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WRITING GUIDELINES FOR THE CAPSTONE PROPOSAL

REVIEW

SIGNIFICANCE

- **What is known**?
- **Where is the Gap in Knowledge**? Controversy?
- **Specific Aims.** Outline the goals of your project to fill in that gap in knowledge
- **Central Hypothesis Statement**: Your specific aims should test a central hypothesis
- **Outlook**.
  - So what? What's the payoff?

WHAT IS KNOWN

- Start with the topic of your research project.
  - The topic should be the first or second word of the first sentence
  - Think of Why you are doing what you are doing.
  - Think anatomy or the disease
- This helps prime your readers expectations
- *Don't start with the method you used*.
  - That is your bias, because that is what you have been doing
  - You want the big picture. Your method plays a role in adding to the big picture. So what's the big picture?

EXAMPLE BAD STARTER SENTENCE (FROM A REAL CAPSTONE DRAFT)

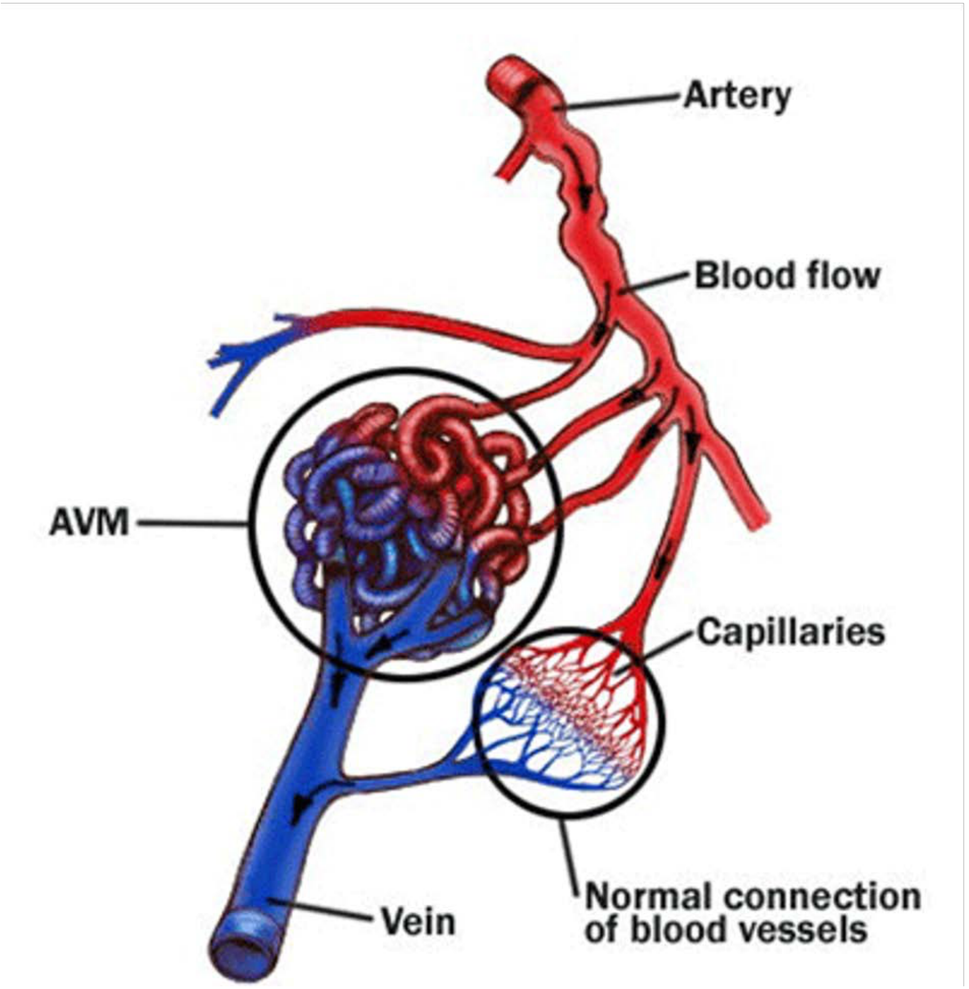
- Using CT scans, a 3D model of a pulmonary arteriovenous malformation (PAVM) has been produced to be printed for use in the Interventional Radiology (IR) clinic at UCHealth in Aurora, Colorado to improve patient education and ease anxiety in patients undergoing treatment for their PAVMs.

