’s financial stability.”

Change management at every level

Inadequate attention paid to the importance of effective change management when making changes of this magnitude has been identified as a barrier to greater use of IT in hospitals. To mitigate this problem, VLF implemented a learning-based strategy to ensure end users’ adoption of the system. (See Exhibit 4.) It installed computer labs with SAP modules that were available 24/7 to facilitate

familiarization with basic transactions. Additionally, it offered special training sessions based on each functionality, e.g., for physicians, back-office personnel, and assistive personnel, etc.

Physicians. Mechanisms were sought to facilitate the transition of physicians to EMR and other support processes involved in the systematization. Eight general physicians who had just graduated from medical school were recruited and hired by VLF based on their interest in and understanding of IT. They joined Jaime Garcia's team and were actively involved in training medical personnel in the use of SAP, working at the help desk, offering go-live support to ease the transition, and the late stages of stabilization and end-user adoption of the system. VLF wanted its doctors to be trained by doctors. When Garcia was asked about physicians' response to the training sessions, he noted a range between enthusiasm and cynicism, more in favour than against the IT initiative. "Many doctors were already regular users of technology, so they were strongly in favour of having electronic MR and all the associated processes."

Assistive Personnel. 58% of VLF's employees worked in the clinical assistive area, and 60% of those were lower-skilled assistive personnel. Familiarity with IT systems varied greatly; some were fairly comfortable with them, while others had never touched a computer. This presented a major challenge since once all clinical procedures were systematized, all these people would have to use the IT system, either to electronically capture information or to read the medical orders that were electronically input into SAP. A training program was launched in the second month of the project providing modules of different levels of complexity so that no one was left untrained. Computer rooms were set up where people could learn the rudiments of Word and Excel and become familiar with a keyboard and a mouse. There was also training in SAP modules for various departments (outpatient, emergency, hospitalization, etc.), and clinical documents such as medical orders and physicians' and nurses' notes. Training was mandatory and time was set aside for training sessions. "We knew that training was critical to the successful implementation of SAP, so we began it early on in the project. Not knowing generates fear and the best way to overcome that fear is by learning," Gomez noted.

Administrative staff. For the administrative staff, the situation was different, but the challenge was equally great. Most back-office processes (invoicing, supply management, human resources, archiving, accounting, etc.) already used information systems that met their needs to some degree. So many of those people were already familiar with one system or another, and some resistance to learning new software was to be expected.

Synapsis Project: Ready to Go Live

During the final development phase, unit tests were run to check the system's performance for specific processes, such as scheduling an outpatient appointment. System integration testing was then done, simulating a full scenario to assess the entire process, including EMR, CPOE, and ERP. Hernando Garcia, head of IT, recalled what happened: "In the first comprehensive test, many inconsistencies surfaced, especially related to billing, giving strong indications that we were not yet ready to go live." In view of this and based on the recommendation of the Synapsis executive committee, the CEO decided to postpone the system roll-out, originally scheduled for November 1, 2010, to January 1, 2011. This decision was communicated via the physicians' executive council,

and all leaders were made accountable for informing their teams, and most of all, for being on the front lines while the system was stabilized.

Big-bang or phased implementation?

A common practice with such IT projects, particularly the implementation of an ERP system and its associated modules, is to introduce elements in a planned sequence, replacing the old system gradually, i.e., one module at a time, such as human resources and inventory management. Another option is called the big bang, or live start, with all modules and related processes launched simultaneously. Both options have potential risks and benefits. A gradual release entails fewer risks and allows end users to become familiar with the new system more gradually; but it also means making interfaces required to maintain parallel systems – the old and the new – meaning that information processing has to be done twice. A big-bang implementation makes it possible to calibrate and stabilize the system much faster because it allows prompt online identification of possible inconsistencies. Additionally, since patients and doctors move between units, a phased or partial implementation – excluding some units, such as ER – would create problems. But a big-bang approach could also be risky. In the end, with top management support, the big-bang approach was chosen.

