Belau Medical Clinic
Executive Summary
Student Consultant, Allison Scibisz
Community Partner, Dr. Victor Yano

I. About the Organization

The Belau Medical Clinic (BMC) was established in 1981 as the first privately owned medical clinic in Palau. Its mission, which continues today, is:

To provide quality healthcare as well as quality service delivery, as an alternative to government healthcare services.

BMC is a family owned organization with a strong connection with community built on trust and mutual respect. The clinic is able to provide a wide range of services, from general outpatient procedures to acupuncture to diagnostic imaging.

A total of 38 people are currently employed by BMC. There are 4 physicians, including Dr. Yano who is also the director of BMC, and 5 nurses. There are also 3 technicians working in the laboratory, 1 X-ray technologist, and 3 people working in the pharmacy. The rest work in various administrative and maintenance roles.

Presently, BMC is doing well financially as a business and medically a healthcare provider. However, there are many opportunities for improving its operational efficiency through technological interventions.

Many critical tasks at BMC are people and paper dependent, including most interactions with the patients in the clinic, interdepartmental communication, and information storage. BMC maintains paper-based records of each patient's medical history and maintaining a storage space for these numerous files is becoming an issue.

The clinic is fairly well equipped with technology. It has 24/7 access to dependable broadband internet and several recently upgraded computer workstations. They use Intuit QuickBooks for accounting purposes and for a point of sales system to manage their pharmaceutical inventory. BMC recently purchased networking hardware, including multiple servers, switches, and ethernet cables, to prepare to centrally organize their various devices on a singular network.

Technology at BMC is not formally managed. BMC does not have any in-house technical expert to manage its existing technology. However, Dr. Yano is determined to improve the clinic's technological landscape in order to continue to provide the best patient care possible. This has led BMC to bring in three CMU technology consultants since 2014.

II. Setup Computer Network and Server

BMC recently purchased networking hardware and had ethernet cables installed, preparing the clinic to be connected on one centralized network. However, the servers were never setup and the network was never fully established, as no one at the clinic had the technological knowledge or time to do

so. BMC desired to set up such a computer network to prepare for a transition to electronic medical records, as well as provide a secure, central space for company files and provide a system to better manage the growing number of computers at the clinic. Having all computers connected to a server also has the added benefit of providing an easy way to backup all of the employee computers, minimizing the chance of critical data loss. The following outputs and outcomes were produced:

- Windows Server Essentials 2016 operating system was selected, installed, and configured on the server
- All computers in the clinic were connected to the server
- BMC manager, Elilai Yano, was trained in basic server management and maintenance

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About the Consultant

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Allison is a recently graduated senior in Electrical and Computer Engineering. She will begin working as a software engineer for Redfin this fall.

Final Consulting Report
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I. About the Organization

Organization

The Belau Medical Clinic (BMC) was established in 1981 as the first privately owned medical clinic in Palau. Its mission, which continues today, is:

To provide quality healthcare as well as quality service delivery, as an alternative to government healthcare services.

Dr. Victor Yano, who currently serves as director at BMC, was with the clinic when it opened its doors. Dr. Yano received his medical education and training in United States and returned to Palau to serve his country. He initially worked at Palau National Hospital with the motivation of helping the Palauan people. However, the government healthcare system lacked in quality and reforming the system was beyond Dr. Yano's control. Therefore, he decided to setup his own practice where he could effectively utilize his medical training to provide quality healthcare services to Palauan community.

In its early days, BMC conducted its operations from a rented apartment in Koror where Dr. Yano was the only physician. Almost two years after its establishment, in 1983, BMC moved its operations to its current building, which was built on Dr. Yano's family owned land. Today, a total of 38 people work at BMC, including 4 physicians.

BMC is one of four healthcare establishments in the state of Koror, but BMC remains the only healthcare facility in downtown Koror. The other three facilities, including the National Hospital and two other private medical clinics, are clustered together across the causeway in Meyungs.

Because of its downtown location, BMC is convenient and more attractive than the other healthcare facilities to many local workers. They have also adjusted their hours to be most accommodating, operating from 8:00am to 11:00am and 5:00pm to 8:00pm daily Monday through Friday.

BMC's services are priced approximately 20% lower than its competitors, which attracts some customers as well. BMC also enjoys significant goodwill from its customers due to its patient-centric operations and director, Dr Yano's, focus on helping Palauan community. Dr.

Yano's service-oriented mindset means that BMC operates differently than most businesses. Regardless, BMC is still doing very well, serving on average 90-100 patients per day.

Presently, BMC is doing well financially as a business and medically a healthcare provider. However, there are many opportunities for improving its operational efficiency through technological interventions. Many critical tasks at BMC are people and paper dependent, including most interactions with the patients in the clinic, interdepartmental communication, and information storage. In fact, almost all internal communication during daily operations is limited to verbal conversations and written memos. Another challenge that BMC currently faces is storage space. BMC maintains paper-based records of each patient's medical history. Storing and managing physical records is slow, in-efficient, susceptible to errors, and requires continuous expansion of storage space. Using technology to improve some of these operational difficulties could allow BMC to continue serving the Palauan community to the best degree possible well into the future.

Facilities

BMC is housed in one building on a singular floor, with a main entrance for patients in the front facing the main street and two rear entrances for employees. During non-operating hours, the clinic is secured using standard lock and key methods.

The clinic has dependable electricity, providing good lighting and air conditioning. There is an open waiting area by the main entrance, with a counter allowing patient access to reception and a window allowing patient access to the pharmacy. There are many smaller rooms for patients to be seen extending down the hallway towards the back of the clinic. Currently, only the pharmacy, reception, the administrative area (located behind reception), Dr. Yano's office, the laboratory, and the X-ray room have computers. However, BMC plans to add computers to the other doctor's offices to coincide with the anticipated future shift from physical medical records to Electronic Medical Records (EMR).

The servers and one of the switches are stored in a small server room next to the pharmacy. It is relatively well ventilated, but a decent amount of dust has built up over the years, as the server room has been used for some additional storage space since prior to this summer, the servers have never been used.

Currently, patient medical records are stored on large sliding shelves next to the server room. However, maintaining all of these physical medical records is tedious, as finding and refiling each patient's records is time consuming. Furthermore, the files themselves take up a large amount of space and running out of space is a concern. These are all significant factors pushing BMC towards EMR.