- Pulmonary arteriovenous malformation (PAVM) is an abnormal connection between arteries and veins that bypasses the alveoli in the lungs and potentially leads to improperly oxygenated blood.

START WITH THE ANATOMY/ DISEASE – MORE COMPELLING

FIGURE

- Be sure to include an edifying figure in your Significance that explains the disease
- What figure what you like to see if you are reading about Pulmonary Arteriovenous Malformations (PAVM)?
  - PAVMs are vascular anomalies where there is a direct communication between pulmonary arteries and veins, bypassing the lung capillary bed



RATIONALE

- Ideally you present the background with an unstated question, a tension
  - Here is what we know, but…
- And then your rationale kicks in
  - And you state everything that is not know
- The rationale helps set up the hypothesis
  - The reason why you are doing what you are doing

BACKGROUND INTRO

Pulmonary arteriovenous malformation (PAVM) is an abnormal connection between arteries and veins that bypasses the alveoli in the lungs and potentially leads to improperly oxygenated blood.
Incidence? Cause? Symptoms? Expand on all of that.

WHAT IS KNOWN

Current treatment for PAVM can involve surgery or embolization by an interventional radiologist.

And...

Patients that develop PAVM are often anxious about their diagnosis and have little understanding of the underlying anatomy of the disorder or of the procedure required to treat the problem.

RATIONALE

But...

Often, during the consult, the physician simply reviews with the patient the 2D cross-sections from a CT scan of the lungs; **however, patients who lack an understanding of the 3D anatomy of lung vasculature can find such a review or the precise details of the embolization procedure difficult to understand.**

CENTRAL HYPOTHESIS AND SPECIFIC AIMS

Given the difficulty in conceptualizing 3D structures from 2D images, we hypothesize that presenting a patient with a 3D-printed model of PAVM will improve their understanding of the disorder and treatment procedure, and reduce their anxiety of the diagnosis.

We address this hypothesis with the following specific aims:

Specific Aim 1. Generate a realistic 3D-printed model of a heart with a PAVM.

Specific Aim 2. Determine the level of patient understanding of their PAVM using 2D or 3D materials

INNOVATION

- Realistic 3D models are not readily available
  - useful tool for both surgeon and patients
- Creating new educational tool could help with patient anxiety
  - Current, no good solutions for patient education

APPROACH SECTION

- Expand on your Specific Aims
- Present enough information to understand your methods, but do not include detailed Protocols
- Important things to include:
  - Datasets - explain where you are going to get your datasets
  - Segmentation and Modeling - brief overview of the segmentation software you used (Slicer, Grow from Seeds, etc)
  - Statistics: a Power Analysis, the types of stats you intend to used,

Specific Aim 1. **Generate a 3D-printed model of a heart with a PAVM**. For this aim, we test the hypothesis that we can generate a realistic 3D-printed model of PAVM. To generate the model, we will segment the vasculature and heart from the CT chest scan of a patient with multiple, untreated PAVMs. We will use a case with many complications as an extreme example for most patients—with the hopes of reducing patient's anxiety by comparison (the 'at least I'm not that bad' conjecture). The model will include both PAVMs and normal vessels for comparison. One PAVM segmentation will featured a particularly large fistula connecting a feeding artery exiting the pulmonary trunk and a vein entering the left atrium. Segmentations will be cleaned up using standard smoothing methods and converted into 3D surfaces models. These models will then be imported into Maya (autodesk.com), sculpted, artistically adjusted, and enhanced to provide anatomically accurate representation of the chest anatomy.

