CASE STUDY FOR DEVELOPING A VETERINARY DATABASE

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PROJECT DESCRIPTION

This project's goal is to take a small business, in this case a veterinary office, and build a more efficient way of storing and retrieving the data needed to run the business.

The business itself does not exist in real life; but, is built based on the numerous hours and thousands of dollars this author has spent intimately observing veterinary care from the aspect of a customer. Casual consultation with veterinary and human doctors over the lifetime experience of the author has also contributed to the creation of this project.

The name of this business is Babler's Veterinary Clinic [BVC].

AREAS OF CONCERN:

Currently the organization is tying data from multiple systems together which is leading to frequent failures; constant issues with tracking patient data, and problems with billing. The clinic is also having difficulty gathering the regulatory data for the pharmaceuticals they administer and distribute.

AREA OF NEED:

Create an integrated database system that allows data to be stored and retrieved in a logical format, to prevent redundancy[1], and loss of data. The various realms of data storage (patient charts, pharmacology, invoicing etc.) will be communicative through the setting of relationships, constraints, and structured program units within the database.

SCOPE STATEMENT

OVERARCHING PROJECT REQUIREMENT:

Create an integrated database system that allows all areas of the business to function seamlessly. Each area of the business should be able to communicate on the "back end" with the other parts of the business.

CHARACTERISTICS

The project will be a Relational Database Management System [RDBMS].
Further physical, logical, and software characteristics can be found elsewhere in this document.
Note: The creation of a customized program interface for the RDBMS is being developed concurrently with another team and is out of the scope of this project.

DELIVERABLES:

ANALYSIS DELIVERABLES:

- Business Rules
  - Business Rules Glossary
- Reporting Requirements
- List of critical transactions required to support the business
- Physical design of the RDBMS
- Logical Design of the RDBMS including:

[1] Except for logical redundancies required for archiving, and/or regulatory requirements.

  - ERD
  - List of Entities with attributes
- Requirements for the equipment that will run, and interface with the database.
- Requirements for the software that will run, and interface with the database.

PRODUCT RELATED DELIVERABLES

Due to the vast scope of the project; the project manager has split the project into two phases.

PHASE 1

Implementation Date: By Mid-July 2018

Create a database that allows for the efficient storage, querying, and aggregation of patient data, owner data (as part of Customer Relations Management, or CRM), patient chart data, pharmacological data, and pathology (lab testing) data.

Critical Success Factor:

Show the implementation of the charting, pharmacology, CRM, and pathology structures with fictitious, but relevant data.

PHASE 2

Implementation Date TBA.

Include invoicing support to the database which will be updated concurrently with each write to a patient file, so invoices are generated automatically.

Critical Success Factor:

Show the implementation of the invoicing structure with fictitious, but relevant data.

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EQUIPMENT REQUIREMENTS

EQUIPMENT

Type of Machine	# Needed	For whom, or what
Workstations	8 to 10	2 for reception. 2-4 for doctors (depending on office set up, 2 should be full workstations, if 4 are needed, 2 laptops could be substituted). 2 for the pathology lab/chemists. 2 for management office. 1 for Grief Counselor (note: this can be a laptop and shared with reception as needed).
Database Server	1	This will run the database, this will also run any 3rd party connectivity and or credentialing systems will also be used to run print server, in the event the printers are unable to connect directly to the router
Tablet devices	4	One for each veterinary doctor.
All in One Fax/Printer/Scanner	2	1 for reception that can also be used by the doctors and the management office 1 that will be used by the Chemists and doctors in the back office
Router	1	For the entire facility
Wi-Fi repeaters	?	As needed
Networking Cable	?	As needed; workstations should primarily be connected by wire if possible.
External Hard drive	1	For database backups, while using an external hard drive is slower than an internal; it's significantly easier to detach a USB and put an object in a safe than it is to keep having to pull a drive from a tower.
Weatherproof safe	1	For storing the external hard drive

EQUIPMENT REQUIREMENTS GLOSSARY

Term	Definition	Options
Workstations	Must contain at minimum computer tower, monitor, input devices (mice, keyboard), connectivity including Wi-Fi and/or ethernet, a reasonably modern graphics card, and several USB ports.	Accessibility hardware based on employee needs, Bluetooth dongle or adapter, DVD-R drive.
Laptop	Must contain at minimum input devices (mice, keyboard), connectivity including Wi-Fi and/or ethernet, a reasonably modern graphics card, and several USB ports.	Accessibility hardware based on employee needs; laptop docking station.

Tablet Devices	These can be laptops with a fully detachable screen, or a tablet only. Must contain some form of keyboard that is either wireless or attachable (a famous example is Microsoft's Surface Brand). They must be Wi-Fi capable, and able to integrate into the printer server.	
All in One Printer	Must contain faxing, scanning, and printing capabilities. Must be wireless, with the option of ethernet connection, must also have a USB slot for diagnosing issues.	Color
Router	Router must be both Wi-Fi and ethernet capable, must include its own internal switch	

DETAILED PROPOSAL

BUSINESS RULES

ID	Area of Business	Rule Definition	Type of Rule	Static or Dynamic	Source	Target Phase
Chart-01	Patient Chart	There needs to be enough space for a doctor to write copious notes during a visit	Constraint	Static	Organizational Policy	Phase 1
Chart-02	Patient Chart	All actively used medicines must be shown in the chart	Constraint	Static	Organizational Policy	Phase 1
Chart-03	Patient Chart	All previously used medicines must be saved in the chart	Constraint	Static	Organizational Policy	Phase 1
Chart-04	Patient Chart	The doctor must be able to see all medicines current and prior easily	Constraint	Static	Organizational Policy	Phase 1
Chart-05	Patient Chart	The doctor must be able to see a historical list of all patient notes.	Constraint	Static	Organizational Policy	Phase 1
Chart-06	Patient Chart	The doctor must see facts about the animal on their chart (height/weight/gender)	Constraint	Static	Organizational Policy	Phase 1
Chart-07	Patient Chart	The chart must show the most recent medical procedures for the pet	Constraint	Static	Organizational Policy	Phase 1
Chart-08	Patient Chart	The vet must be able to easily access all known medical procedures for the animal	Constraint	Static	Organizational Policy	Phase 1
Chart-09	Patient Chart	The vet must be able to see all the most recent lab work for the animal	Constraint	Static	Organizational Policy	Phase 1
Chart-10	Patient Chart	Even if it's not used in the database model, the lead Vet is insisting on there being a chart number. She's ok if it's the same thing as the PetID	Constraint	Static	Organizational Policy	Phase 1