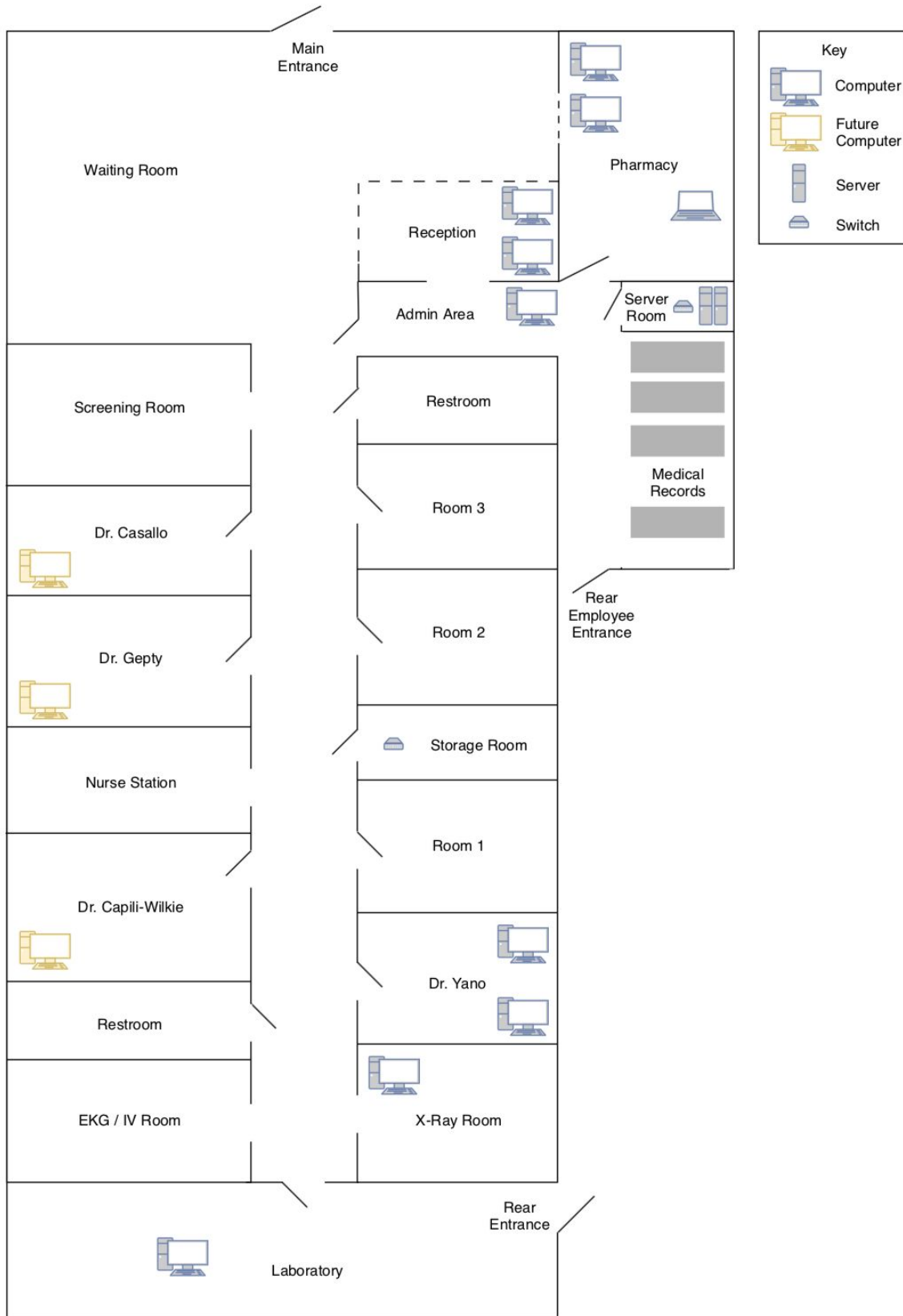Figure 1 shows an approximate rendering of BMC's floorplan.

Main Entrance

Waiting Room

Pharmacy

Reception

Admin Area

Server Room

Medical Records

Screening Room

Restroom

Room 3

Dr. Casallo

Dr. Gepty

Room 2

Rear Employee Entrance

Nurse Station

Storage Room

Room 1

Dr. Capili-Wilkie

Restroom

Dr. Yano

EKG / IV Room

X-Ray Room

Rear Entrance

Laboratory

Key

Computer

Future Computer

Server

Switch

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Figure 1

Programs

BMC provides a number of services to achieve its goal of providing well rounded patient care. In fact, BMC is popular in part because of its great variety in services provided. Table 1 lists the services provided by BMC.

Service	Comments
General Out Patient Services	In-patient and emergency services are not offered
Gynecology and Obstetrics	BMC has 2 doctors focused in this area
Drug Tests	
Diagnostics	Basic radiology and pathology tests
Immunizations	
Basic Surgical Procedures	Can pay use facilities at the National Hospital if needed for a patient, as BMC doesn't have the facilities necessary for using anesthetics
Medical Examinations for Travelers to Australia and New Zealand	BMC is the only clinic authorized to conduct these exams
Physical Examinations for Expatriates	
Cervical Cancer Screening	Funded by a non-communicable diseases grant
Outreach Wellness Services to Community	Funded by National Health Insurance
DNA Testing Sample Collection	Sample collection at BMC, actual testing done in Guam

Table 1

Staff

There are 38 people currently employed by BMC. There are 4 physicians, including Dr. Yano who is also the director of BMC, and 5 nurses. There are 3 technicians working in the laboratory, 1 X-ray technologist, and 3 people working in the pharmacy. 2 employees handle insurance and billing while 2 others handle accounting. There are 2 filing clerks and 6 people in administrative work, including Elilai Yano, the manager of BMC. There are 10 maintenance workers. Many of these employees are family members of Dr. Yano.

Dr. Yano is the only medical practitioner who has had access to a computer in their office. The other doctors, although they do not have dedicated computers in their offices, are able to use their personal computers to process referrals or endorse medical insurance documentation, but they do not have any formal computer access. There is BMC Wi-Fi, but the signal strength is poor in the

back of the clinic where the doctors' offices are located. Because of this, a WiFi extender was recently installed near the doctors' offices. Currently, the doctors have used their cellphones to look things up on the internet and type up reports, sending them to a printer in the admin area via Bluetooth.

There has not been a strong need for the doctors to have computers in their offices, but as the clinic prepares to transition from physical to electronic medical records, this computer access would become necessary. Ethernet cables have been run to the doctors' offices, connected to a switch in the storage room, so their offices are ready to be connected with the rest of the BMC network once their computers are installed. 4 computers have been purchased and are available to put into the doctors' offices with Windows 10 installed but monitors still need to be purchased.

Nurses do not have specific assigned areas of work or offices, rather they are rotated around based on work load and clinic's needs on any given day. They do not have designated computer access.

The pharmacy has a computer on which pharmacy workers use an Intuit QuickBooks point of sales system. This POS system was put in place by Askari Shah, the student consultant at BMC last summer, and this tool allows the pharmacy to easily track and manage their inventory. Now one year after its introduction, the system is still heavily used and is working sufficiently to meet the clinic's needs.

The employees in insurance and billing handle the patients using insurance as a form of payment to BMC. After their visit, patients can pay either through the use of insurance, through their individual Medical Savings Account (MSA), or by paying out of pocket. The insurance billing process consists of manually filling out insurance claim forms, consulting insurance payment information for the specific insurance provider, and determining the co-payment amount. A laptop is used for maintaining Excel spreadsheets to track insurance billing. This is sent to the insurance companies on a weekly basis.

BMC's accounting specialists handle the accounting process. Manual sales reports are used to populate a spreadsheet-based accounting template. The data from that spreadsheet is then transferred into QuickBooks. A licensed copy of QuickBooks 2017 is currently being used by BMC for tracking its financial data.

BMC's manager, Elilai Yano, is in charge of the administrative affairs. She has a dedicated computer with internet access and utilizes QuickBooks to manage financial matters of BMC.

The administrative staff is responsible for processing MSA payments when a patient desires to use this form of payment. BMC reception has a computer dedicated to processing MSA payments. BMC receives updated details of patient's MSA balances daily. These details are received in the form of a PDF document via email. BMC reception staff consults that PDF document to determine patients' available MSA balances. An MSA form is filled by reception staff to process MSA payments. A manual itemized invoice is attached with that form which is then submitted to MSA authorities for payments to BMC.