Many industries are seasonal, with peak workloads and low-flow periods. These are taken into account by companies determining the best time to go live. Hospitals such as VLF are open 24/7, all year long, making it difficult to determine the best way to minimize workflow disruptions. Still, it was helpful to know when the zero hour would be. The Compunet consultant explained: “The go-live was traumatic, but it was a learning curve we knew we had to navigate; there was a zero hour, and whether that was January 1, or February 28, or any other day, we would just have to get through it. People would be anxious and unsure what to do in the beginning. The system had to be calibrated, and the only way to do that was by operating it. It was a step we had to take.”

Contingency plans were in place throughout the hospital to avoid delaying critical patient care. Change management included communications with patients and their families, as they would also be affected by the implementation of the new system and its possible implications for service delivery. Notices were posted in all units; flyers were distributed to patients and their families; announcements were inserted in answering machine messages; and explanations were posted on the website.

To support end users, a help desk was open 7/24. Process leaders who had participated in the design stage staffed the help desk as on-site experts for the most critical units; these included the eight doctors who had worked with Jaime Garcia, the eight head nurses, the leaders of the back-office processes, consultants, and members of the IT department. These people were familiar with both SAP transactions and the main processes in their units or departments affected by the redesign, so they were able to explain the changes to end users. They were also trained by Compunet consultants on help desk service. They worked in shifts, so someone was available 24/7. Those scheduled to work the first shift had a dinner to say goodbye to the old year and the old system. At midnight on December 31, 2010, the balances were already loaded into SAP, and the old system was stopped. The green light was given to start.

January 1, 2011: paperless healthcare delivery in VLF

All VLF directors – including the CEO and the chief administrative officer – as well as leaders of the various back-office processes and the medical units visited the hospital at some point during that day. Granados recalled: “We could not do much in terms of helping end users solve specific problems with the system, but we wanted to send a strong message of unconditional support for the people and the project.”

Some of their fears were realized; many end users found it difficult to remember all of the information learned during training sessions. They were dealing with online data for the first time and did not fully understand the connections between the various steps of each process; incomplete transactions blocked the system, and they didn’t know what they had done wrong. The following comments illustrate what staff members experienced that day:

It was something like turn off, turn on. We went to sleep with paper-based processes and woke up paperless; everything was electronic. It was a pretty drastic change. (Chief nursing officer)

The first day was chaotic, and so were the following weeks. I would have preferred a phased approach. We changed from processes that were already well established, that we all knew and performed quickly; suddenly everything slowed down: nursing assistance, pharmacy, diagnostic aids. We were all just beginning to understand the system; it was like crawling when we used to run. (ICU critical care physician)

In ER that day I estimate waiting times were 4-5 hours. We gave priority attention to the most critical cases; the others had to wait. Although we had been trained, when going live, many things are forgotten or confused, and on top of that, if you weren’t familiar with how the system operated, everything slowed down. (ER physician)

I remember there was an appendectomy case in the operating room that day. The surgical procedure took twenty minutes, and it took the doctor six hours to input the clinical note in SAP. (Surgeon and head of the transplant program)

On the other hand, the first invoice was created that day, and this was considered a triumph compared to other hospitals in Colombia, which were reporting delays of up to three months for billing for services rendered. There were difficulties with billing, however.

About thirty emergency patients were given medical attention, but we could not enter the information into SAP. It took us almost three months to catch up with those cases. (Chief of billing and accounts receivable)

Stabilization and adoption of the system

The new system significantly slowed workflow. Both the people who issued medical orders and those who executed them were learning to operate SAP, and this made the interaction between them much slower than if they were communicating directly. Granados gave an example of what happened in those early days. “In the first week, I remember one of the ICU physicians’ calling me to say, ‘Dr. Granados, I have the patient’s body here, but not his soul!’ She was referring to the fact that the patient had not been entered in SAP, so she could not ask for laboratory tests or order anything. I often authorized procedures and medications to be entered later in SAP, knowing that that some things would likely be missed.”

People at the help desk were overloaded. During the first week, units with greater patient flow were assigned additional on-site personnel. Staff also made an extra effort to let patients and their families know what was happening, since delays in care delivery were affecting them.