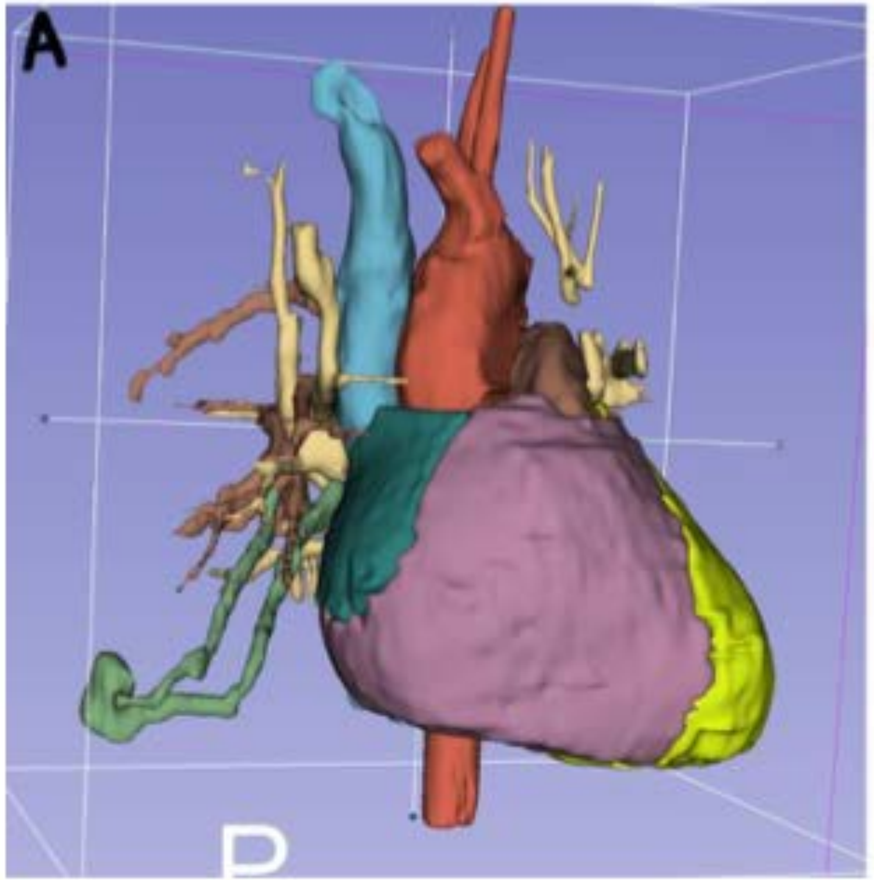
To determine the accuracy of our model, we will survey several surgeons and residents and… We will get this many participates to ensure a high enough power

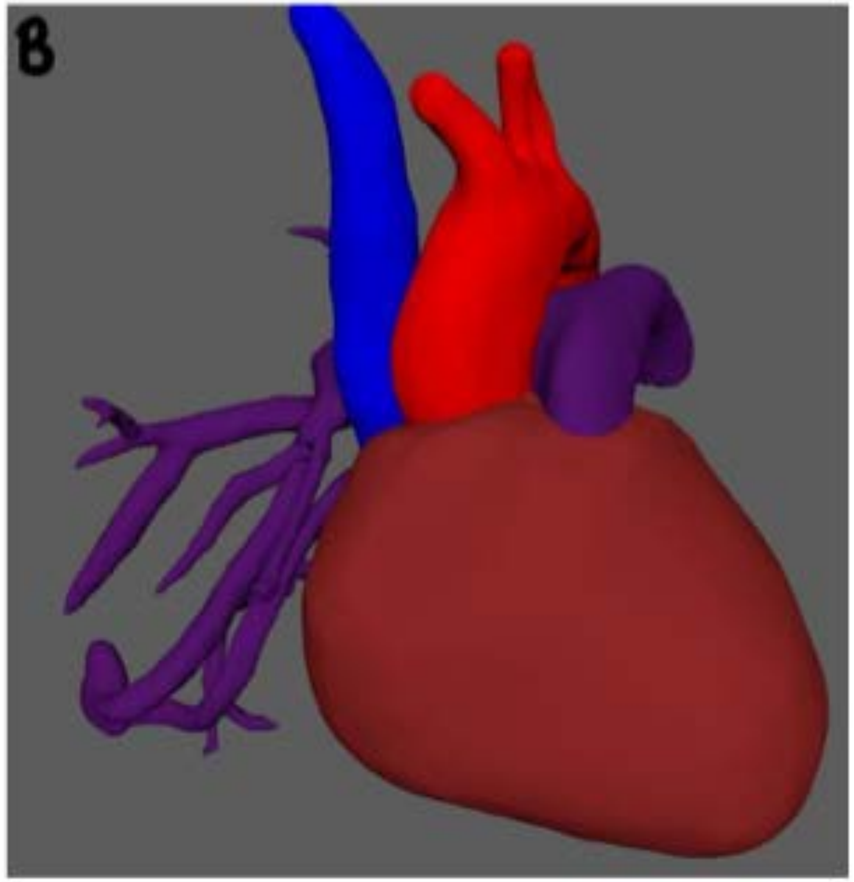
Specific Aim 2. Measure Patient understanding of PAVM. For this aim, we will test the hypothesis that presenting a patient with a 3D-printed model of PAVM will improve their understanding of the disorder and treatment procedure, and reduce their anxiety of the diagnosis.

