

2019-nCoV Wuhan Coronavirus

A new contagious CORONAVIRUS has emerged from a large food market in Wuhan, China, that has fish, birds and live animals.

This virus is transmissible person to person.

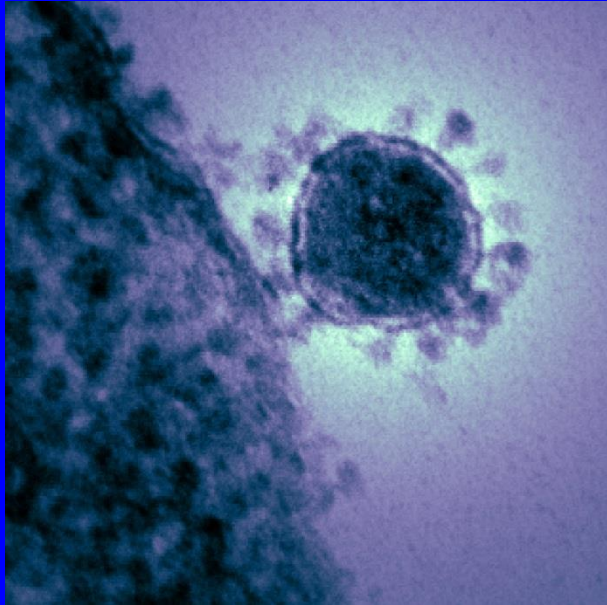
China has 9,783 confirmed cases and 213 deaths as of 31.January 2020.

Furthermore, it has spread quickly across borders to North America, Australia and Europe.

This talk will review prominent medical and public health features of this new viral pandemic termed “a public health emergency of global concern” by the World Health Organization (WHO).

2019 n-CoV

Wuhan Coronavirus



Flipper died *a natural death, he caught a nasty virus*

Then there was the ever present football player-rapist
They were all in love with dyin', they were doin' it in Texas

Paulie caught a bullet, but it only hit his leg
Well, it should have been a better shot, and got him in the head
They were all in love with dyin', they were drinkin' from a fountain

That was pourin' like an avalanche comin' down the mountain
I don't mind the sun sometimes, the images it shows

I can taste you on my lips and sme0ll you in my clothes

Cinnamon and sugary and softly spoken lies

You never know just how you look through other people's eyes

Marky got with Sharon, Sharon got Sherice
She was sharin' Sharon's outlook on *the topic of disease*