Historically, the different departments of BMC have operated in silos. The institution of a singular computer network will hopefully improve the ease of interdepartmental communication, helping to alleviate this issue.

Technology Infrastructure

BMC is fairly well equipped technologically. It has computers which have been recently updated and have 24/7 internet access, provided by Palau National Communication Company (PNCC). The clinic has two 10 Mbps PNCC connections on a five year contract. One of these connections is currently used for administrative purposes by in the front rooms, including reception, the admin room, and the pharmacy. There is also a wireless router attached to this internet connection, providing Wi-Fi to those in the front of the clinic. The other PNCC connection is reserved for Dr. Yano's use for his work as the director of BMC. Dr. Yano also has a Fairwaves internet connection for his teleradiography system, on which shares scans with remote radiologists to get their expert opinions. There are also public PNCC and Fairwaves hotspots accessible in BMC, which require the use of prepaid internet cards.

Networking hardware has been installed at BMC, although prior to this summer it has not yet been fully utilized. BMC's objective in purchasing networking hardware was to get an internal network fully setup to pave the way for implementation of an EMR system. Four servers were purchased, one of which is now serving as the domain controller and file server for the BMC domain. The other three servers are not currently necessary for BMC's needs.

The following tables and figures provide more specific details about the technology present at BMC. Table 2 provides a location wise summary of all of the available technology. Table 3 provides the specifications and usage details of the computers available. Table 4 provides the location and details of each of the printers and scanners. Table 5 provides the location and details of the networking hardware components that have been installed. Figure 2 provides a visual map of the switches and connections within the network.

Location	Item	Quantity	Comments
Pharmacy	Computers	2	1 new, 1 legacy
	Printers	2	1 dot matrix, 1 regular
Reception	Computers	2	1 reception, 1 MSA
	Printers	2	1 general purpose, 1 health certificates
Admin.	Computers	2	1 new, 1 laptop
	Printers	2	1 printer, 1 copier/ scanner
	Internet router	1	general purpose
Server room	Servers	4	1 current networking needs, 1 future backup, 2 unused
	Networking switch	1	5 ports, for existing networking needs
Room 3	Printer	1	ultrasound printing
Storage room	Networking switch	1	5 ports, for future expansion
Dr. Yano's office	Computers	2	1 personal, 1 tele-radiography
	Printers	2	
	Internet routers	1	
X-ray room	Computer	1	processing and storing x-ray images
	Scanner	1	x-ray image scanning
Laboratory	Computer	1	general purpose
	Printers	4	printing diagnostic tests' results
Inventory	Computers	4	available for use
Total	*Computers*	*14*	
	Printers	*11*	
	Routers	*2*	
	Servers	*4*	

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Table 2

em	odel	S	emory	otes
omputers (x8)	enovo ThinkCentre M Series Tiny	indows 10	GB RAM – 500 GB HDD	– Pharmacy – Reception – lab – X-ray - available
omputer	enovo ThinkCentre M Series Tiny	indows 7	GB RAM – 500 GB HDD	– Reception
omputer	enovo IdeaCentre 300-20ISH	indows 10 Professional – 64 bit	GB RAM – 1 TB HDD	MC Manager
omputer	cer Aspire SA85/AP S285	indows 10 Professional -64 bit	2 MB RAM– 128 GB HDD	harmacy legacy PC – Printing labels
irector CT/ X-ray	P Compaq 8200 Elite SFF PC	indows 10 Professional 64 bit	GB RAM – 1 TB HDD	ain PC for teleradiography
irector PC	Machines EL1331G	indows 10 Home Premium – 64 bit	GB RAM – 320 GB HDD	ain PC for other work

Table 3

ocation	odel	omments
eception	rother DCP – L5650DN Copier	ultifunction copier. Black and white prints only
eception	P Deskjet 3637 Printer	inting health certificates. Colored printing option is available
dmin Room	P Officejet 4635 Printer / Fax	olored and black and white printing
dmin Room	anon Imageclass D420	ld machine available for general use
harmacy	P Envy 5534 Printer	arely used
harmacy	XP1131E Printer	inting medicine labels for prescriptions, dot matrix printer
irector	P Officejet 5745	or word processing. Colored option printing is available
irector	P Laserjet pro MFP M127 FW	aser printer brought in as an upgrade. Colored printing option is available.
oom 2	P Laserjet pro 200 color M251 MW	olored printing is available. Used for printing ultrasound images
-ray room	PSON Expression 1640 XL Scanner	ecial purpose large size scanner for scanning Xrays
-ray room	P Deskjet 990CXI Pro series Printer	inting bone density images. Colored printing option is available
ab	PSON LX 300-II (x2)	ot matrix, black and white printing
ab	KIDATA B4600	ot matrix, black and white printing
ab	liemark LQ - 360K	ot matrix, black and white printing

Table 4

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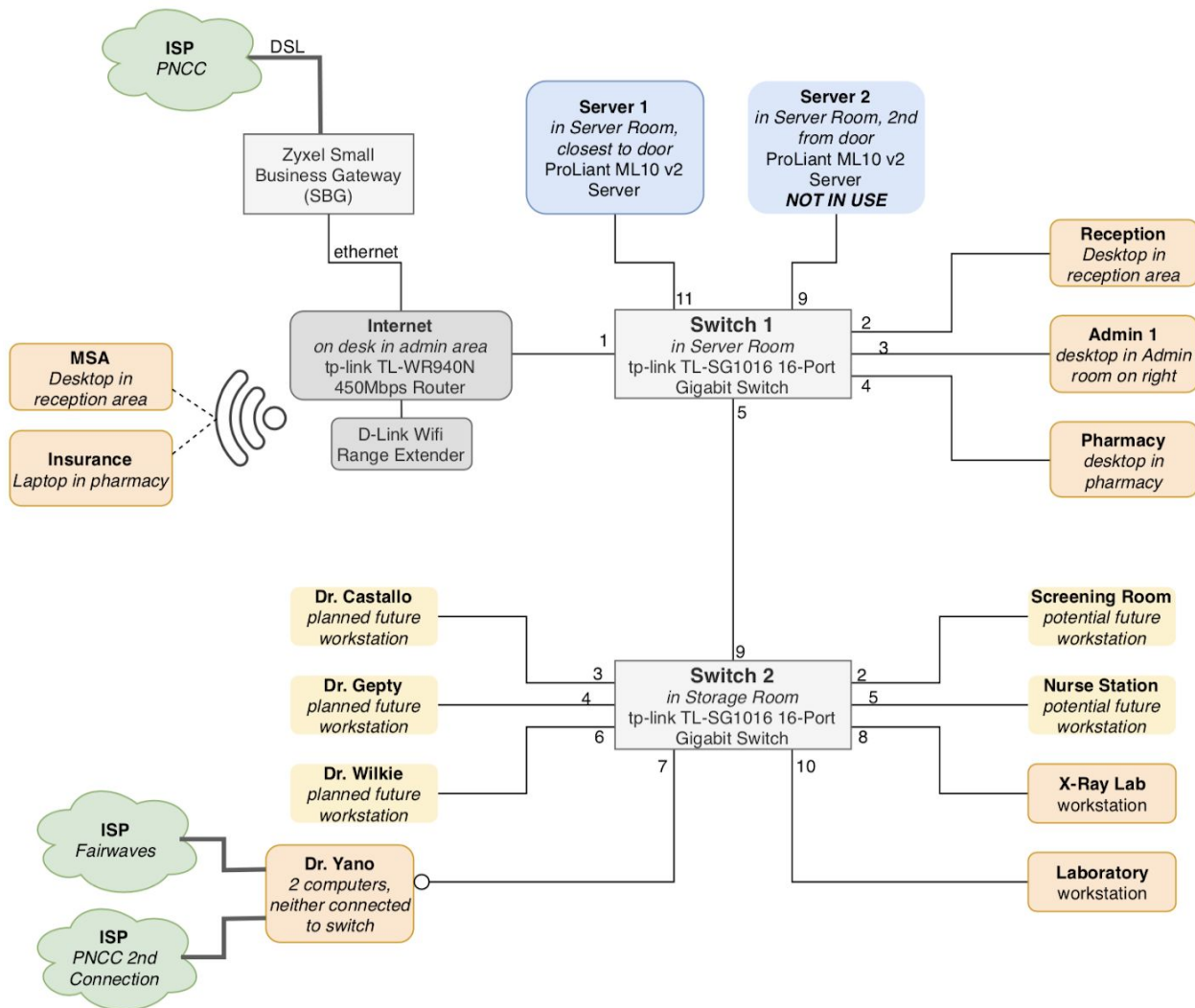| ocation	quipment
erver room	PE ProLiant ML10 Gen9 Server (x2)
erver room	PE ProLiant ML10 v2 Server (x2)
erver room	oyo 12" TFT LCD Monitor (x4)
erver room	link TL-SG1016 16 port switch
orage room	link TL-SG1016 16 port switch