As a general rule, when a system goes live, the consultant's job is over, and the organization is left on its own to operate the new system. The process of stabilizing the system and having end users take ownership of it does not always end well. There are documented cases where an organization has only partially adopted a new system or abandoned it and returned to its previous practices. Knowing this, VLF decided that, after go-live, Compunet would provide on-going support to fine tune and stabilize the system for ninety days. The help desk was disbanded six months after go-live, and a projects department was opened to manage post-implementation issues and maximize the value of the system. In June 2011, the Compunet consultant was hired to head this department and was made responsible for ongoing support, upgrades, and new developments as well as for SAP training of all personnel entering VLF. Granados explained the rationale for this decision: "It's difficult to say exactly when a project of this nature ends. We knew when it began and when the support of consultants ended, but we wanted to take ownership of the system because we knew there was still a lot of room for improvement, and we were also sure new needs would arise that would require new developments."

Despite previous large-scale training efforts, true learning began when people began to operate the system. In the end, it was learning by doing, practising, using the system on a day-to-day basis that boosted the learning curve. Knowledge transfer was also done in an informal one-on-one manner; co-worker support became common when anyone had trouble with SAP transactions.

People incorporating SAP in their daily routines reacted in different ways. The following testimonials help explain what happened in the first few months.

The chief of billing and accounts receivable recalled that stage: "The first three months were very difficult; I would say that it took us six months to stabilize the billing process. Learning to operate the system, handling unexpected problems on a day-to-day basis, unlearning routines we were used to; all this required a major effort from many of us. We knew we had a responsibility to safeguard income for VLF; not doing it well would endanger the financial stability of the hospital."

An ICU critical care physician gave us her perspective: "When we first started, some of us were reluctant to change, because the workflow was different from the one we were used to, and change creates resistance; so there was disagreement while we adapted and made adjustments. However, over time, things began to relax as we learned more about the system because we all became more familiar with it, and this allowed us to resume our normal work pace. In addition, the system's performance improved significantly."

Some units adopted SAP more easily than others. Such was the case with ER, where doctors and other end users began using it quickly. But, in the operating rooms, the anesthesiologists objected to pre-ordering supplies to be used during surgery, so it was almost a year before it was fully adopted. Moreano, chief operating room physician, recalled how this situation was handled: "When I was appointed chief operating room physician in early 2012, I sat down with the anesthesia group to discuss their objections to using SAP. As it was designed, the system was not fully compatible with their process, since their needs are difficult to predict with 100% accuracy; requirements vary

during the surgical procedure depending on the patients' condition and how they respond to anesthesia. The anesthesiologists had a point, so we came to an agreement and modified the system to make them feel at ease. It was a matter of making adjustments." On the other hand, Valencia offered the nurses view: "Sometimes it was hard for us to understand that the anesthesia group was reluctant to use SAP in the operating rooms, since they had to use it – and did – in other units, such as ICU and ER."

A few doctors had developed their own information systems that fit the needs of their medical practice and facilitated their processes but operated independently of VLF's other systems. These doctors strongly resisted the adoption of SAP; for them, there was a trade-off between customization and standardization. "Our strategy with these people was to offer alternative SAP developments to provide them with what they already had. It was a long and sometimes difficult process, but these doctors now see the benefits of having integrated information on a single platform. Today they are using SAP," Granados concluded.

It took about six months to reach system stabilization and resume the previous work pace. The learning curve for using the system had repercussions at all levels: revenues for services rendered in 2011 were up just 6% over the previous year. This was attributed to the fact that most processes associated with patient care delivery slowed down; everyone involved was learning how to work with SAP. Additionally, there were consultants and support medical, nursing, and administrative staff during the design stage and for the first six months after going live. The total cost of the project was about US\$12 million – about 19% related to head count – which significantly affected operating costs. However, since 2012 all financial indicators have significantly improved. (See Exhibit 3.)