Chart-11	Patient Chart	For critical illnesses in labs the chart must be flagged so the doctor is aware…avian flu, rabies, etc.	Constraint	Static	Government Regulation	Phase 1
Chart-12	Patient Chart	Most recent radiology tests (MRI/X-Ray) images must show up on the chart	Constraint	Static	Organizational Policy	Phase 1
Chart-13	Patient Chart	Vet must be able to access historical radiology information	Constraint	Static	Organizational Policy	Phase 1
Chart-14	Patient Chart	Vet must be able to see what another animal brothers & sister's the current patient has	Constraint	Static	Organizational Policy	Phase 1
Chart-15	Patient Chart	There needs to be a way to import records from other vets/specialists and keep them separate?	Constraint	Static	Organizational Policy	Phase 1
Chart - 16	Patient Chart	Radiology is not yet done in house but is done next door; by regulation Radiology must be separate from the patient care setting; they will manually import that data into the chart. Charges are incurred at the "business" next door.	Fact	Static	Government Regulation	Phase 1
Chart-17	Patient Chart	Any procedures that can be done by nurses or assistants must be done under the direct supervision of a vet, thus the responsible vet must be noted in the chart for ALL procedures, even something as simple as removing a bur from a dog's foot-pad	Fact	Static	Government Regulation	Phase 1
CRM-01	Record Keeping	An owner/parent may have multiple pets, a pet can only belong to one owner	Constraint	Static	Common Sense/Organizational Policy	Phase 1
CRM-02	Record Keeping	A pet may only have one owner, but an owner can designate a responsible adult to pick up the animal after outpatient procedures.	Fact	Static	Organizational Policy	Phase 1
CRM-03	Record Keeping	When a Customer's information is called up only their living animals should be shown	Constraint	Static	Organizational Policy	Phase 1
CRM-05	Record Keeping	When a parent brings in a new animal family member a "chart" should be created as soon as we have the animal's information.	Action Enabler	Static	Organizational Policy	Phase 1
CRM-06	Record Keeping	The Grief counselor wants to know before meeting with the human what types of pets they like, to facilitate a potential adoption.	Action Enabler	Dynamic	Organizational Policy	Phase 1

CRM-07	Record Keeping	A list of all owner's pets should be easily available	Inference	Static	CRM-06; Chart-13	Phase 1
Proc-01	Procedure	Once a procedure is completed it should be added to the list of procedures performed on the patient, with the date it was done	Action Enabler	Static	Organizational Policy	Phase 1
Rx-01	Chemist/Pharma	Controlled ℞ may only be filled for 14 days at a time	Constraint	Static	Government Regulation	Phase 1
Rx-02	Chemist/Pharma	When there are less than 10 units of any medicine in stock a reorder flag should be set.	Action Enabler	Dynamic	Organizational Policy	Phase 1
Rx-03	Chemist/Pharma	When a chemist fills (and marks it filled) a Rx the amount should be deducted from inventory.	Computation	Dynamic	Organizational Policy	Phase 1
Rx-04	Chemist/Pharma	When a doctor adds a pathology lab or an ℞ it should be added to a list that the Chemists can see where they can mark it complete when done	Action Enabler	Static	Organizational Policy	Phase 1
Rx-05	Chemist/Pharma	When a chemist performs a lab, the results should be added to the patient's chart.	Action Enabler	Static	Organizational Policy	Phase 1
Rx-06	Chemist/Pharma	When a chemist performs a lab and after it has been added to the patient chart the supplies used should be subtracted from inventory	Computation	Static	Organizational Policy	Phase 1
Rx-09	Chemist/Pharma	Medicines given during surgery do not have proper ℞ written; they are documented after the operation is done and the animal is safe	Fact	Static	Government Regulation	Phase 1
Rx-10	Chemist/Pharma	If it becomes important to create wholly separate data storage for Procedurally administered medicines, such as anesthesia, vs traditionally prescribed pharmacotherapeutic agents; there should be a separate ID for each incoming Rx			Government Regulation	Phase 1

Please see attachment 5.1 Business Rules for further viewing options including dropdown filters.

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BUSINESS RULES GLOSSARY

Business Rule Type	Definition
Action Enablers	A rule that triggers some activity if the condition is true
Computations	Transform existing data into new data by using math or algorithms
Constraints	A statement that restricts the actions that the system or its users are allowed to perform; *Organizational Policies, Government Regulations, & Industry Standards* all create constraints.
Facts	Statements that are true about the business at a specified point in time.
Inferences	Often written in an if/then form; these derived facts create a new fact based on other facts.
Atomic Business Rules	Rules that are broken down to their simplest components: they are combined to make a larger rule.

Note. Definitions from Wiegers, K. E., & Beatty, J. (2013). Software requirements (Third edition). Redmond, Washington: Microsoft Press, s division of Microsoft Corporation.

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REPORT REQUIREMENTS		
Name	**Area of Business**	**Verbose Report Requirements**
Report-01	Chart	The vet must be able to see the following information all at once when they first pull up a chart: • Age •Weight • Species & breed • Previous & Current Medications • Most recent pathology results (most recent lab), &/or all labs • At minimum the last 5 procedures performed on the animal (if any) • Last encounter notes
Report-02	Pharmacology	The Chemist & any Pharmacists they hire as contractors must be able to: • See the available medications on hand • Know when the medications expire • See if they have reached a quantity limit where more most be ordered
Report-03	Pharmacology	The Chemist, Vets, & any Pharmacists they hire as contractors must be able to: • See if the medication being prescribed is safe for the species of the animal • See the quantity on hand based on the name of the drug
Report-04	Pharmacology	The Chemist, Vets, & any Pharmacists they hire as contractors must be able to: • See what medications are available based on type of medication
Report-05	CRM	The receptionists must be able to see: • The name of the parent & the name of the pet checking in • The names of any living pets that are also part of the household • Any temperament anomalies (so aggressive pets can be put in the smaller waiting room away from the main area
Report-06	Grief-Counseling	The grief counselor must be able to see: • The name of the deceased pet • The length of the deceased pet's life • The name of the pet parent • The phone number of the pet parent • The species, breed, and coloring of previously or currently owned pets by the pet parent.