Patients will be given and pre- and post-survey on PAVMs. We aim to survey this many patients to get this power, etc.

APPROACH FIGURE

- Your Figure should illustrate the approach





TITLE

- What is a good title?
  - Come up with a title that is straightforward, clear, and partially understandable to even to non-experts.
    - The punnier the better.
  - A 3D Printable model of pulmonary arteriovenous malformations will ease patient anxiety and increase patient understanding of the syndrome

WRITING TIPS

TOPICS OUTLINE

- Word Choice
- Word Order
- Paragraph Organization
- Style considerations

WORD CHOICE

- Avoid Wordiness and Redundancies
- Wordy sentences contain many unnecessary words and unnecessary transitions
  - “Have been shown to,”
  - “is all that”
  - “…is beginning to show…”
  - “in order for”
  - “to be able to”
  - Due to the fact
- Redundant Sentences say the same thing Twice
  - identify where you’re using two synonymous words where one would do.

WORDINESS

Wordy: A few inches of snow **on the ground is all that** is necessary **in order for a person to be able** to go sledding. (bolded words could be cut)

Better: A few inches of snow is necessary to go sledding. (10 hard-working words)

REDUNDANCY

- The resulting liquid was purple **in color**
- **Various modifications of the** procedure **have** recently **been developed**
- The compound **exhibited competition** with the ligand for binding
- Antibody **was added to each individual** sample for labeling

- The liquid was purple
- The procedure was recently modified
- The compound competed with the ligand for binding
- Samples were labeled with antibody

WORD CHOICE

- Use adjectives/adverbs sparingly
  - These are seductive because they often ***seem*** to add meaning but only do in rare situations
- Avoid Excessive Hedging
  - “The results suggest that it **may be possible** to start to show how lasers may be used **in such a** way.” (21 words)
  - “The results suggest how lasers may be used in this way.” (11 words)

UNNECESSARY ADJECTIVES AND ADVERBS

- very
- extremely
- highly
- truly
- un/fortunately
- primarily
- especially
- actually
- really

PRACTICE – SPOT THE UNNECESSARY WORDS

- It is also worth pointing out that collagen synthesis returned to normal 3 days post injury.
- A substantial proportion of HIV patients also develops tuberculosis.
- After 3 hr, the old medium was dumped, and the same amount of fresh medium was added.
- The data in Table 1 are very consistent with Brokl's (1999) model.
- This appears to indicate that factor A possibly may have a tendency to interact with factor B.
- In a considerable number of cases, degradation leads to topsoil loss and a reduction in soil fertility.
- We analyzed helium content in steam escaping from fractures and thermal features of Yellowstone National Park for the purpose of determining the proportions of helium-3 and helium-4 in gas emissions by the super volcano.