Taking advantage of IT

After go-live, Dr. Garcia joined the projects department and, as of the case date, is still there. "My role now is basically the same as when we started Synapsis: to serve as intermediary between the medical staff and SAP functionality; we are still receiving requests from various clinical units and some doctors." Since SAP has integrated all information in a single database, any initiatives VLF wishes to undertake must take into account SAP's functionality, whether it be a new clinical procedure or a new service such as home care or a new extended care facility. The Projects department is accountable for upgrading SAP performance to meet the specific needs of the medical units. This was the case for an ICU module that was modified to better meet end-user needs, for example, and user interfaces with specialized medical applications such as lab tests, diagnostic imaging, endoscopy, and the blood bank. One of the major benefits of having all patient-related information on a single platform has been the implementation of a bar-code system for pharmacy management, launched in 2012. (See Exhibit 5.) This module includes the entire medication administration process, from the time the drugs reach VLF and are entered into the inventory database to the time they are distributed in the satellite unit stores, e.g., OR, ER, and ICU, dispensed at those unit stores, administered to patients in accordance with medical orders, and finally, charged to the patient's bill. In addition to supply chain processes is the advanced clinical decision support (CDSS) system paired with a computerized provider order entry (CPOE) system that checks for drug-drug interactions, drug allergy, and other patient specific alerts that help to reduce adverse drug events. The entire pharmacy process is thus trackable. This new module, developed by the Projects department and Compunet, was certified by SAP.

Administrative departments such as billing and supply chain management also continued to benefit from having centralized data and processes. The billing process was significantly improved since physicians now placed medical orders in SAP, specifying which supplies and medicines were to be used for each case; the system alerted physicians when the insurer required that the use of a drug or procedure be justified (see Exhibit 5). Insurance auditors reported substantial improvements in information traceability, and the audit process became faster and more accurate. With online inventory information, supply chain management-related processes also reported significant progress; this was the case for planners, who finally had accurate information with which to predict inventory requirements and reduce out-of-stock events.

For many end users, care delivery processes became more efficient and integrated as a result of the implementation. Here are some comments:

For nurses, the pharmacy management module made it possible to check compliance with the “five rights” – right patient, right drug, right time, right route, right dose. This had been much more difficult to trace in the paper-based world. (Chief nursing officer)

For those of us in the archives, the reduction in paperwork was awesome; lost and misfiled records fell to almost zero. SAP has made our work much easier! (Head of inpatient registration and archives)

By eliminating many clerical activities, SAP has facilitated a more analytical focus on the work done by billing clerks. (Leader of the billing process)

We have substantially increased the number of bills we process without hiring new people; there were no layoffs in my department when SAP went live since the demand for services also increased. (Chief of billing and accounts receivable)

Using SAP has greatly facilitated my work; I adopted it immediately. For example, patients coming to ER often cannot remember what medicines they are taking, or they may confuse their names, or cannot remember doses. This was a major constraint for doctors. Today, if a patient has an MR at VLF, that information is immediately available; there is no margin for error. (ER physician)

Over time, some changes we requested have been implemented, such as SAP’s interface with monitors; all vital signs during surgery are now recorded in the system. We did it manually before. That’s a plus. (Anesthesia group coordinator)

The systematization of MR has brought many benefits, but those of us who manage patients who require many years of follow up – sometimes twenty years or more – need access to information in the paper charts. In our medical group, we already had several paper forms for recording the information we needed. It was easier to do. So far, it has not been possible to input those records in SAP. Most benefits have been noticed at the administrative level. (Head of the transplant program)

Another observed benefit has been in the area of protecting patient privacy. Electronic medical records have control mechanisms to limit access to information and trace who enters the system and what they do there. This was more difficult to control when MR were paper-based. The standardization of information and its storage in a single database has also facilitated the collection of information for clinical and epidemiological studies and for tracking quality indicators. For over fifteen years, VLF has had a culture of quality and continuous improvement. SAP became a useful tool for improving processes by providing timely and reliable information far more efficiently than was possible with paper records, greatly facilitating quality management. Regarding patient safety,

the indicator of preventable adverse events for every one hundred hospital discharges dropped from 7.16 in 2013 to 5.48 in 2014.

As users took ownership of the system, many wanted more of their job-related activities to be supported by SAP, leading to many requests to the Projects department for new developments. To maintain its policy of standardization vs. customization, the Projects department prioritizes requests coming from units or departments, rather than individuals.

Today VLF is a national benchmark for healthcare providers seeking to improve patient care delivery processes.