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TRANSACTIONS REQUIRED TO SUPPORT BUSINESS OPERATIONS

PHASE 1

ID	Area of Business	Transaction Name	Transaction Parts
TRX-01	Chemist	Using Blood	• Update incoming and outgoing quantities of blood
TRX-02	Chemist	Lab Supply	• Decrease the amount of supply for a test each time a test is performed
TRX-03	Chemist	Disposable Equipment	• Select the on-hand quantities of disposable equipment (gloves, thermometer covers)
TRX-04	Chemist	Update Chart Chemist	• Update the patient's chart with the results from a pathology lab
TRX-05	Chemist	Critical Illness Flag	• In the event a lab shows positive for a critical illness (avian flu for example) the lab results will automatically flag the patient chart
TRX-06	Counseling	Pet Historical	• Select owner data to get owner's ID • Select all current, previous pets based on species, breed
TRX-07	CRM	Add New Owner	• Enter in new owner data • Commit data
TRX-08	CRM	Add New Pet	• Select owner data to get owner's ID • Enter in new pet data • Commit data
TRX-09	CRM	Update Chart Death	• Update the patient's chart/CRM info when a pet is reported dead.
TRX-10	Pharmacology	Rx Filled	• Select patient species • Verify the medication is species safe • Reduce the amount of drug on hand and note date of Rx fill
TRX-11	Pharmacology	Seeing Blood	• Be able to see available blood on hand, by species, and type
TRX-12	Veterinarian	Update Chart	• Update patient chart on each encounter with notes

TRX-13	Veterinarian	Update Chart Procedure	• Update patient chart with relevant data when a procedure is done
TRX-14	Veterinarian	Patient Chart Global View	• Select a view of all the most recent and most critical areas of a patient chart.

PHASE 2

ID	Area of Business	Transaction Name	Transaction Parts
TRX-15	Estimates/Invoices	Estimate Approval	• Update an invoice with data from an Estimate when approved by customers
TRX-16	Estimates/Invoices	Invoice Rx	• Update invoice with Rx prescribed that day
TRX-17	Estimates/Invoices	Invoice Procedures	• Update invoice with procedures done that day
TRX-18	Estimates/Invoices	Invoice Specialty	• Update invoice with fees for premium vet services (specialty care)
TRX-19	Estimates/Invoices	Invoice Pathology	• Update invoice with pathology lab work done
TRX-20	Estimates/Invoices	Invoice Fee	• Update late invoices with late fee

PHYSICAL DESIGN

NOTES AND ASSUMPTIONS

Assuming 1TB space on server, reserved *only* for the database. Extant, block size, etc. shall be set to defaults.
Clarification: prototype database build will be made with proportionally smaller tablespaces.
Color scheme for the areas of business that are set in the next table will carry through the rest of this document for easy reference.
All invoice related objects are part of Phase 2.

TABLESPACE DESIGN

Tablespace Name	Tablespace Size	Objects in Tablespace
CRM	250GB	Owner
		Pet
		Pet_Historical
		Pet_Deceased
		Animal_Breed
		Animal_Species
		Animal_Gender
		Grief_Counselor_Alert
		Grief_Counselor_Adoption_V
		Patient_Check_In_V
		Pet_Siblings_V
		Invoice_Procedure_Builder
		Invoice
		Estimate
		Invoice_Procedure_Builder
		Invoice_Rx_Builder
		Procedure_Cost_Aggregator
		Rx_Cost_Aggregator
		Estimate_V
		Invoice_V
CHART	400GB	Animal_Facts
		Procedure_History
		Rx_History
		Pathology_History
		Radiology_History
		Imported_Chart_Data
		Imported_Chart_Data
		Rx_History_5Yrs&All_Maint_Meds_V

		Procedure_Hist_V
		Lab_Work_V
		Chart_Meta_V (possibly Mtrlzd)
CHEM	100 GB	Pathology_Lab_Tests
		Pathology_Lab_Orders
		Pharmacology_Stock
		Rx_Order
		Rx_Refills
		Local_Blood_Bank
		Disposable_Products
		Blood_Report_V
		Pharmacology_On_Hand_V
PERSONNEL	5GB	Specialties
		Procedure
		Veterinarian
		Staff
TEMPORARY	300GB	

lease see attachment 6. Physical Design.xlsx for a single page view of this section.

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LOGICAL DESIGN

Note: for space considerations and legibility for the purposes of this document I have created a portmanteau of Primary Key and Foreign Key for those rare instances where they are the same called a *Formary Key*.

Reminder: all invoice related tables are part of phase 2.

LIST OF OBJECTS WITH ATTRIBUTE DETAILS

CRM Objects

Owner Table

Attribute Name	Data Type	Size	Constraint	Notes
OwnerID	number(p,s)	10	PRIMARY KEY	
First_Name	varchar2(size)	40		
Last_Name	varchar2(size)	40	INDEX	Index this field; programming says it will likely be a field used when looking up customers
Phone_Primary	varchar2(size)	9	INDEX	Index this field; programming says it will likely be a field used when looking up customers
Phone_Secondary	varchar2(size)	9		
Address_Street	varchar2(size)	60		
Address_Apt	varchar2(size)	10		
City	varchar2(size)	40		
State	char(size)	2		
Zip	char(size)	5		
Email	varchar2(size)	50		
Alt_Family_Mem_First_Name	varchar2(size)	40		Can pick up animal in lieu of primary parent being unavailible
Alt_Family_Mem_Last_Name	varchar2(size)	40		
Alt_Family_Mem_Phone	varchar2(size)	9		
Emerg_Cont_First_Name	varchar2(size)	40		For when there is an emergency and no other contact is availible.
Emerg_Cont_Last_Name	varchar2(size)	40		
Emerg_Cont_Phone	varchar2(size)	9		

Pet Table

Attribute Name	Data Type	Size	Constraint	Notes
PetID	number(p,s)	12	PRIMARY KEY	
OwnerID	number(p,s)	10	FOREIGN KEY	
Pet_First_Name	varchar2(size)	40	INDEX	
Pet_Middle_Name	varchar2(size)	40		

SpeciesID	number(p,s)	5	FOREIGN KEY	Yes, technically birds and lizards are not species, and feline, canine are genera but this is how customer requested
BreedID	number(p,s)	5	FOREIGN KEY	
GenderID	number(p,s)	5	FOREIGN KEY	
Coloring	varchar2(size)	30		
Birth_Date	date			
Is_Lving	char(size)	1		Y or N; Subtype discriminator
Photo	blob			
Temperament_Notes	varchar2(size)	80		

Pet_Historical Table

Attribute Name	Data Type	Size	Constraint	Notes
PetID	number(p,s)	12	PRIMARY KEY	
OwnerID	number(p,s)	10	FOREIGN KEY	
Pet_First_Name	varchar2(size)	40		
Pet_Middle_Name	varchar2(size)	40		
SpeciesID	number(p,s)	5	FOREIGN KEY	Yes, technically birds and lizards are not species, and feline, canine are genera but this is how customer requested
BreedID	number(p,s)	5	FOREIGN KEY	
GenderID	number(p,s)	5		
Coloring	varchar2(size)	30		
Birth_Date	date			
Photo	blob			
Death_Date				May be set when the Is_Livng Flag is changed in living pets, or manually changed by staff?
Temperament_Notes	varchar2(size)	80		