Mikey had a facial scar, and Bobby was a racist

They were all in love with dyin', they were doin' it in Texas

Tommy played piano like a kid out in the rain

Then he lost his leg in Dallas, he was dancin' with a train

They were all in love with dyin', they were drinking from a fountain

That was pourin' like an avalanche comin' down the mountain

I don't mind the sun sometimes, the images it shows

I can taste you on my lips and smell you in my clothes

Cinnamon and sugary and softly spoken lies

You never know just how you look through other people's eyes

Some will die in hot pursuit in fiery auto crashes

Some will die in hot pursuit while sifting through my ashes

Some will fall in love with life and drink it from a fountain

That is pouring like an avalanche comin' down the mountain

I don't mind the sun sometimes, the images it shows

I can taste you on my lips and smell you in my clothes

Cinnamon and sugary and softly spoken lies

You never know just how you look through other people's eyes

Another Mikey took a knife while arguing in traffic

Lyrics by PEPPER by Butthole Surfers

Science Circle Saturday 1.February 2020

Robert A. Hendrix, MD

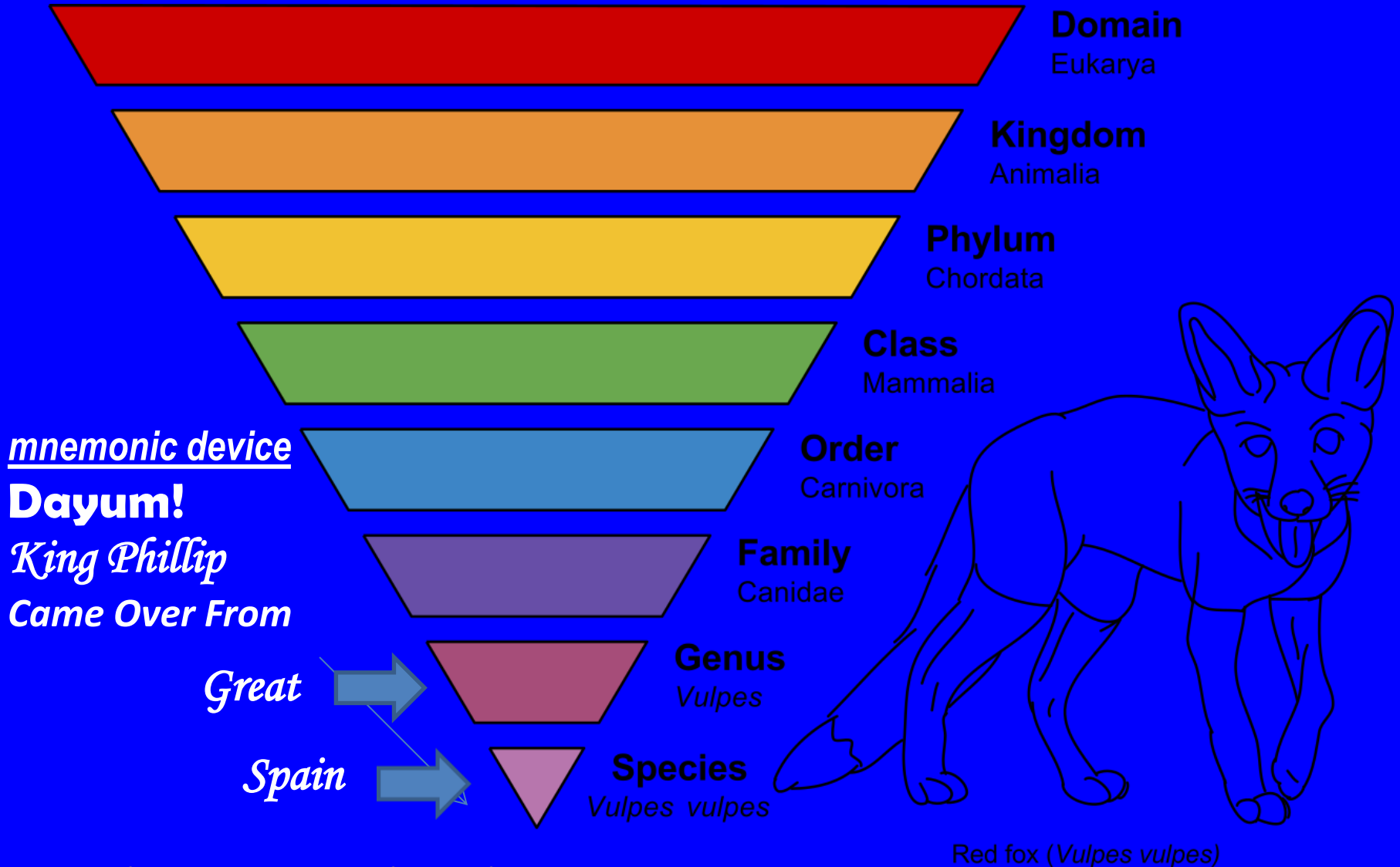
2019-nCoV Wuhan Coronavirus

The pneumonia-causing virus,
which is spreading rapidly in China and
beyond, is currently being identified as

2019-nCoV

shorthand for a **novel or new** (i.e. “n”) **coronavirus (CoV)** that was first detected
in December **2019**

TAXONOMIC RANK KPCOFGS



File:Taxonomic Rank Graph.svg

By Annina Breen - Own work, Creative Commons (CC) BY-SA 4.0,
<https://commons.wikimedia.org/w/index.php?curid=40559754>

VIRUSES THAT CAN CAUSE DISEASE IN THE AERODIGESTIVE TRACT

Table 1. Viral Families and Genera
From
VIRUSES OF THE UPPER RESPIRATORY TRACT
book chapter by Robert A. Hendrix, M.D.
In Chapter 47 of ***Otolaryngology*** Vol.2 (1993)
Gerald M. English, M.D., editor
J.B. Lippincott Company, Philadelphia