Table 5

Figure 2

Technology Management

Technology at BMC is not formally managed. BMC does not have any in-house technical expert to manage its existing technology. Whenever a problem is faced, it is reported to BMC's manager. The BMC manager gathers as much information about the problem as she can, and then tries to solve the problem through online research. In the event that a solution cannot be found, she reaches out to individuals she knows in the community who have computer expertise. There is no longer a local IT service providing company, so BMC has limited resources in handling technology problems. This

lack of technology expertise is one of the largest technical concerns amongst BMC employees. For example, when something goes awry with the current computer network, there is a period of panic in which people restart their devices and aimlessly hope for the best.

Historically, there have not been any formal maintenance routines in place, although some have been implemented for maintaining the server. BMC's manager will be initially primarily responsible for the server management, although this task could be delegated to another employee if it is too time consuming.

Technology Planning

Technology planning has never been a part of any employee's job description, and thus technology planning has historically been fairly non-existent at BMC. Technology is replaced and upgraded on an as needed basis. In 2015, BMC realized the need for upgrading its computers and setting up a network and spent the next few years purchasing the required hardware, a difficult task due to logistical and sourcing issues. Since then, BMC has been working to upgrade their software systems.

Last summer, BMC was able to successfully implement an updated digital point of sales system and inventory management system using QuickBooks. This summer, they turned their focus to setting up a computer network to create a seamless digital environment. Their objectives for having a computer network, complete with a designated server, were as follows:

1. Provide secure data storage for financial and patient data

2. Create a file sharing system to streamline the transfer of information

3. Connect the different departments through a centralized system

4. Lay the groundwork for setting up an Electronic Medical Records (EMR) system

With the network fully functional, BMC's next plan of action is to begin using an EMR system. It is known that the National Hospital in Palau is also looking into an EMR system, but it is not known where that process has led them. BMC's goals for this system are as follows:

1. Digitize medical record keeping and retire physical record management process

2. Be able to utilize medical data to track healthcare trends over time

3. Use health data to measure treatment's effectiveness

4. Use health data to evaluate its healthcare service delivery performance

The use of CMU's student technology consultants in previous years has allowed BMC to make these upgrades in their inventory management and computer network, as well as provided them with some guidance in focusing their vision towards specific technological solutions.

Communication

There isn't a singular standard mode of communication at BMC. During operating hours, critical information is shared either verbally, requiring an employee to physically find the necessary person to communicate with, or in printed form via notices or memos. During non-operating hours, any

critical information is shared via text messages. The doctors, the manager, and the director of BMC also use emails to communicate with each other.

In the past, digital files and data have been manually shared using either flash drives or external hard drives. With the implementation of a centralized network, this process can now be done using the shared file system hosted on the server.

Currently, the only data which digitally goes out of BMC are ultrasounds and computed tomography (CT) scans. These scans are shared electronically with remote radiologists for their expert opinions. The ultrasounds are sent to contracted radiologists in India while the CT scans are sent to contracted radiologists in the Philippines. BMC utilizes the services of a Guam based company, M&D Web Creations to manage the transfer of these scans. M&D provides secure access to an online repository where BMC can upload the images. These images can then be remotely accessed by doctors in a read only manner. M&D deletes the uploaded images every month to ensure the security and privacy of the patients' data.

BMC does not have a website, but last summer they created a Facebook page for the clinic. Such a page is sufficient to serve BMC's public communication needs at this time, largely serving to display the clinics hours and broadcast when that the clinic is closed. Moreover, using a Facebook page did not require any technical expertise or financial investment from BMC, making it a good solution. The maintenance of this Facebook page currently falls on the BMC manager.

Information Management

Important information for BMC includes patient records, vendor details, sales figures, and inventory data. All this information is managed manually using independent software or physical files. Spreadsheets, QuickBooks, a Microsoft Access database and paper-based records are used to track most information of interest.

Patient records are kept on paper, but there is a desire to move to electronic patient records, as space is becoming an issue. These paper medical records are currently kept in folders on large rolling shelves, so accessing a patient's records requires moving shelves, using a step ladder, and manually searching for and removing the proper folder.

Inventory tracking requires manual input into spreadsheets or QuickBooks software. Intuit Point of Sales software is now used for managing the pharmacy inventory, making it easier for the pharmacy workers to keep track of the inventory and restock appropriately than the manually rigorous spreadsheet-based system used previously. There are currently over 500 different types of medicine in the pharmacy which are tracked using this POS system.

One of the primary goals of setting up a computer network was to be able to store the critical information in a secure, centralized, electronic system. The server now provides such a space, although the process of migrating all of the critical physical and digital files to the server is still in its early phases.

II. Setup Server and Computer Network
Motivation

BMC currently owns four functional servers, located in the server room, yet none of them had been used prior to this summer. Further, ethernet cables have been installed, creating a network which connects all of the different offices in the clinic, yet this system had not been fully utilized. BMC had all the tools required to set up a fully operational computer network, it just needed to be setup and configured properly.

While current daily operation appears to be working sufficiently without using a dedicated server, using the server can further improve BMC's computer use. For example, the server can provide backups of all client computers, minimizing the risk of losing valuable data. Further, using a server has the benefit of enabling centralized file sharing across the clinic. This is a seamless alternative to the use of flash drives and external hard drives and would improve the efficiency of transferring of data.

In addition, BMC has a larger goal to switch to an EMR system. For such a system, either the use of physical, on-site servers or cloud-based servers is required, so setting up a physical server brings the clinic one step closer to achieving this goal. Moreover, once an EMR system is put in place, more computers will need to be in use in the clinic, as each of the doctor's offices will need a way to access the medical records. Setting up a server allows for easier, centralized management of all these computers.