Pet_Deceased Table

Attribute Name	Data Type	Size	Constraint	Notes
PetID	number(p,s)	5	PRIMARY KEY	
OwnerID	number(p,s)	10	FOREIGN KEY	
Pet_First_Name	varchar2(size)	40		
Pet_Middle_Name	varchar2(size)	40		
SpeciesID	number(p,s)	5	FOREIGN KEY	Yes, technically birds and lizards are not species, and feline, canine are

				genera, but this is how customer requested
BreedID	number(p,s)	5	FOREIGN KEY	
GenderID	number(p,s)	5		
Coloring	varchar2(size)	30		
Birth_Date	date			
Death_Date	date		DEFAULT	Default = NULL will be used as pseudo-Boolean to prevent showing dead animals
Photo	blob			
Is_Lving	char(size)	1		Y or N; Subtype discriminator
Temperament_Notes	varchar2(size)	80		

Animal_Breed Table

Attribute Name	Data Type	Size	Constraint	Notes
BreedID	int	5	PRIMARY KEY	
SpeciesID	int	5		
Breed_Name	varchar2(size)	25		

Animal_Species Table

Attribute Name	Data Type	Size	Constraint	Notes
SpeciesID	int	5		
Species_Name	varchar2(size)	25		

Animal_Gender Table

Attribute Name	Data Type	Size	Constraint	Notes
GenderID	int	5		
Gender_Name	varchar2(size)	25		

Grief_Counselor_Alert Table

Attribute Name	Data Type	Size	Constraint	Notes
AlertID	number(p,s)	5	PRIMARY KEY	
Alert_Date	date			
PetID	number(p,s)	12		
OwnerID	number(p,s)	10	FOREIGN KEY	It's likely a PL/SQL procedure will be used to fill in this table to prevent transcription errors
Parent_First	varchar2(size)	40		

Parent_Last	varchar2(size)	40		
Pet_First	varchar2(size)	40		
Complete_Date	date		DEFAULT	Default=NULL
Resolution_Notes	clob			
Phone_Primary	varchar2(size)	9		
Death_Date	date		FOREIGN KEY	This may not actually end up being a relational constraint; especially if the table is filled in by PL/SQL

Grief_Counselor_Adoption_V	View
Fields	**Notes**
Parent_First	
PetID	
SpeciesID	
BreedID	
GenderID	
Coloring	

Patient_Check_In_V	View
Fields	**Notes**
Pet_First	
Pet_Middle	
Parent_Last	
Parent_First	
Species	
Breed	
Other_Pet_Names	May end up getting dropped from the view

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Pet_Siblings_V	View
Fields	Notes
OwnerID	
SpeciesID	
BreedID	
GenderID	
Is_Living	
Pet_First_Name	
Birth_Date	

Chart Objects

Animal_Facts	Table			
Attribute Name	Data Type	Size	Constraint	Notes
PetID	number(p,s)	12	FORMARY KEY	Child of Pet table
ChartID	number(p,s)	12	CHECK	*LITERALLY THE SAME AS PK PetID here to soothe the concerns of Chief Vet. Will likely not be used. May beable to purge on demonstration*
Pet_First_Name	varchar2(size)	40		
Pet_Middle_Name	varchar2(size)	40		Most of this table will likely be built with a PL/SQL stored procedure, data entry will be done by Reception and a chart will be created upon a program button push (some SELECT INTO statement, etc.)
Owner_Last_Name	varchar2(size)	40	INDEX	Assuming Vets will look up animals by human last name?
SpeciesID	number(p,s)	5	FOREIGN KEY	
BreedID	number(p,s)	5	FOREIGN KEY	
GenderID	number(p,s)	5	FOREIGN KEY	
Coloring	varchar2(size)	30		
Birth_Date	date			
Temperament_Notes	varchar2(size)	80		
Chart_Create_Date	date			

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Procedure_History	Table	Note on Chart Tables; Patient data is kept longer than laboratory records, so data will have to be copied, that's ok.		
Attribute Name	**Data Type**	**Size**	**Constraint**	**Notes**
Patient_ProcedureID	number(p,s)	10	PRIMARY KEY	
ProcedureID	number(p,s)	10	FOREIGN KEY	
PetID	number(p,s)	12	FOREIGN KEY	
Procedure_Date	date			
Procedure_Notes	clob			
Procedure_Follow_Up_Date	date			
Procedure_Follow_Up_Outcome	clob			
RxID	int	10	FOREIGN KEY	
VetID	int	5	FOREIGN KEY	

Rx_History	Table			
Attribute Name	**Data Type**	**Size**	**Constraint**	**Notes**
RxID	int	10	PRIMARY KEY	
PetID	number(p,s)	12	FOREIGN KEY	
Drug_ID	int	5	FOREIGN KEY	
Drug_Dosage	number(p,s)	9,2		
Drug_Units_Dispensed	number(p,s)	9,2		Will have to use Pl/Sql likely to copy this information back into from the actual fill date info
Date_Filled	date			
Patient_ProcedureID	number(p,s)	10	FOREIGN KEY	Can be null
Is_Maintenance_Med	char(size)	1		To be used as pseudo-Boolean: Check = Y, N, or NULL only
Notes	varchar2(size)	1000		

Pathology_History	Table			
Attribute Name	**Data Type**	**Size**	**Constraint**	**Notes**
LabHistoryID	int	10	PRIMARY KEY	
LabOrderID	int	10	FOREIGN KEY	

PetID	number(p,s)	12	FOREIGN KEY	
LabID	int	10		
Critical_Disease	char(size)	1	CHECK	Y(es) or N(o) is a flag field
Date_Completed	date			
Results	varchar2(size)	1000		

Radiology_History Table

Attribute Name	Data Type	Size	Constraint	Notes
PetID	number(p,s)	12	FORMARY KEY	
RadImgID	int	10	PRIMARY KEY	
RadImg_Date_Taken	date			
RadImg_Notes	clob			Notes on radiology image, I would imagine could get quite large.
RadImg_Files	bfile			Radiological images will likely have several files

Imported_Chart_Data Table

Attribute Name	Data Type	Size	Constraint	Notes
PetID	number(p,s)	5	FORMARY KEY	
ImportID	int	5	PRIMARY KEY	
Import_Files	bfile			Apparently, it's custom to keep files from other health care providers separate