Surviving SAP: internalizing new routines

SAP brought considerable changes to both business processes and the understanding of the role played by each person (see Exhibit 5). When dealing with online data, if everyone doesn't do their part, the next person in the sequence won't be able to do theirs. This significantly altered the way people worked since everyone had to think about the entire process, not just their individual part in it and had to understand the role played by others as well. It was not simply that everything previously done with pen and paper was computerized; workflows also changed. Hernando Garcia, head of IT, explained: "Synopsis was not a technology project; it was a process redesign project: everyone had to learn to work differently than they had before."

IT implementation also created challenges for people involved in patient care delivery. One such challenge related to errors that can arise in daily practice, such as the possibility of impaired communication between doctors and other healthcare professionals such as nursing and pharmacy staff if personal contact is lost and communication is done only electronically. In a hospital the size of VLF this risk was likely present even before IT implementation, however. The sense of security that computerized decision support systems create can also lead to an overreliance on such systems and a failure to use one's own judgment in patient care decisions, particularly in the case of those with special or unusual health considerations.

In any case, some VLF staff members believed that some things never change, despite the benefits offered by IT. The head of the transplant program explained his perspective: "Patient safety is always in the hands of patients and those caring for them, whether they be healthcare assistants or physicians. This is a philosophy, a culture, at VLF that we have always had. These systems provide us with more information and are certainly useful; it's good that the system alerts me of allergies and drug interactions, of prescription dosage limits; all that is helpful, but it can't replace the physician's judgment. We could have allowed doctors to access SAP from outside VLF, but we decided not to. We don't want doctors prescribing from a distance; we want to be sure that contact with patients and families is not lost."

When staff members were asked whether, if given a choice, they would eliminate SAP and return to previous organizational routines and practices, the answer was unanimous: no one wanted to return to the previous model.

Almost five years after the launch of SAP at VLF, Granados decided the time was ripe to carry out a project post-mortem. She summarized her approach: "These projects must be evaluated from an

overall perspective, from that of the institution as a whole, not just that of individual needs or preferences. If you ask them whether they are satisfied with SAP, some doctors may answer negatively. They may say they were better off before, although I dare say most feel that SAP has added value. But, if you look at the overall results of VLF in terms of patient safety and financial results, the results obtained with Synapsis have been extremely positive.” Granados was certain that ongoing support for end users, extensive training of newcomers, and new software developments to improve the quality and efficiency of healthcare for VLF patients will help consolidate the project’s achievements. With this in mind, she was prepared to draft a report of the accomplishments and lessons learned throughout the journey.

2016-04-13

Exhibit 1
Valle del Lili Foundation Statistical Highlights

<i>Patients</i>	2014	2013	2012	2011	2010
Inpatients	15,368	14,164	12,716	11,214	11,059
Intensive care	6,398	6,093	6,777	6,596	6,737
Average length of stay (days)	6.2	6.4	6	5.6	5
Emergency room visits	67,365	66,044	62,848	59,173	58,979
<i>Outpatient visits</i>					
Specialists	372,261	351,189	333,823	289,941	279,796
Laboratory tests	1,910,962	1,706,216	1,510,771	1,276,280	1,196,018
Diagnostic tests	148,547	141,473	127,052	120,849	109,757
Other ambulatory procedures	582,945	303,617	282,775	274,581	209,680
<i>Surgical procedures</i>					
Inpatients	15,901	14,707	14,310	12,994	11,865
Outpatients	9,132	8,456	8,561	7,930	7,442
	6,769	6,251	5,749	5,064	4,423
<i>Oncology</i>					
Chemotherapy (patients)	9,952	9,212	8,484	6,914	2,093
<i>Transplants</i>					
Marrow	63	58	58	42	56
Kidney	49	44	73	93	121
Liver	60	55	63	56	44
Heart	12	9	10	8	13
Others	8	5	8	6	11
Floor beds	330	324	303	268	263
Intensive care beds	180	175	170	163	163

Adapted from Tucker and Edmondson (2011)

Source: Valle del Lili Foundation

Exhibit 2

	2014	2013	2012	2011	2010
Full-time specialists	260	239	230	207	214
Part-time physicians	50	48	54	47	37
Nurses	336	308	282	257	280
Nursing assistants	632	565	504	469	443
Other assistive personnel	620	552	513	493	494
Administrative staff	1,027	1,008	923	865	886