Outcomes

At the beginning of the summer, BMC's technological operations were observed and an updated map of the clinic's technological infrastructure was produced. With that information, in addition to conversations with the BMC manager regarding the goals of having server, as discussed in the Motivation section, a rigorous research process was undertaken to identify potential server operating systems was conducted. The decision matrix summarizing these results is included in Appendix A.

Ultimately, Windows Server Essentials 2016 was selected. Since BMC workstations are all running Windows 10 or Windows 7 OS, staying within the Windows product line is ideal from an ease of compatibility viewpoint. Further, since the BMC manager, who will be largely managing the server, is comfortable with the Windows environment, sticking with Windows is the best choice for future server maintenance and thus the overall sustainability of the network.

Since the clinic has fewer than 25 users and 50 devices and no IT department, Windows Server Essentials (WSE) was chosen over Windows Server Standard because of its user-friendly nature and cost effectiveness. The 2016 version was selected over the newer 2019 version because the helpful Windows Server Essentials Dashboard, which provides a number of convenient and user-friendly tools, was discontinued in the 2019 version.

A 180-day free trial of WSE 2016 was booted on two of the four servers. Gradually, all of the desktops connected to the PNCC internet connection in the front of the clinic were added to the new BMC domain. Files and applications from the previous local user accounts were moved to the new domain accounts. There are currently 13 user accounts activated and 7 computers set up on the server. Some computers needed upgrades, special security configurations, and other updates to be properly connected to the server, but the network is running smoothly. A shared folder system was set up, with different folders accessible to different users and some folders available company wide.

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Client computer backups and file redirection was also configured. Fortunately, many parts of the network were setup in the first 7 weeks, providing time to troubleshoot and ensure the sustainability of the system.

Midway through the summer, the second server was removed from the network. The only purpose it was serving was additional storage space, but it added significant complexity with client computer backups, folder sharing, and server backups. Instead, increased storage space was provided by the installation of an additional internal hard disk drive in the primary server. This also cuts costs, as only one WSE 2016 license needed to be purchased with this configuration. Screenshots from this server are seen in Appendix B.

A server backup system was set up using external hard drives. There are two different external hard drives to be rotated on a weekly basis, minimizing the chance of failure. Cloud backup systems were investigated, but we determined that they were not necessary at this time.

Dr. Yano's computers were unable to be directly connected to the server, as they are on a separate internet connection. I worked to set up Anywhere Access to give Dr. Yano VPN access to the server, but challenges in setting it up, potentially due to issues with PNCC, prevented this task from being completed. Dr. Yano does have an ethernet cable in his office, using which he could easily join the BMC domain. However, that would render one of his two internet connections useless, one of which is tied to a grand and the other of which was recently signed into a 5-year contract with PNCC.

Another issue that was not fully resolved involves the computers in the doctors' offices. Ethernet cables are installed connecting all of the doctors' offices to the internet network, but monitors have not been purchased. In the final week, I tried connecting some of the doctors' personal laptops to the network, but many had MacBooks which were running operating systems that were not compatible with WSE 2016. While setting up new computers in the doctors' offices would be a relatively simple task, it was simply not possible this summer.

An extensive guide to the server was produced to help BMC manager Elilai Yano continue to maintain the server beyond this summer. This can be found in Appendix C. In person training was also conducted.

Recommendations

As BMC begins to implement their EMR system, they may find that they need additional storage on their server. To accommodate this, additional hard drives can be purchased and easily installed in the server. The server currently has space for four more hard drives: two in the drive cage and two in the upper drive carrier. BMC Manager Elilai Yano has been trained to do this and instructions are included in the server guide in the appendix.

In addition, as the clinic begins to store valuable patient data on the server, they may find that they want an additional backup procedure in place, beyond the use of rotating external hard drives. Cloud based backup storage could be a good solution. This provides an off-site backup location, securing the clinic's data in the event of a catastrophic event at BMC, like a fire, a natural disaster, or a ransomware attack. Unfortunately, Microsoft Azure is not available in Palau at this time. However, Amazon Web Services is a dependable cloud platform and it is available in Palau. I would recommend looking at the Amazon S3 product line, especially Amazon S3 Glacier, which is

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a low-cost highly durable cloud storage solution. With this, BMC can upload their backups to their own secure, private S3 buckets. Then, if needed, the backups can be downloaded and a system restore can be performed locally. More information can be found at the following link: https://aws.amazon.com/glacier/

Now that the x-ray room has a functional computer that is connected to the server, I would recommend trying to set up the scanner to take good images of the x-ray films. There's a large flatbed scanner in the x-ray room which is now functionally working with the computer, but it is not set up to scan films properly. I would recommend ordering the Epson Transparency Unit, which can be installed directly in the scanner, and start scanning and keeping x-ray films on the server, allowing access to necessary films across the clinic without having to physically carry them around.

Regarding the doctors' computers, I would recommend installing desktops or laptops in the offices with Windows 10. Although in theory using the doctors' personal computers seems convenient, compatibility with the server makes it difficult and trying to manage a variety of personal devices on the clinic network is overall not ideal. Computers will be necessary once the EMR system is implemented, and they can be convenient in the meantime with writing reports, researching medical issues, and viewing x-rays in the near future.

For Dr. Yano's office, having a physical connection to the server via the ethernet cable in his office would be ideal, as this is the most seamless way to be connected to the server. However, if this not ideal and Dr. Yano prefers to maintain his own internet connection, remote access is a good secondary option. Some sort of VPN access should be set up regardless, as a means of enabling the teleradiography computer to communicate with the server and enabling Dr. Yano to access the server during his frequent travels. Unfortunately, I was unable to get remote access set up in my time at the clinic, as I could not handle the error that ports 80 and 443 were blocked. However, the remote domain name belaumedicalclinic.remoteaccess.com has been established.

About the Consultant

Allison Scibisz recently graduated from Carnegie Mellon University with a bachelor's degree in Electrical and Computer Engineering. In summers prior to coming to Palau, she has worked as a software engineer at Nike and VMware in the United States. She will be returning to the United States after taking part in the Technology Consulting in the Global Community program to commence full time employment as a software engineer for Redfin in Seattle, WA.
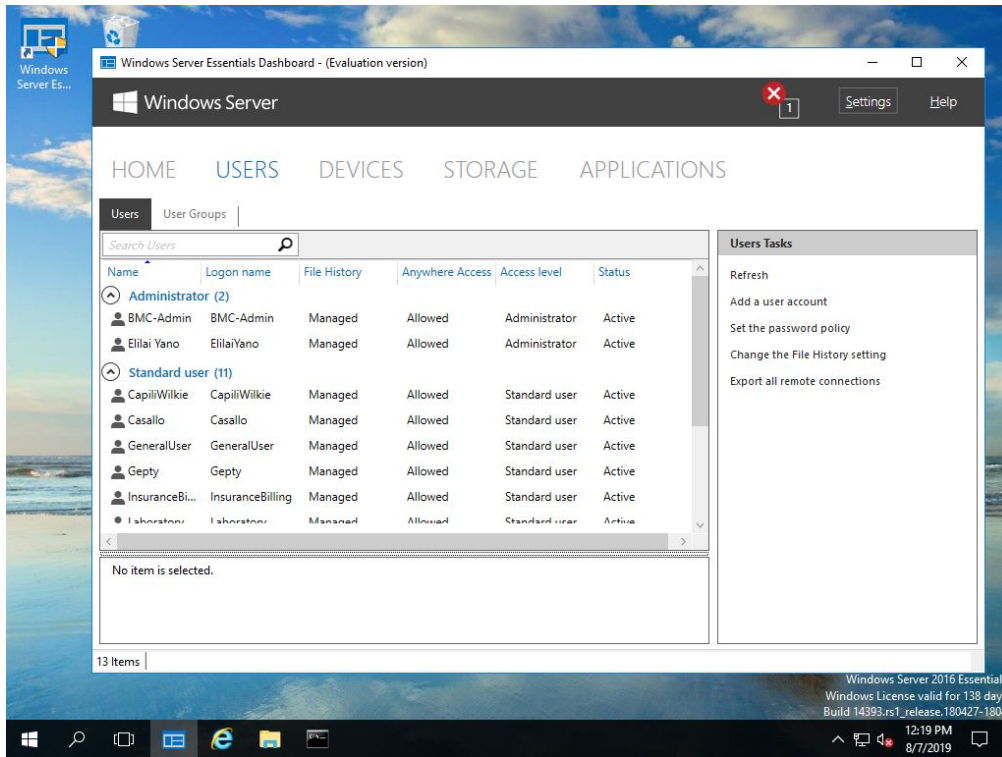
Appendix A.