Imported_Chart_Data Table

Attribute Name	Data Type	Size	Constraint	Notes
EncounterID	int	10	PRIMARY KEY	
PetID	int	10	FOREIGN KEY	
Encounter_Weight	number(p,s)	8,2		Adding enough room in the event the business expands to equine pets.
VetID	int	5	FOREIGN KEY	
Encounter_Notes	clob			

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Rx_History_5Yrs&All_Maint_Meds_V	View
Field	**Notes**
PetID	Pet Name is also ok
Drug_Name	
Drug_Dosage	
Date_Prescribed	
Is_Maintenance_Med	

Procedure_Hist_V	View
Field	**Notes**
PetID	
ProcedureID	
Procedure_Date	
Procedure_Notes	
Procedure_Follow_Up_Outcome	
VetID	Performing Vet

Lab_Work_V	View
Field	**Notes**
PetID	
LabID	
Date_Completed	
Results	
Critical_Disease	

Chart_Meta_V (possibly Mtrlzd)	View
Field	**Notes**
Patient_First_Nake	AKA Pet_First_Name
Parent_Last_Name	
Parent_First_Name	
BreedID	
GenderID	
Birth_Date	
Temperament_Notes	
Procedure_Name	

Procedure_Date
Procedure_Notes
Procedure_Follow_Up_Date
Procedure_Follow_Up_Outcome
Lab_Name
Lab_Date_Complete
RadImg_Notes
RadImg_Date_Taken
Drug_Name
Drug_Dosage
Drug_Units_Dispensed
Date_Prescribed
Rx_Notes
Last_Encounter_Notes
Critical_Disease

Specialist/Procedure Objects

Specialties Table

Attribute Name	Data Type	Size	Constraint	Notes
SpecialtyID	number(p,s)	3	PRIMARY KEY	
VetID	int	5	FOREIGN KEY	
Specialty	varchar2(size)	30		
Specialty_Add_On_Cost	varchar2(size)	7,2		

Procedure Table

Attribute Name	Data Type	Size	Constraint	Notes
ProcedureID	number(p,s)	10	PRIMARY KEY	
Procedure_Name	varchar2(size)	30		
Is_Surgery	char(size)	1	CHECK	To be used as pseudo-Boolean: Check = Y, N, or NULL only
Procedure_Cost	number(p,s)	7,2		
SpecialtyID	number(p,s)	3	FOREIGN KEY	Which specialist performs the procedure

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Chemical/Pharma

Pathology_Lab_Tests Table

Attribute Name	Data Type	Size	Constraint	Notes
LabID	int	10	PRIMARY KEY	
Lab_Name	varchar2(size)			
Lab_Cost	number(p,s)	7,2		
Kits_on_Hand	int	5		

Pathology_Lab_Orders Table

Attribute Name	Data Type	Size	Constraint	Notes
LabOrderID	int	10	PRIMARY KEY	
LabID	int	10	FOREIGN KEY	
PetID	int	5	FOREIGN KEY	
VetID	int	5	FOREIGN KEY	
Date_Completed	date			

Pharmacology_Stock Table

Attribute Name	Data Type	Size	Constraint	Notes
Drug_ID	int	10	PRIMARY KEY	
Drug_Name	varchar2(size)	60	INDEX	It's likely the chemists and doctors will look up the drug by drug names
Drug_Dosage	number(p,s)	9,2		
Drug_Units_Inv	number(p,s)	9,2		
Drug_Units_Meas	varchar2(size)	20		What is the drug dispensed as? Tablets, mL, bags, pre-filled injections?
Drug_Cost_Per_Unit	number(p,s)	7,2		
Is_Controlled	char(size)	1	CHECK	To be used as pseudo-Boolean: Check = Y, N, or NULL only
Avian_Safe	char(size)	1	CHECK	To be used as pseudo-Boolean: Check = Y, N, or NULL only
Canine_Safe	char(size)	1	CHECK	To be used as pseudo-Boolean: Check = Y, N, or NULL only
Feline_Safe	char(size)	1	CHECK	To be used as pseudo-Boolean: Check = Y, N, or NULL only
Reptile_Safe	char(size)	1	CHECK	To be used as pseudo-Boolean: Check = Y, N, or NULL only

Date_Stocked	date			
Date_Expiration	date		INDEX	Expiration Date of the oldest on hand stock
Order_Level	number(p,s)	7,2		At what level should a report generate and call for a refill
Reorder_Flag	char(size)	1	CHECK	Flag field, will autopopulate, then manually be reset by users

Rx_Order Table

Attribute Name	Data Type	Size	Constraint	Notes
RxOrderID			PRIMARY KEY	
RxID	int	10	FOREIGN KEY	
VetID	int	5	FOREIGN KEY	
PetID	int	5		
Date_Submitted	date			
Drug_ID	int	10	FOREIGN KEY	
Drug_Units_Prescribed	number(p,s)	9,2		
Drug_Units_Dispensed	number(p,s)	9,2		Optional attribute may be purged from final release
Procedure_ID	int			Can be NULL, is only to reference if a drug is given during an operation/procedure
Date_Filled	date			

Rx_Refills Table

Attribute Name	Data Type	Size	Constraint	Notes
RxOrderID	int	10	PRIMARY KEY	
RefillID	int	5	FOREIGN KEY	This table though not a join table might be a good candidate for a composite primary key simply because of tracking. For example: same Rx#, but each refill date creates a new instance of the record;
RxID	int	10	FOREIGN KEY	
Num_Refills_Left	int			if no refills then this field will still be populated with a zero and the date filled would be that day
Date_Filled	date			

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Local_Blood_Bank	Table			
Attribute Name	Data Type	Size	Constraint	Notes
BloodBagID	int	5	PRIMARY KEY	
Type_Blood	char(size)	5		
Species_Id	int		FOREIGN KEY	

Disposable_Products	Table			
Attribute Name	Data Type	Size	Constraint	Notes
Product_ID	int	5	PRIMARY KEY	
Product_Description	varchar2(size)	40		
Product_Size	varchar2(size)	10		
Product_On_Hand	int	5		

Blood_Report_V	View
Fields	Notes
Bags_On_Hand	
Count_by_Avian	
Count_by_Canine	
Count_by_Feline	
Count_by_Reptile	

Pharmacology_On_Hand_V	View
Fields	Notes
Drug_Name	
Drug_Dosage	
Drug_Units_Inv	
Is_Controlled	
Date_Stocked	
Date_Expiration	

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Staffing

Veterinarian Table

Attribute Name	Data Type	Size	Constraint	Notes
VetID	int	5	FOREIGN KEY	Subtype of Staff will be a 1:1 relationship with a primary/foreign key.
Rx_Auth_Num	char(size)	11		Typically starts with a letter, so char is required