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SENTENCE STRUCTURE

- Information is interpreted more easily and more uniformly if it is placed where most readers expect to find it
- We read from left to right
  - we prefer the context on the left, where it can more effectively familiarize the reader.
  - We prefer the new, important information on the right, since its job is to intrigue the reader.
- Each sentence has a primary actor
  - Your job is to place the verb immediately after the subject
  - Any separation between the subject and the verb is considered secondary information and an interruption
- Whose story is it?
  - Jack loves Jill
  - Jill is loved by Jack

SUBJECT VERB PLACEMENT

- Write the way people expect
  - People interpret sentences based on its structure
- Consider the following:

t(time)=15', T(temperature)=32o, t=0', T=25o; t=6', T=29o; t=3', T=27o; t=12', T=32o; t=9'; T=31o

time (min)	temp (°C)
0	25
3	27
6	29
9	31
12	32
15	32

temp (°C)	time (min)
25	0
27	3
29	6
31	9
32	12
32	15

FOCUS ON THE SCIENCE, NOT THE SCIENTISTS

- **Recent work** has shown a link between abnormal oscillatory patterns in the beta frequency recorded from the basal ganglia and the pathophysiology of patients with Parkinson's disease(1–3).
- **Additionally, studies are beginning to show** there is a link between changes in myelin and patients with PD such that patients with PD have increase myelin compared to age matched controls (4)

These sentences are hard to understand. Who did the work? What are these studies?

LOCATION, LOCATION, LOCATION

- Where words are within more complex sentences can affect how we feel about them
  - Beginning vs. end of sentence
  - Main clause vs. dependent clause

Example:

Although vitamin B6 seems to reduce the risk of macular degeneration, *it may have some side effects*.

Vitamin B6 reduces the risk of macular degeneration, but it may have some side effects.

Taking vitamin B6 may have some side effects, but vitamin B6 also reduces macular degeneration.

Although taking vitamin B6 may have some side effects*, vitamin B6 reduces macular degeneration*.

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Example:

30% Although vitamin B6 seems to reduce the risk of macular degeneration, *it may have some side effects*.

40% *Vitamin B6 reduces the risk of macular degeneration,* but it may have some side effects.

60% *Taking vitamin B6 may have some side effects*, but vitamin B6 also reduces macular degeneration.

70% Although taking vitamin B6 may have some side effects*, vitamin B6 reduces macular degeneration.*

ESTABLISHING PATTERNS

Macular degeneration is affected by diet. One of the diet components that influences the progression of macular degeneration is vitamin B6. Although vitamin B6 seems to reduce the risk of macular degeneration, it may have some side effects.

What will the next sentence be about?

Depression in the elderly is thought to affect more than 6.5 million of the 35 million Americans who are 65 years of age and older. It is considered to be a disorder that is commonly underdiagnosed, undertreated, and mismanaged by pharmacotherapy both in community dwelling seniors and in those residing in nursing facilities. Depression in the elderly has also been closely associated with dependency and disability that presents in both emotional and physical symptoms, thus amplifying the difficulty in diagnosis. Major depression, dysthymic disorder, and subsyndromal depression tend to be higher in persons over 65 who live in a long-term care facility.

How does each sentence of this paragraph start?

AVOID THE “HAS SHOWN” CREEP

- “Studies show…”
- "A study from…”
- Conceivably you could start every sentence with one of these fillers and it is not necessary.
  - They detract from your message by adding complexity to your sentence structures
  - They also disrupt the flow of the paragraph

Kill all HAS SHOWN statements

- **Recent work has shown** a link between abnormal oscillatory patterns in the beta frequency recorded from the basal ganglia and the pathophysiology of patients with Parkinson's disease(1–3).
- Abnormal oscillatory patterns in the beta frequency recorded from the basal ganglia have recently been linked to pathophysiology of patients with Parkinson's disease (1–3).
- Additionally, **studies are beginning to shown there is** a link between changes in myelin and patients with PD such that patients with PD have increase myelin compared to age matched controls (4)
- Additionally, patients with PD have increased myelin compared to age matched controls4 and the level of myelin pathology correlates with disease severity4.

YOU TRY IT

- Previous studies have shown that integration of 3D anatomical models into the gross anatomy laboratory have enhanced student learning outcomes (Lim et al., 2016; Kong et al., 2016). One study from Monash University found that students perform better on tests after interacting with 3D printed heart models over cadaveric materials (Lim et al., 2016). The study suggested that 3D printed materials may even have certain benefits over cadaveric materials, such as the elimination of student emotional and cultural sensitivity to human remains (Lim et al., 2016). Another study from Southern Medical University found that students demonstrate enhanced learning outcomes after interacting with 3D printed liver models versus traditional anatomy atlas illustrations (Kong et al., 2016). Both the Monash University and Southern Medical University studies demonstrate the benefits of 3D printed models over other resources in regards to adult anatomy, but again, the potential benefits of 3D printed embryonic models have yet to be explored.