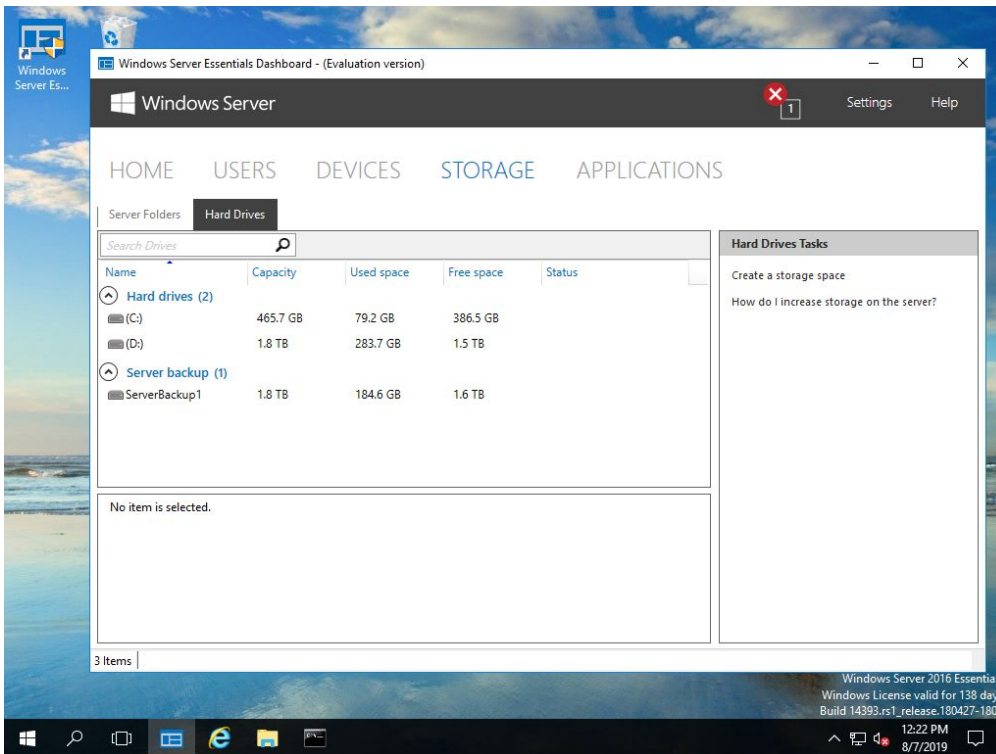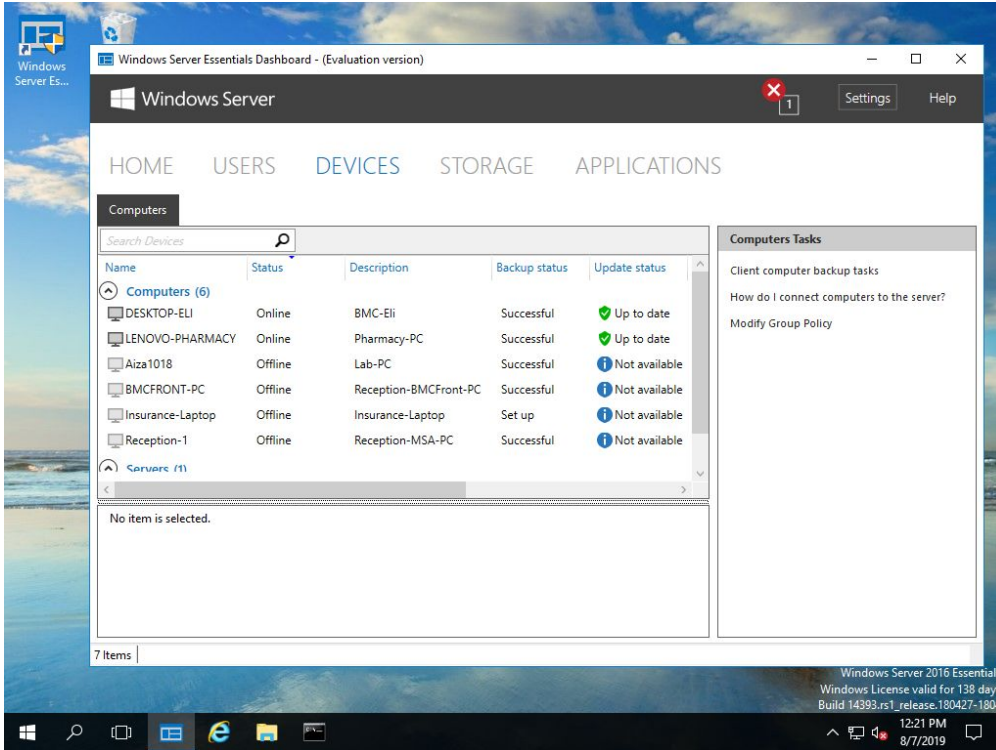Decision Matrix for Server Software Decision.