Source: Valle del Lili Foundation

Exhibit 3

	2014	2013	2012	2011	2010
Income*	202,631,353	179,764,244	160,282,589	133,062,684	125,417,398
Operating margin	9.01%	4.10%	4.30%	2.10%	3.00%
Net margin	7.66%	1.20%	3.20%	1.20%	1.20%
EBITDA *	28,316,990	17,161,165	16,062,621	10,824,757	8,700,000
Number of bills	708,389	655,916	622,066	555,948	497,462
% revenues with HPOs	51%	58.10%	64.60%	65.12%	59.62%

* US dollars

Source: Valle del Lili Foundation

Exhibit 4

Communication Strategy

Stakeholder	Communication	Training	Transition
Patients /families	<ul style="list-style-type: none"> Web page Recorded waiting message on telephones Videos in waiting rooms, cafeterias Flyers, posters Face to face 		<ul style="list-style-type: none"> Most processes associated with patient care delivery were slower Wait times increased Regular patients learned new workflows
Health insurers	<ul style="list-style-type: none"> Meetings 	<ul style="list-style-type: none"> Medical auditors trained in SAP modules 	<ul style="list-style-type: none"> Adjustments to SAP reports to comply with insurer needs
Doctors	<ul style="list-style-type: none"> Synapsis's leader was a doctor who sent a positive buy-in message to other physicians <p>Top-down</p> <ul style="list-style-type: none"> CEO informed the physicians medical council Heads of clinical units informed doctors <p>Bottom-up</p> <ul style="list-style-type: none"> Doctors given a voice, participated in design teams; gave feedback to optimize the system 	<ul style="list-style-type: none"> Doctors were trained by doctors Training sessions on SAP functionality SAP Interactive module (RWD) for personal training Computer labs with SAP modules made available for practice 24/7 	<ul style="list-style-type: none"> Help desk for 120 days after go live, extra staffing maintained after go live Physician help line Support staff present on-site in main clinical units Projects department managed clinical unit requests for SAP functionality; new interfaces with diagnostics and lab software added Projects department continued to offer support to end users Learning of new workflows associated with online information and paperless service delivery Increased understanding by end users of the role of their transactions in the overall care delivery process Increased awareness of the impact of their tasks on other people Learning to perform new roles and responsibilities, post-adoption behaviours (e.g., placing medical orders and clinical notes in SAP) Walking the talk, visible leadership support, visible actions, clinical unit leaders using SAP Co-worker support in case of trouble with SAP transactions; knowledge transfer in an informal one-on-one fashion
Assistive personnel	<ul style="list-style-type: none"> Synapsis's leader was a doctor; project supported by CMD to ensure physicians' buy-in <p>Top-down</p> <ul style="list-style-type: none"> CEO informed physicians medical council Chief nursing officer informed head nurses and other assistive department leaders (pharmacy, physiotherapy, etc.); leaders informed their teams <p>Bottom-up</p> <ul style="list-style-type: none"> Nurses participated in design teams, gave feedback to optimize the system 	<ul style="list-style-type: none"> Training in basic computer skills offered as soon as project announced Training sessions on SAP functionality Computer labs with SAP modules available for practice 24/7 Training mandatory, time set aside for training sessions 	<ul style="list-style-type: none"> Help desk for 120 days after go live Learning of new workflows associated with on-line information and paperless service delivery Walking the talk, visible leadership support, visible actions, head nurses using SAP Co-worker support in case of trouble with SAP transactions; knowledge transfer in an informal one-on-one fashion Increased understanding by end users of the role of their transactions in the overall care delivery process Increased awareness of the impact of their tasks on other people Users felt SAP allowed them to do their jobs more efficiently, leaving less room for preventable mistakes (e.g., "five corrects")
Administrative staff, back office	<ul style="list-style-type: none"> Synapsis's leader was a doctor; project supported by CMD to ensure physicians' buy-in <p>Top-down</p> <ul style="list-style-type: none"> CEO informed physicians medical council Chief administrative officer informed department leaders; leaders informed their teams <p>Bottom-up</p> <ul style="list-style-type: none"> Process leaders participated in design teams, gave feedback to optimize the system 	<ul style="list-style-type: none"> Computer labs with SAP modules available for practice 24/7 Training sessions on SAP modules (e.g., billing, supply chain) Training mandatory, time set aside for training sessions 	<ul style="list-style-type: none"> Help desk for 90 days after go live Learning of new workflows associated with on-line information and paperless service delivery Walking the talk, visible leadership support, visible actions With the "big-bang" implementation, the old systems disappeared; no parallel systems operating Co-worker support in case of trouble with SAP transactions; knowledge transfer in an informal one-on-one fashion Increased understanding by end users of the implications of their transactions on the overall care delivery process Users felt SAP made their job easier
Suppliers	<ul style="list-style-type: none"> Meetings 		<ul style="list-style-type: none"> Learning of new workflows associated with on-line information and SAP functionality

