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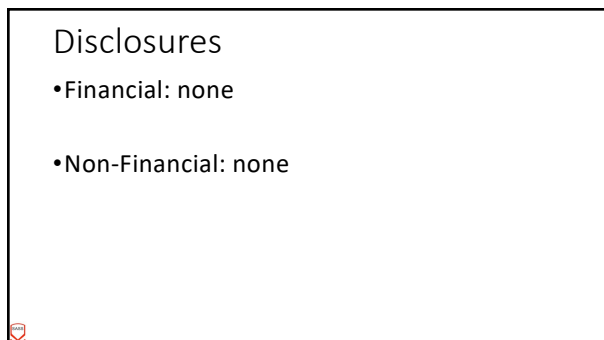
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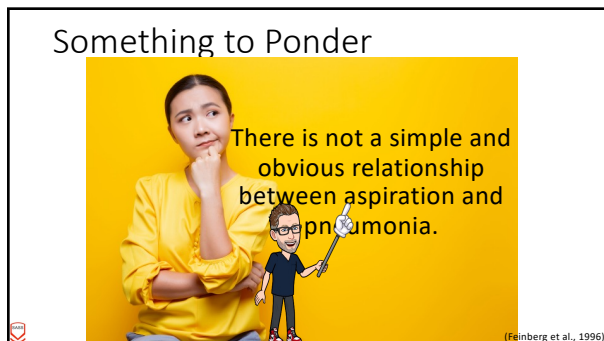
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### The Lungs: Quick Facts

- The surface area of the lungs is **30x greater** than that of the skin.
- The lungs contain a **diverse microbial community** that play a vital role in maintaining healthy lung function and **preventing disease**.



(Dickson et al., 2014)

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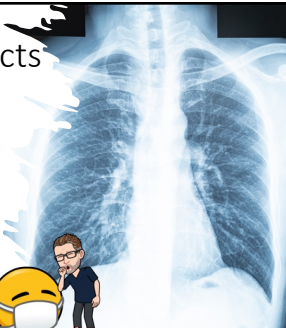
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### The Lungs: Quick Facts

- The average person swallows **~2 liters** of saliva per day.
- There is **no barrier** between the lungs and the outside environment.
- The lungs are exposed to **~10,000 liters** of unfiltered air per day.



(Dickson et al., 2014)

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### Pneumonia: Quick Facts

- There are an estimated **1.5 million** cases of community acquired pneumonia (CAP) in the U.S. each year.
- **1 in 3** patients with CAP die within one year of developing CAP.



(Barron et al., 2017; Crown & Singer, 1997)

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### Pneumonia: Quick Facts

- Healthcare acquired pneumonia (HCAP) is one of the most common nosocomial infections and accounts for more deaths than other nosocomial infections.



(Ramirez et al., 2017; Craven & Steggis, 1997)

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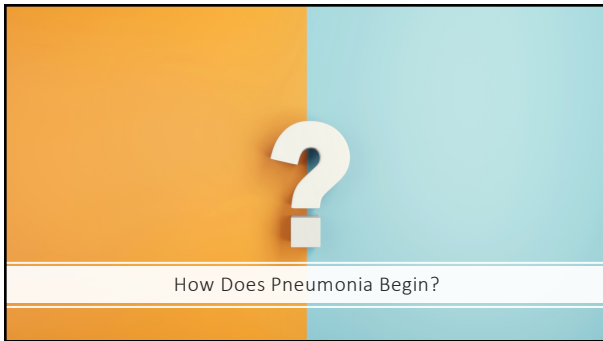
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How Does Pneumonia Begin?

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What About "Aspiration Pneumonia?"

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“Aspiration Pneumonia”

Is it different that other forms of pneumonia?



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“Aspiration Pneumonia”

“...nearly all forms of pneumonia are **caused by aspiration.**”



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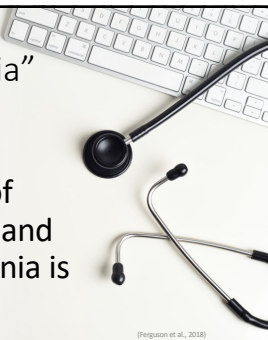
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“Aspiration Pneumonia”

“The pathophysiology of ‘aspiration pneumonia’ and non-aspiration pneumonia is **identical.**”



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### Pneumonia: What We Thought We Knew



- Aspiration of food and liquid results in pneumonia
- Aspiration alone is sufficient for the development of pneumonia
- The lungs do not contain significant microbial life—including known pathogens.

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### Why Doesn't Aspiration Lead to Pneumonia?



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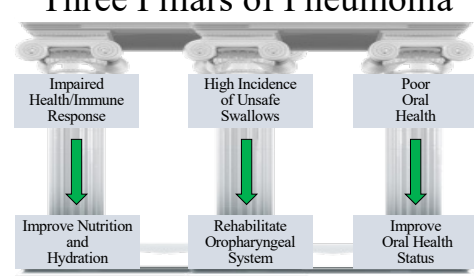
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### Three Pillars of Pneumonia



Impaired Health/Immune Response	High Incidence of Unsafe Swallows	Poor Oral Health
↓	↓	↓
Improve Nutrition and Hydration	Rehabilitate Oropharyngeal System	Improve Oral Health Status

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Pillar 1:  
Impaired  
Immune  
Response



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How  
Impaired?