VIRUSES OF THE UPPER RESPIRATORY TRACT

Chapter 47

TABLE 1. Viral Families and Genera

	Unenveloped	Enveloped
RNA Viruses		
Genome		
Positive-sense, single-stranded, nonsegmented	Picornaviridae* Rhinovirus† Enterovirus Echovirus† Coxsackievirus† Poliovirus Hepatitis A	Coronaviridae* Coronavirust
Negative-sense, single-stranded, nonsegmented		Paramyxoviridae* Paramyxovirus Parainfluenza virus† Mumps virus Newcastle disease Morbillivirus Measles-rinderpest-distemper Pneumovirus Respiratory syncytial virus†
Negative-sense, single-stranded, segmented		Orthomyxoviridae* Influenza virus Influenza A and B† Influenza C
DNA Viruses		
Genome		
Double-stranded, nonsegmented	Adenoviridae* Mastadenovirust h1-h49†	Herpesviridae Subfamilies: Alpha herpesvirinae Herpes simplex 1 and 2 Varicella-zoster virus Beta herpesvirinae Cytomegalovirus Gamma herpesvirinae (lymphocryptovirus) Epstein-Barr virus
Double-stranded, circular DNA	Papovaviridae Papillomavirus Polyomavirus	

* Families containing common cold virus.
† Common cold viruses.

The David **BALTIMORE CLASSIFICATION of VIRUSES**

Based on method of viral genome and mechanism of viral m-RNA replication

I: dsDNA viruses

(e.g. Human Papillomavirus, **Adenoviruses**, Herpesviruses, Poxviruses)

II: ssDNA viruses (+ strand or "sense") DNA

(e.g. Parvoviruses)

III: dsRNA viruses

(e.g. Reoviruses)

IV: (+) ssRNA viruses (+ strand or sense *like m-rna*) RNA



Replication in **positive-strand RNA** viruses is via a **negative-strand** intermediate.

(e.g. Coronaviridae, Picornaviruses incl **Rhinovirus**, etc.)



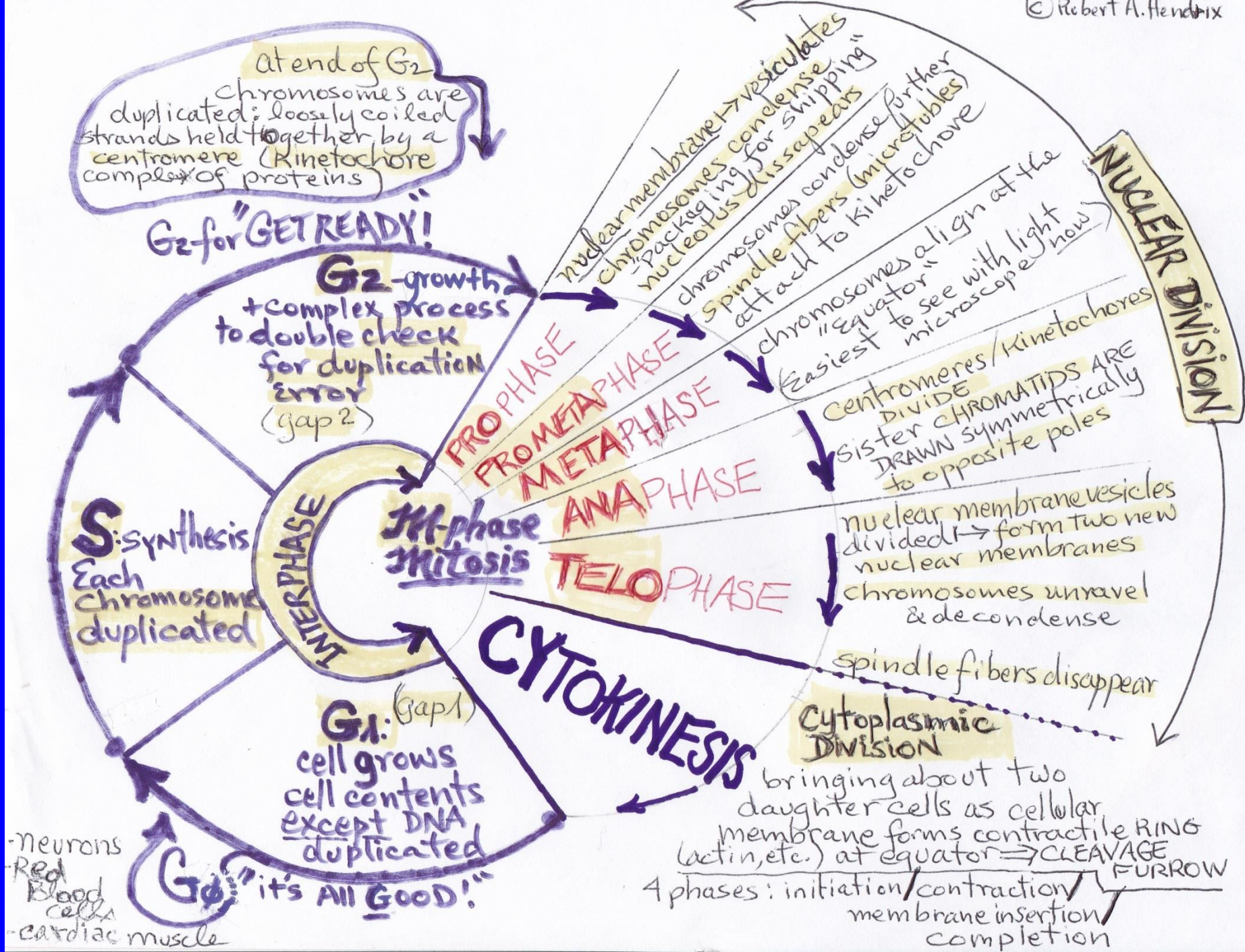
V: (–)ssRNA viruses (– strand or antisense) RNA