YOU TRY IT (SEE ASSIGNMENT)

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FIXED IT

- Integration of 3D anatomical models into the gross anatomy laboratory can enhance student learning outcomes (Lim et al., 2016; Kong et al., 2016).
- In fact, students perform better on tests after interacting with 3D printed heart models than with cadaveric materials (Lim et al., 2016).
- 3D printed materials may have certain benefits over cadaveric materials, such as the elimination of student emotional and cultural sensitivity to human remains (Lim et al., 2016).
- One study demonstrated enhanced learning outcomes after interacting with 3D printed liver models versus traditional anatomy atlas illustrations (Kong et al., 2016).
- While the benefits of 3D printed models over other resources has been demonstrated for adult anatomy, the potential benefits of 3D printed embryonic models remain to be explored.

SIMPLE INFORMATION COMES FIRST.

Follow with more *complexity.*

Outbreaks of limb deformities in natural populations of amphibians across the United States and Canada, especially in wetland associated with agricultural fields, were evaluated in this study.

We evaluated outbreaks of limb deformities that occurred in natural populations of amphibians across the United States and Canada, especially in wetlands associated with agricultural fields.

PARAGRAPH ORGANIZATION

- Topic sentence provides an overview of the paragraph
- Details are arranged in the middle of the paragraph in a logical order using transitions
  - In addition,
  - Because of this,
  - First,
  - Subsequently,
- Use key terms to generate cohesion - repeat them exactly each time (don’t use synonyms)

PRACTICE

Both GAD-positive cell bodies and processes were found in the ventral lateral posterior nucleus and thalamic reticular nucleus. Almost all of the neurons in the thalamic reticular nucleus appeared to contain GAD-immunoreactivity. Only small round cells in the ventral lateral posterior nucleus were GAD-positive.

We observed GAD immunoreactivity in both neuronal cell bodies and processes of the ventral lateral posterior nucleus and thalamic reticular nucleus. In the ventral lateral posterior nucleus, only small round cells contained GAD immunoreactivity. In contrast, almost all of the neurons in the thalamic reticular nucleus appeared to contain GAD immunoreactivity.

SOME BASIC STYLE POINTERS…

- Use the first person (I / we) to maintain your sentences in an active voice
- Use the active voice (except in a Methods section)
- Use the **past tense** for observations and specific conclusions that **you made**
- Use the **present tense** for **established knowledge**
- **Aim for one main idea per sentence - keep sentences short**

MORE BASIC STYLE POINTERS…

- Use active verbs
  - Responses in the Mauthner neuron **depend on** inputs from the feedforward spiral fiber neurons.
  - Responses in the Mauthner neuron **are dependent on** inputs from the feedforward spiral fiber neurons.
- Avoid noun clusters
  - Porcine tracheal fluid samples
  - Peter Carri is a condensed matter and quantum many-body theoretical physicist.
- Avoid Excessive Abbreviations
  - “MPTP is converted to MAOB by MPP, which reaches SNpc nerve cells via DA uptake systems.”
- Arrange lists by item length

WRITING PROCESS

- Make an outline
  - outlines can be composed of words or figures or both
  - What are your sub-sections?
  - What are the main points you want to get across in each section?
- Don’t get bogged down - if you’re not sure how you want to phrase something, leave yourself a note and move on
- Start by writing less - write a brief, 1 paragraph introduction - you can add more later
- Don’t worry about grammar or style - just get some ideas on paper

OVERCOMING PROCRASTINATION

- Organize yourself: Get everything you need together in one place: lab notebook, figures / tables, references. Print items as needed if this helps.
- Start on whatever task appeals to you - abstract, introduction, results, whatever!
- Imitate how others write - read an example introduction and use this to help organize your own thoughts
- Take the task in chunks. Write your title, write a paragraph, tackle the results, make a figure, complete one section of your materials and methods
- Stick to the deadlines (and tell your mentor what the deadlines are)
- Write informally to start (just get the words on the page)