Staff Table

Attribute Name	Data Type	Size	Constraint	Notes
StaffID	int	10	PRIMARY KEY	
Staff_First_Name	varchar2(size)	40		This whole situation may need to be cleaned up possibly combining the Specialist Table and the Vet Table
Staff_Last_Name	varchar2(size)	40	INDEX	
Employment_Date	date			
Termination_Date	date			
Is_Rehireable	char(size)	1	CHECK	To be used as pseudo-Boolean: Check = Y, N, or NULL only
Is_Vet	char(size)	1	CHECK	To be used as pseudo-Boolean: Check = Y, N, or NULL only
Database_Role	varchar2(size)	40		Information irrelevant to anyone but the DBA

Invoicing Objects

Invoice Table

Attribute Name	Data Type	Size	Constraint	Notes
InvoiceID	int	12	PRIMARY KEY	Start at 1000
PetID	int	12	FOREIGN KEY	
LabOrderID	number(p,s)	7,2	FOREIGN KEY	
VetID	int	5	FOREIGN KEY	
Date_Invoice_Creation	date		INDEX	
Lab_Name	varchar2(size)			
Total_Add_On_Costs	number(p,s)	12,2		Total of Lab_Cost + Specialty_Add_On_Cost
Total_Invoice_Cost	number(p,s)	12,2		Sum of Total_Procedure_Rx_Costs + Total_Add_On_Costs
Specialty	varchar2(size)	30		

Specialty_Add_On_Cost	varchar2(size)	7,2		
Late_Charges	number(p,s)	7,2		5% on 30 days +
Total_With_Late_Charges	number(p,s)	12,2		
Total_Invoice_Cost	number(p,s)	12,2		
Date_Paid	date			
Is_Estimate	char(size)	1	CHECK	Y or N; Subtype discriminator
SpecialtyID	int	3	FOREIGN KEY	

Estimate Table

Attribute Name	Data Type	Size	Constraint	Notes
InvoiceID	int	12	PRIMARY KEY	Everything in this table will get renamed from Invoice to Estimate upon printing for customers, let programming know
EstimateID				Except...for of course EstimateID, and InvoiceID
PetID	int	12	FOREIGN KEY	
LabOrderID	number(p,s)	7,2	FOREIGN KEY	
VetID	int	5	FOREIGN KEY	
Date_Invoice_Creation	date		INDEX	
Lab_Name	varchar2(size)			
Total_Add_On_Costs	number(p,s)	12,2		Total of Lab_Cost + Specialty_Add_On_Cost
Total_Invoice_Cost	number(p,s)	12,2		Sum of Total_Procedure_Rx_Costs + Total_Add_On_Costs
Specialty	varchar2(size)	30		
Specialty_Add_On_Cost	varchar2(size)	7,2		
Total_Invoice_Cost	number(p,s)	12,2		
SpecialtyID	int	3	FOREIGN KEY	
Estimate_Approved	char(size)	1	CHECK	Y or N; Subtype discriminator

Invoice_Procedure_Builder Table

Attribute Name	Data Type	Size	Constraint	Notes
InvoiceProcID	int	10	PRIMARY KEY	
ProcedureID	int	10	FOREIGN KEY	

Procedure_Name	varchar2(size)	30		
Is_Surgery	char(size)	1		This field adds an additional $250 for use of the operating theater it is a one time fee per invoice if valid.
Procedure_Cost	number(p,s)	7,2		
Procedure_Date	date			This table will be used to build the Estimate Table because an animal can have one or more procedures during a surgery. No need for petID, as this is unique, can be joined in later.

Invoice_Rx_Builder Table

Attribute Name	Data Type	Size	Constraint	Notes
Invoice_RxID	int	12	PRIMARY KEY	
PetID	int		FOREIGN KEY	Couple of options with these tables, can either use PL/SQL or connector tables.
Drug_ID	int	10	FOREIGN KEY	
Drug_Cost_Per_Unit	number(p,s)	7,2		
Drug_Dosage	number(p,s)	9,2		
Drug_Units_Prescribed	number(p,s)	9,2		From Rx_Order table
Rx_Cost	number(p,s)	7,2		(Drug_Cost * Drug_Units_Prescribed)
RxID				

Procedure_Cost _Aggregator Table

Attribute Name	Data Type	Size	Constraint	Notes
InvoiceID	int	12	FORMARY KEY	Compound Primary Key
InvoiceProcID	int	12	PRIMARY KEY	Compound Primary Key
Sum_Proc_Cost	number(p,s)	9,2		

Rx_Cost _Aggregator Table

Attribute Name	Data Type	Size	Constraint	Notes
InvoiceID	int	12	FORMARY KEY	Compound Primary Key

Invoice_RxID	int	12	PRIMARY KEY	Compound Primary Key
Sum_Rx_Cost	number(p,s)	9,2		

Estimate_V	View
Field	**Notes**
EstimateID	
Pet_Name	
Parent_Last	
Parent_First	
Lab_Name	
Lab_Cost	
Vet_Last	
Sum_Proc_Cost	
Sum_Rx_Cost	
Specialty_Add_On_Cost	
Total_Add_On_Cost	
Total_Estimate_Cost	
Date_Estimate_Creation	
Date_Expires	

Invoice_V	View
Field	**Notes**
InvoiceID	
Pet_Name	
Parent_Last	
Parent_First	
Lab_Name	
Lab_Cost	
Vet_Last	
Sum_Proc_Cost	
Sum_Rx_Cost	
Specialty_Add_On_Cost	
Total_Add_On_Cost	
Total_Invoice_Cost	
Date_Invoice_Creation	
Date_Due	
Late_Charges	
Total_With_Late_Charges	