(e.g. Orthomyxoviruses incl **Influenza** , Paramyxoviruses incl **Parainfluenza**,
Rhabdoviruses, Orthohantavirus)

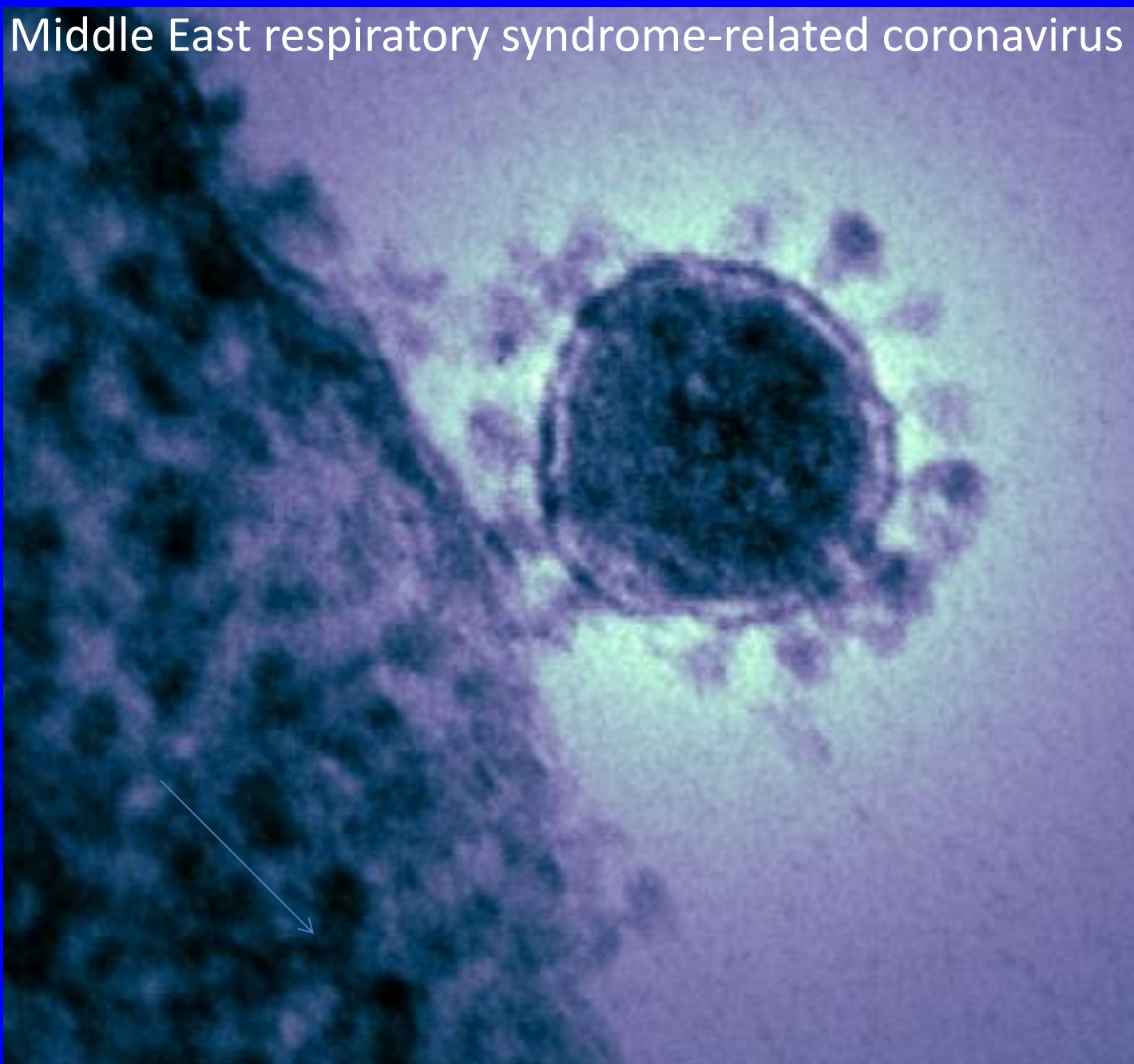
VI: ssRNA-RT viruses (+ strand or sense) RNA with DNA intermediate in life-cycle