- Must be significantly impaired.
- But what is significant?

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CVA and  
Immune  
Response

CVA causes overactivation of the sympathetic nervous system that results in significant immunodepression



(Langhorne et al., 2000)

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CVA and Immuno-Suppression

- Most Common Infections Post-CVA
  - 24% developed UTI
  - 22% developed chest infections
  - 19% developed other infections

(Langhorne et al., 2000)

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“...immunodepression by sympathetic hyperactivity is **essential** for progression of bacterial aspiration to pneumonia.”



(Prass et al., 2006)

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Pillar 2: High Incidence of Unsafe Swallows



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Prandial Aspiration and Pneumonia

- Dysphagia is a consistent pattern of behaviors.
- Dysphagia alone is insufficient for the development of pneumonia (Campbell-Taylor, 2008).



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Altered Diets and Thickened Liquids

- Thickened liquids are ordered for up to ¼ of all long-term care residents.
- 30-45% of residents in rehabilitation facilities receive modified diet textures.



(Campbell et al., 2016; Miller et al., 2012)

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Prandial Aspiration and Pneumonia

- “There is **no convincing evidence** to suggest that texture modified foods and thickened liquids benefit adults with dysphagia by preventing pneumonia and its consequences.”



(O’Keeffe, 2018)

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**A Significant Body of Evidence**

- Over 20 rigorous and well-designed studies
- Covering 28 years (since 1996)
- Results continue to agree that aspiration alone is insufficient to develop pneumonia

(Abdelhamid et al., 2016; Alagiakrishnan et al., 2013; Anderson et al., 2013; Bassis et al., 2015; Beck et al., 2017; Bilney et al., 2003; Campbell-Taylor, 2008; Feinberg et al., 1996; Foley et al., 2008; Greeganage et al., 2012; Hanson et al., 2011; Hines et al., 2010; Jones et al., 2016; Knuijt et al., 2011; Loeb et al., 2003; Painter et al., 2017; Sakashita et al., 2014; Speyer et al., 2010; Steele et al., 2015; Thomas, 2008; Vogel et al., 2015)

(O’Keeffe, 2018)

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**Modified Diets: Known Complications**

- **Malnutrition**
  - Dehydration, poor recovery from illness, debilitation, prone to infections
- **Dehydration**
  - Renal failure, constipation, UTI, impaired mental status, respiratory infection, hypotension, delirium, poor recovery from illness, fever
- Interfere with medication absorption
- Slowed digestion/delayed gastric emptying
- Increase economic cost
- Significantly reduced quality of life
  - Patient descriptions: “vile” & “awful”

(Begum, 2010; Cichero, 2013; Mukand, 2003; Nadel, 1980; O’Keeffe, 2018; Swann et al., 2015; Wotton, 2008)

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**Interference with Daily Life**

- “Modified diets are a **more intrusive intervention** than any medication and are widely used in the absence of a high-quality evidence base.”



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Pillar 3: Oral Health



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Oral Cavity



- In **1 cm<sup>3</sup>** of saliva there are roughly **100,000,000** bacterial pathogens
- Aspiration of **0.01 ml** of water, secretions, food, etc., originating the the oral cavity can introduce **1,000,000 – 100,000,000** pathogens into the lower respiratory tract

(Skerrett, 1994; Tobin & Grenvik, 1984)

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A Diverse Microbial Community

- The normal respiratory system extending in its entirety from the nasal and oral cavities to the lung alveoli is considered to be a **single and open ecosystem**.

(Ashford, unpublished; Bassis et al., 2015; Dickson et al., 2016)

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Lung Microbiota

- The microbial composition of the lungs most closely matches what other anatomical region of the body?



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Aspiration: Good or Bad?

“Collectively, these observations support an emerging model that exposure to oral-derived microbiota (notably *Prevotella spp.*) during health is part of *the central homeostatic processes* that regulate pulmonary inflammatory processes.”



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- In other words, micro-aspiration is required to maintain healthy and functioning lungs.



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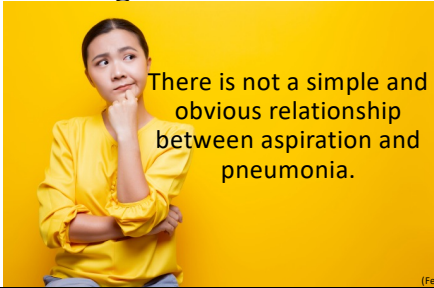
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### Something to Ponder



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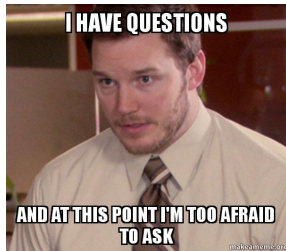
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### Questions?



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### Questions for you

How many liters of saliva does the average person swallow in one day?

The lungs are exposed to \_\_\_\_ (how many) liters of unfiltered air each day?

(Kaufman et al., 2007)

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