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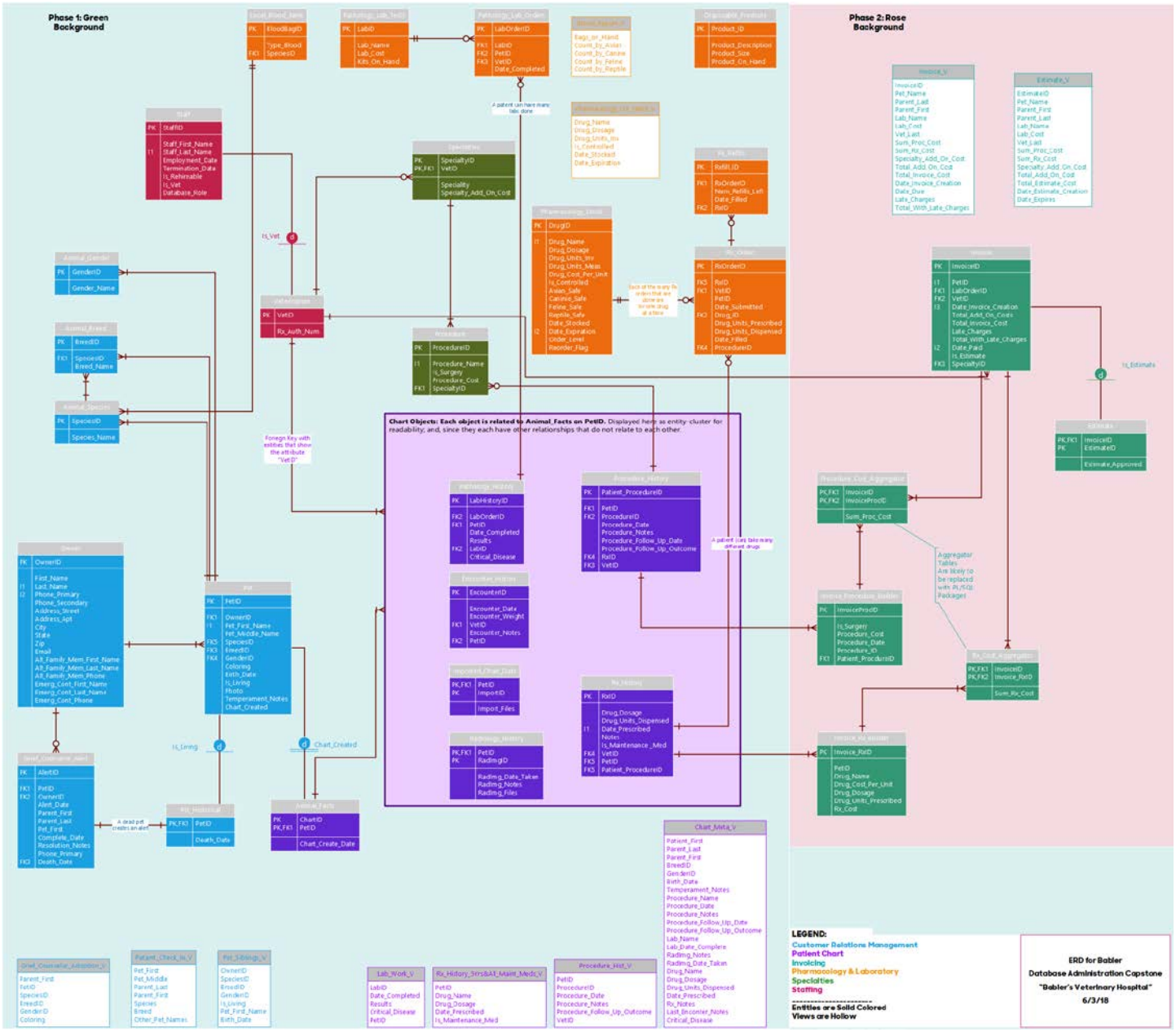
Please see attachment 7. Objects & Attributes.xlsx for further viewing options including dropdown filters.

ENTITY RELATIONSHIP DIAGRAM [ERD]



Please see attachment ERD-Babler-Capstone.vsdx or ERD-Babler-Capstion.png for a zoomable and more accessible version of this image, or simply right click and choose open link to view in browser.

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HARDWARE REQUIREMENTS

SERVER

Type of Hardware	Minimum Requirement	Recommendation	Justification
CPU	1.4 Ghz 64 bit processor AMD or Intel	Quad Core 64bit 3.6 Ghz or higher.	As a small business It's likely IT will want other things running on the server such as an email processor, and possibly a webhost, this will add to the server load. A more robust server will last longer, process data faster, and cause less frustration with customers and employees. The cost of going from minimum to a 3.6 or higher is within a few hundred dollars; which can save thousands of dollars in headaches later. 1.4 Ghz is bare minimum to function; not the bare minimum to create a pleasant user experience.
External Backup	1TB reserved only for database	2 TB	Currently Amazon is having a sale on these where the extra terabyte for some models is only $3.00 more. This backup is to be clearly labeled as for database backups only, no server OS backups, no program backups, etc. JUST the database, and data.
Fire Safe Document chest	Large enough to hold external backup.	Please see attached image.	The external backup should be kept in the safe at all times so a backup can be retrieved in the event of flood, fire, or other unpredictable cataclysm.
Graphics Card	1GB with minimum two video outputs	1GB with minimum two video outputs	To allow for dual monitors and to take some of the graphics processing load off the processor if someone is having to interface directly with the computer.
Hard drive	500 GB	Two 1 TB drives or a single 2TB	Upfront reminder: Radiology will take up a great deal of space on its own. Recommend 1 hard drive to put the OS on and any other servers, 1 for just the database. Virtual Partitioning of a large hard drive is acceptable but not ideal. In my professional opinion it is better to spread out opportunities for critical hardware failures, i.e. if the OS disk fails, at least you don't have to restore the database from last commit, and vice versa.

	not required.		The database itself won't be interacting with the internet; unless we install add-ons for things like credit card processing. LAN connectivity is more important. Database can be upgraded via external media if required.
Internet Speed		24 MBS connection or higher	
Keyboard/Mouse	Each connectable via USB	Each connectable via USB	
LAN	NIC with 1 Gigabit speed and one port	Anything higher than 1 Gigabit and 2 ports.	The server will not have wireless connectivity, there is no need for it, furthermore having it connected to the router by CAT-6 cable is often significantly faster than even the best wireless speeds.
Monitor size, minimum	20"	Two 20" +	Most workstations these days need 2 monitors, if something is going wrong with the database, it will be easier to look up information on one screen and interact with the database on the other.
RAM	4 GB: 2 for Windows 2 for Oracle	16 GB +	Same justification as for a better CPU; more ram, more space for the programs to actually do their work. Will allow bigger Oracle Pools to be set up, and thus faster transaction speed. RAM cost if shopped carefully is inexpensive.
UPS	UPS - 1000 Watt - 1440 VA	anything higher.	This will give approximately 5 minutes to shut the server down in the event of a power outage, allowing open transactions to finish.

WORKSTATIONS

Type of Hardware	Minimum Requirement	Recommendation	Justification
CPU	1.4 Ghz 64 bit processor AMD or Intel	2 Ghz 64bit or higher	1.4 Ghz at the time of publication feels like a crawl, even 2 Ghz can seem slow.
Hard drive	250 GB	500 GB	Cost difference will be minimum; image sizes seem to get larger as imaging software gets better. Additional software related to business (Microsoft Office, possibly Adobe Creative Suite will need to be installed).