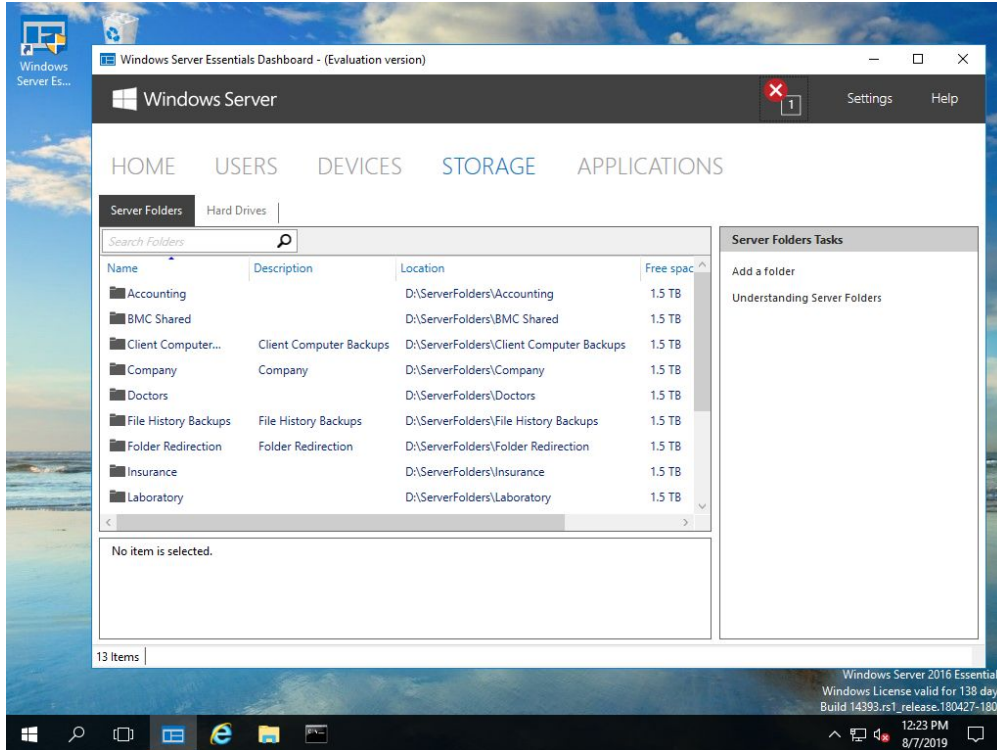| Linux OS			
Red Hat Enterprise Linux (RHEL)	SUSE Linux Enterprise Server (SLES)	Canonical Ubuntu Server	ClearOS
• Well known and widely distributed Linux OS • Specifically designed for business • Quite stable, "gold standard for enterprise Linux distros" • Good support, both from online community and from Red Hat itself • Less robust than SLES Compatible with all four servers Roughly $1598/year	• The other enterprise Linux distro (RHEL and SLES are only two) • Built on open source Linux kernel and distributed with system & application software from other open source projects • Not as good software support as RHEL but more robust • Great built-in tools • Maybe overkill for basic servers • Best for system administrators Compatible with all four servers $720-$1499/year	• User friendly, secure, fast, and upgradable • Reputable and well trusted • Very popular, so it's compatible with many applications • Very customizable, • Fairly stable distribution • Best Linux option for novice users • Ideal for basic servers • Works best when paired with Ubuntu OS on other computers in network Likely only compatible with first two servers Free	• Does not come as highly recommended as the other Linux distros • Many different apps and tools • Best for Linux experts, not as good for Linux novices • High-quality built-in firewall • Free updates, but they aren't well tested Likely only compatible with last two servers Ranging from free to $1308/year, depending on specific distribution

Windows OS		
Windows Server Essentials	Windows Server Standard	Windows Server Datacenter
• Previously named Windows Small Business Server • For small businesses with up to 25 users and 50 devices • Single license that includes Client Access Licenses for up to 25 users on 50 devices • Limited to one instance of the server per domain, but can be used as the primary server in a multi-server domain • Current version released Nov 2018 Compatible with all four servers $559	• Designed for business with more than 25 users and 50 devices • Allows you to run two instances of the server software in a virtual operating system on the licensed server • Has remote desktop services • Can install Essentials Experience Role (if 2016 version or earlier) • Priced per core and per client access license (CAL) Compatible with all four servers $1528	• Likely overkill for BMC • Allows one server to run an unlimited number of Windows Server instances • Allows for an unlimited number of virtual machines (VMs) • Good for use with large databases Compatible with all four servers $6155

Appendix B.

Screen shots of Windows Server Essentials as implemented at BMC.

Appendix C.

Server manual created by consultant for BMC.

Server Basic Info

Primary Server Name: WIN-BMC-SERVER1
Server Type: Windows Server Essentials 2016
Company Name: BMC
Domain Name: BMC
Admin Login Information: Username = BMC-Admin Password =Ngerdengoll
Remote Domain Name: belaumedicalclinic.remotewebaccess.com

Server Manual

Connecting a Computer to the Server:
- make sure you already created the user account for a desired user of the computer
- login to computer that you want to connect to the server
- open an internet browser
- go to http://win-bmc-server1/connect (our server is named WIN-BMC-SERVER1)
- click **Download software for Windows**

Belau Medical Clinic

Allison Scibisz, Student Consultant

August 9, 2019

- click on the .exe file that was just downloaded to run
- if the file download security warning message appears **Run**
- if the User Account Control message appears, click **Yes** and type in the computer's username and password, if prompted
- the *Connect a Computer to the Server* wizard should appear now
  - **accept** the end-user license agreement
  - on the *Find my server* page, auto-detect the server in the local networks and select the server you want to connect to (WIN-BMC-SERVER1 / IP Address = 192.168.0.116). This may automatically complete without you doing anything
  - on the *Type your new network username and password* page, enter the username and password created on the server
  - **if running Windows 7, select Move my data and settings to my new network user account**
  - select **Yes, wake up this computer if it is either in sleep or hibernate mode to back it up**
  - follow remaining instructions in the wizard, you may be prompted to restart the computer
- use your new username and password to login to computer
- if running Windows 8, follow instructions on the *How do I migrate files and applications from my old user account?* page, which should appear upon login

Troubleshooting:
- Make sure the computer has a valid internet connection
- Make sure computer operating system is supported. If it isn't, upgrade to a supported OS
  - Windows Server 2016 supports the following operating systems: Windows 7 Home Basic, Windows 7 Home Premium, Windows 7 Professional, Windows 7 Ultimate, Windows 7 Enterprise, Windows 7 Starter, Windows 8, Windows 8 Pro, Windows 8 Enterprise, Windows 10, Windows 10 Pro, Windows 10 Enterprise, Windows 10 Education, Mac OS X v10.5 Leopard, Mac OS X v10.6 Snow Leopard, and Mac OS X v10.7 Lion
- Make sure computer's name is no more than 15 characters, does not have an underscore (_), and does not have any non-ASCII characters
  - https://support.office.com/en-ie/article/do-you-need-help-locating-your-computer-name-00384381-8aa9-4398-b81b-475f09fed618
- Make sure computer has 1.4 GHz or faster processor, 1 GB RAM or more, and at least 1 GB of available hard drive space
- Make sure the computer's date and time match that of the server
- Make sure the server is powered on and isn't showing any problematic error messages (viewable by logging into the server and going to the dashboard). Check and see if the computer shows up under the devices tab of the essentials dashboard on the server and see if this computer shows up / if there are any error messages there as well
- Make sure the computer is on the same IP subnet as the server when the client computer is on the same network as the server

- On the computer, open the command prompt (can be found by searching **command prompt** or **cmd** in the search box by the start menu, or by pressing the Windows key and the "R" key at the same time)
- When the command prompt opens, type **ipconfig** and then press the Enter key
- Look for the **Subnet Mask** and the **IP Address** (might be called IPv4 Address) fields, take note of them
- Repeat steps 1-3 on the server
- The subnet masks should be identical, and the IP addresses should be close to one another, likely only differing in the last field

Sign into Old Local Account
- Username: computer name\local username (i.e. RECEPTION-1\Reception)
- Password: same as before

Move Files from Local Account to Domain Account
- These are instructions for connecting existing computers to the domain, it is not necessary for new computers!
- First connect computer to the network, using the desired domain account for the designated computer. When you login to this new domain account, you will see that it is relatively empty. Logout of the domain account
- Login to old local account
- Backup local files to a flash drive or external hard drive
- Download the free ForensIT User Profile Wizard Personal Edition (available here: https://www.forensit.com/downloads.html)
- Click on the executable file that is downloaded and follow installation the instructions
- Launch the User Profile Wizard and follow the instructions. Be sure to select the proper old local account that you want to transfer to the new account, and select the BMC domain and enter your new domain username for the old files to be transferred to.
- The ForensIT Wizard will automatically move all of your files and applications, simply wait a few minutes for it to be completed. When it is done, it will prompt you to restart your computer.
- After restarting, login to your domain account, it should look just like your old local account did!