Exhibit 5

Major changes in business processes and roles

Process	Before SAP	With SAP
Medical records	<ul style="list-style-type: none"> The doctor handwrote medical notes Assistive personnel handwrote clinical notes regarding patient care delivered The doctor dictated patient notes into a dictaphone. This was transcribed by a secretary and then attached to the patient's chart Difficulty understanding what was written in the medical notes Difficulty in identifying who wrote what in medical and clinical notes Chance of omitting information from medical and clinical notes MRs filed in the patient's chart. They were moved daily to and from the units and the archives Chance of misfiled documents, missing charts 	<ul style="list-style-type: none"> The doctor types all medical notes into SAP Assistive personnel type clinical notes about patient care into SAP All information in SAP is legible Users who access SAP are traceable, with date and time System stops if required information is not entered 24-7 on-line access of MR from any computer at VLF
Medical orders	<ul style="list-style-type: none"> The doctor handwrote orders Difficulty understanding what was written in the medical orders Orders could be given verbally 	<ul style="list-style-type: none"> Doctors must enter orders in SAP. If they do not do so, supplies and medicines are not dispatched, and no procedures are performed All information contained in electronic medical orders is legible Assistants do not comply with orders that are not in the system, e.g., the pharmacy does not supply medicines when medical orders are not placed in SAP
Drug administration	<ul style="list-style-type: none"> The doctor handwrote medical orders The nurse read the medical orders and handwrote clinical notes regarding drug administration (patient, medication, dose, route, time) Drug allergy alerts were handwritten and attached to the patient's chart; there was a risk they might not be seen. The "five rights" of medication administration were checked manually (patient, medication, dose, route, time) 	<ul style="list-style-type: none"> The patient receives a bracelet with a barcode when admitted into VLF The doctor types into SAP the medication orders for the patient (medication, presentation, route of administration, dosage, time of administration) SAP alerts about patient allergies SAP alerts the doctor about possible drug-drug interactions The nurse receives medical orders in SAP and prepares the drugs/procedures The nurse uses a bar-code reader to check compliance with the "five rights." Warning system alerts in case of inconsistency (e.g., wrong patient, wrong drug, wrong dose, wrong route, wrong time) Administered drugs are charged to the patient's bill, to inventory, and to accounts receivable
Charges to patients and billing	<ul style="list-style-type: none"> Assistive personnel handwrote supplies and medications on a charge account form The doctor handwrote a justification for drugs not included in the OHP or the contract with the insurer. This step could be skipped in some cases, resulting in reimbursement delays and inventory inconsistencies. 	<ul style="list-style-type: none"> The physician types in SAP supplies and medicines to be used for the case The system alerts the physician if a drug requires justification. If the doctor does not enter a justification, SAP does not allow the physician to continue with the order
Medical fees	<ul style="list-style-type: none"> Doctors gave a paper invoice for their fees to the billing clerk Doctors had to keep track of their bills to collect fees 	<ul style="list-style-type: none"> SAP has the price list of the fee for each procedure SAP generates reports on-line so doctors can check their current fee statement at any time
Supply chain management	<ul style="list-style-type: none"> The movement of supplies and medications interfaced with accounting and inventory management systems 	<ul style="list-style-type: none"> On-line inventory management, availability of information in real time The movement of supplies and drugs impacts the inventory account and charges to the patient's account
Accounting	<ul style="list-style-type: none"> Information required an interface to impact accounting control 	<ul style="list-style-type: none"> Information entered on-line exported to ledger accounts