Keyboard/Mouse/ Accessibility	USB support for these accessories	Include the option for trackballs, and ergonomic keyboards.	Physically uncomfortable employees are unproductive.
LAN	1 Gigabit NIC with ethernet adaptor	N/A	Standard PCI/PCIe or onboard ethernet enabled NIC
Monitor	Two 20" monitors	Anything larger	If it fits in the work area, and is ergonomic, larger sizes are fine.
RAM	2 GB	4 GB	More RAM = more space for the programs to do work, 4 seems standard today based on entry level towers at Dell.
UPS	500 Watts	Anything higher.	In the event of a power loss: should give approximately 3 minutes to finish immediate transaction and shut down.
Wireless	150 Mbs Dual Channel	Anything higher	Most work stations will be connected via CAT-6; however, for the workstations that cannot, or to allow for the option of having wireless, this will suffice.
Digital Camera	5 Megapixels	Additional one made safe for Operating Theater	For taking pictures of pets, for documenting problems in surgeries?

TABLETS

Type of Hardware	Minimum Requirement	Recommendation	Justification
CPU	1.4 Ghz 64 bit processor AMD or Intel	2 Ghz 64bit or higher	1.4 Ghz at the time of publication feels like a crawl, even 2 Ghz can seem slow.
Hard drive	512 GB	1 TB	The vets will also likely run various other programs, and probably have copies of their veterinarian textbooks stored on the device for reference.
LAN	N/A	N/A	Will likely only connect via Wi-Fi
RAM	2GB	8GB	Vets do not want to sit there and tell patients "sorry it will take some time to reload this" when they are working with patients.
Touch Screen	13.5" & Completely Removable from Keyboard	Anything higher	Removability from keyboard is critical, it should be able to function like a pad of paper and feel natural.

Wireless	802.11 Protocol must match router, minimum 5 MBs	N/A	speed
External Protection	Some form of liquid and impact protection for the screen is mandatory. If a vet sets the device down in a wet area, or an excited animal knocks it to the floor, the device should not be ruined.		

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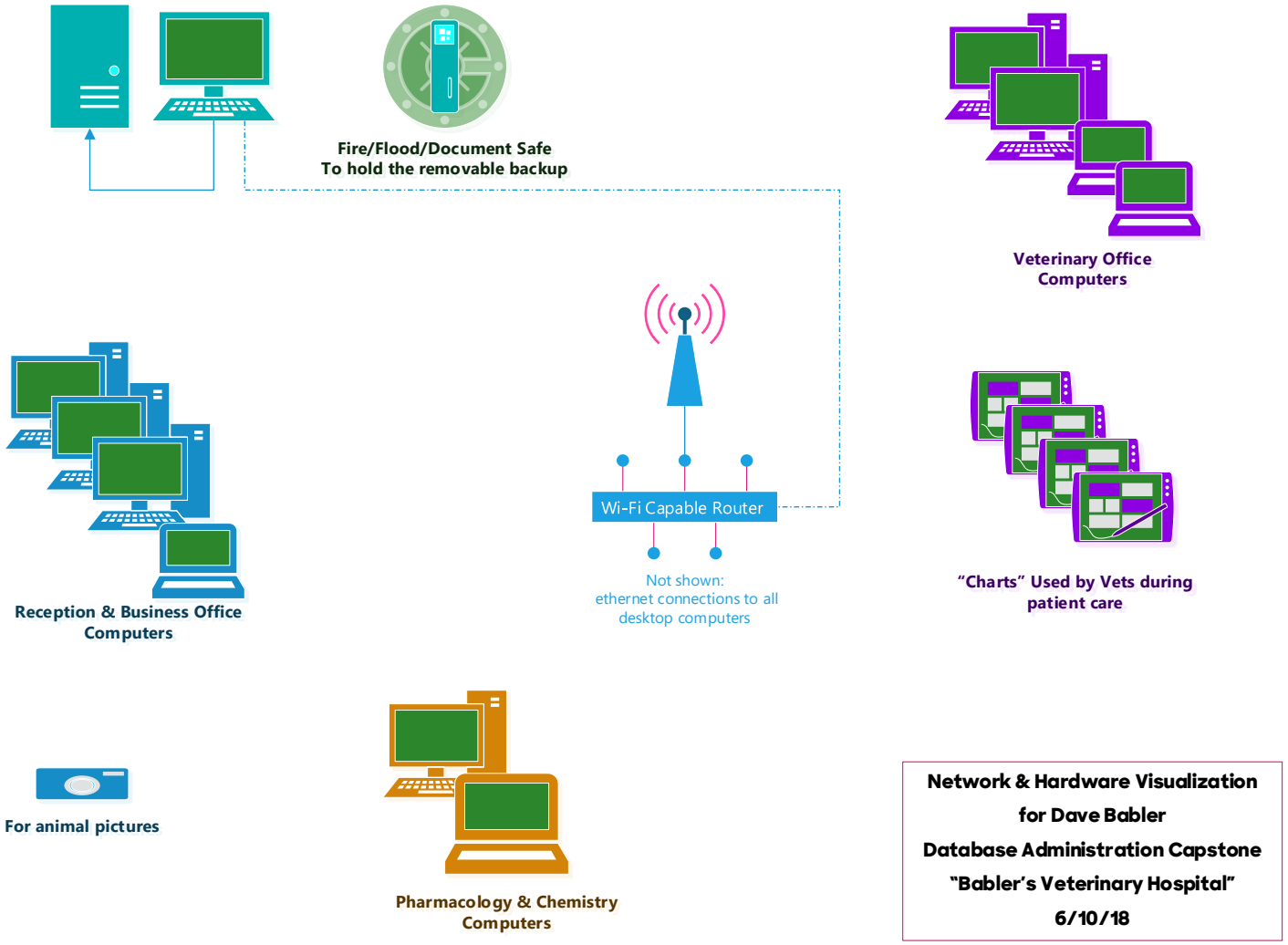
HARDWARE DIAGRAM



SOFTWARE REQUIREMENTS

DIRECT REQUIREMENTS

- The database itself will be loaded onto Oracle 12c
- The server for the database will be running on Windows Server 2016
- Administration of the database will be done with a combination of the following programs:
  - Oracle's SQL Plus
  - Oracle's SQL Developer

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CONCURRENT REQUIREMENTS

A custom GUI is being developed concurrently with the database by another team; this program will be built in the .NET framework in C#.

ANCILLARY REQUIREMENTS

- Each of the workstations including the portable computers/tablets will run on Windows 10.
- Microsoft Office's Suite will also be required for the business and appropriate licenses have been procured.
- The office has decided to use their own scheduling program. An interface will be written to interact with the database will be outsourced to a third party well after the database has been loaded on to the server.
- All peripheral drivers will be dealt with by the office manager as needed.

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