Creating a New User Account:
- Login to the server using the BMC-Admin account
- Open the *Windows Server Essentials Dashboard*
- Click on the **USERS** button on the top
- Select **Add a user account** in the Users Tasks side panel on the right
- Follow the on-screen instructions
- Note: for level of access, it is best to limit the number of Administrators, try to keep as many people as possible as Standard users

Changing Existing User's Password:

- Login to the server using the BMC-Admin account
- Open the *Windows Server Essentials Dashboard*
- Click on the **USERS** button on the top
- Click on desired user, highlighting their name
- In the tasks panel on right side, select **Change the user account password**
- Follow the on-screen instructions

Make New Shared Folder:
- Login to the server using the BMC-Admin account
- Open the *Windows Server Essentials Dashboard*
- Click on the **STORAGE** button on the top
- Select **Add folder** on the Server Folder Tasks panel on the right
- Follow the on-screen instructions, giving the necessary users appropriate access

Change Shared Folder's Accessibility:
- Login to the server using the BMC-Admin account
- Open the *Windows Server Essentials Dashboard*
- Click on the **STORAGE** button on the top
- Click on desired folder, highlighting it
- Click **View the folder properties** on the right side panel
- When the properties pop-up window appears, select the **Sharing** tab at the top
- Adjust the listed users' access level appropriately and press **Apply** to save changes

Creating Bootable USB to Restore Computer:
- Login to the server using the BMC-Admin account
- Open the *Windows Server Essentials Dashboard*
- Click on the **DEVICES** button on the top
- Click on desired computer, highlighting it
- Click **Client computer backup tasks** under Computer Tasks on the right side panel
- Click on the **Tools** tab on the top of the window that opens
- Click **Create key…** under Computer recovery
- Insert USB flash drive into the server and follow the instructions

Backing Up the Server:
- Plug external hard drive into server. With the two WD Elements external hard drives we have, the backup routine is already set up, and should happen automatically. Unplug (eject and safely remove is best practice to prolong life of hard drives) and switch hard drives weekly to improve security.
- To check that backups are happening, login to the server using the BMC-Admin account, Open the *Windows Server Essentials Dashboard*, click on the **DEVICES** button on the top, and double-click on the server
- To set up a backup with a new external hard drive, connect it to the USB port, login to the server using the BMC-Admin account, Open the *Windows Server Essentials Dashboard*, click on the **DEVICES** button on the top, click on the server, and select **Customize Backup for the**

server on the right side panel. Select **Change Server Backup settings** and select the new device. Follow the instructions, giving it a useful name and making sure to select all hard drives to backup to this external drive.

Adding a new hard disk drive (if server is running out of storage):
- Turn off the server and unplug it
- Unlock and remove the front tower bezel of the server
- Remove the side access panel of the server
- Disconnect cables from drives in drive cage
- Unscrew and remove the drive cage
- Slide in new hard disk drive, screw in to secure
- Re-insert drive cage, screw in to secure
- Connect cables to each of the drives (cables are labeled 1-4 for each slot in drive cage)
- Put the side access panel and the front tower bezel back on
- Plug in server and power on
- Log-in to server using the BMC-Admin account
- Open the *Windows Server Essentials Dashboard*
- Go to the **Health Monitoring** tab and see if there is an alert about the disk being unformatted
- If there is an alert, click on it and then click **Troubleshoot this issue** on the right side pane. Follow the instructions to complete the *Add a New Hard Drive Wizard*.
- Go to the **STORAGE** tab. When you click on the **Hard Drives** tab, there should be a new drive under Hard drives
- You can move folders to this new drive by clicking on **Server Folders**, right clicking on the desired folder, and selecting **Move the folder**
- Make sure you add new hard drive to backup routine so it will be backed up to the external hard drive as well!

Additional Resources:
- Video of changing hard disk drives on HPE ProLiant ML10 v2 (skip ahead to 6:45): https://www.youtube.com/watch?v=CO0d23P5sFI
- Manual for servers (helpful diagrams on pages 24-27): https://support.hpe.com/hpsc/doc/public/display?docId=emr_na-c04622389&docLocale=en_US
- Instructions for formatting hard drive on WSE: https://docs.microsoft.com/en-us/windows-server-essentials/manage/manage-server-storage-in-windows-server-essentials

Compatible Hard Disk Drives:
- Below are the hard drives specifically listed as compatible with the server. I suspect that any hard drive that is 6G SATA, 7.2k rpm, Large Form Factor (LFF / 3.5in), and non-hot plug will work
  - HP 1TB 6G SAS 7.2K rpm LFF (3.5-inch) SC Midline Hard Drive (652753-B21)
  - HP 3TB 6G SATA 7.2K rpm LFF (3.5-inch) Non-hot plug Midline Hard Drive (628065-B21)
  - HP 2TB 6G SATA 7.2K rpm LFF (3.5-inch) Non-hot plug Midline Hard Drive (659339-B21)   *** this is the one we purchased in July 2019 ***

- HP 1TB 6G SATA 7.2K rpm LFF (3.5-inch) Non-hot plug Midline Hard Drive (659337-B21)
- HP 500GB 6G SATA 7.2K rpm LFF (3.5-inch) Non-hot plug Midline Hard Drive (659341-B21)
- HP 500GB 6G SATA 7.2K rpm LFF (3.5in) Non-hot Plug Entry 512e Hard Drive (815612-B21)
- HP 1TB 6G SATA 7.2K rpm LFF (3.5in) Non-hot Plug Entry 512e Hard Drive (815614-B21)
- HP 2TB 6G SATA 7.2K rpm LFF (3.5in) Non-hot Plug Entry 512e Hard Drive (815631-B21)
- HP 3TB 6G SATA 7.2K rpm LFF (3.5in) Non-hot Plug Entry 512e Hard Drive (815633-B21)
- HP 4TB 6G SATA 5.9K rpm LFF (3.5in) Non-hot Plug Entry 512e Hard Drive (815635-B21)

Change Product Key:
- Login to the server using the BMC-Admin account
- Go to **Update and Security**
- Click on **Activation** in the left side column
- Click **Change product key** and input the new product key

Complete Documentation for Windows Server Essentials can be found here:
https://docs.microsoft.com/en-us/windows-server-essentials/get-started/get-started

Basic Troubleshooting:
- If a computer hasn't been backed up to the server in a while, try doing a manual backup by selecting that computer on the server (under Window Server Essentials Dashboard > DEVICES) and clicking **Start a backup for the computer**.
- If a computer continuously shows up as offline even when it's on and seemingly connected to the server, go through the steps of adding it to the server again (go to http://win-bmc-server1/connect, etc). It should be a quick process since it is already connected to the server.