(e.g. Retroviruses)

VII: dsDNA-RT viruses DNA with RNA intermediate in life-cycle (e.g. Hepadnaviruses)



MERS – Middle East respiratory syndrome-related coronavirus



National Institute of Allergy and Infectious Diseases (NIAID), National Institutes of Health (NIH) 19.Nov 2012

https://commons.wikimedia.org/wiki/File:Middle_East_respiratory_syndrome-related_coronavirus.jpg

ACUTE RESPIRATORY DISTRESS SYNDROME

RESPIRATORY FAILURE of sudden onset in adults or children
that **FOLLOWS INJURY** to the **ENDOTHELIUM** of the lung

- sepsis
- chest trauma
- massive blood transfusion
- aspiration of the gastric contents
- pneumonitis

and results in

ACCUMULATION of protein-rich **FLUID** in airspaces of the lung

- collapse of alveoli

leading to

- difficult, rapid breathing (**DYSPNEA**)
- very **LOW LEVELS OF OXYGEN** in the blood (**hypoxia**)



EPIDEMIOLOGY of ACUTE RESPIRATORY DISTRESS SYNDROME

Estimates of the **incidence of ARDS** in the United States range from 64.2 to 78.9 cases/100,000 person-years.

Classification of ARDS cases at INITIAL PRESENTATION:

25%	MILD
75%	MODERATE TO SEVERE

However, a third of the mild cases go on to progress to moderate or severe disease.

A literature review \Rightarrow mortality decrease of 1.1% per year from 1994 through 2006.

*However, the overall pooled mortality rate **43%** for all the studies evaluated.*

MORTALITY of ARDS is commensurate to the severity of the disease:

27% MORTALITY for MILD disease

32% MORTALITY for MODERATE disease

45% MORTALITY for SEVERE disease

.....

Matthew Diamond; Hector L. Peniston Feliciano, et.al.: **Acute Respiratory Distress Syndrome (ARDS)**; StatPearls Publishing; 2020 Jan-. <https://www.ncbi.nlm.nih.gov/books/NBK436002/>

BETACORONAVIRUS EPIDEMICS – ZOONOSIS

SARS = SEVERE ACUTE RESPIRATORY SYNDROME

severe respiratory illness that is caused by a

coronavirus (**SARS-CoV** of genus *Betacoronavirus*)

- transmitted especially by CONTACT with infectious material (such as RESPIRATORY DROPLETS or body fluids), and is characterized by: fever, headache, body aches, a dry cough, hypoxia, and usually PNEUMONIA.

MERS = MIDDLE EASTERN RESPIRATORY SYNDROME, a.k.a. “CAMEL FLU”

is caused by a coronavirus: species *Middle East respiratory syndrome coronavirus* of the genus *Betacoronavirus*)

related to the causative virus of SARS. The first cases of MERS appeared in Saudi Arabia and most cases originate from countries in or near the Arabian Peninsula.

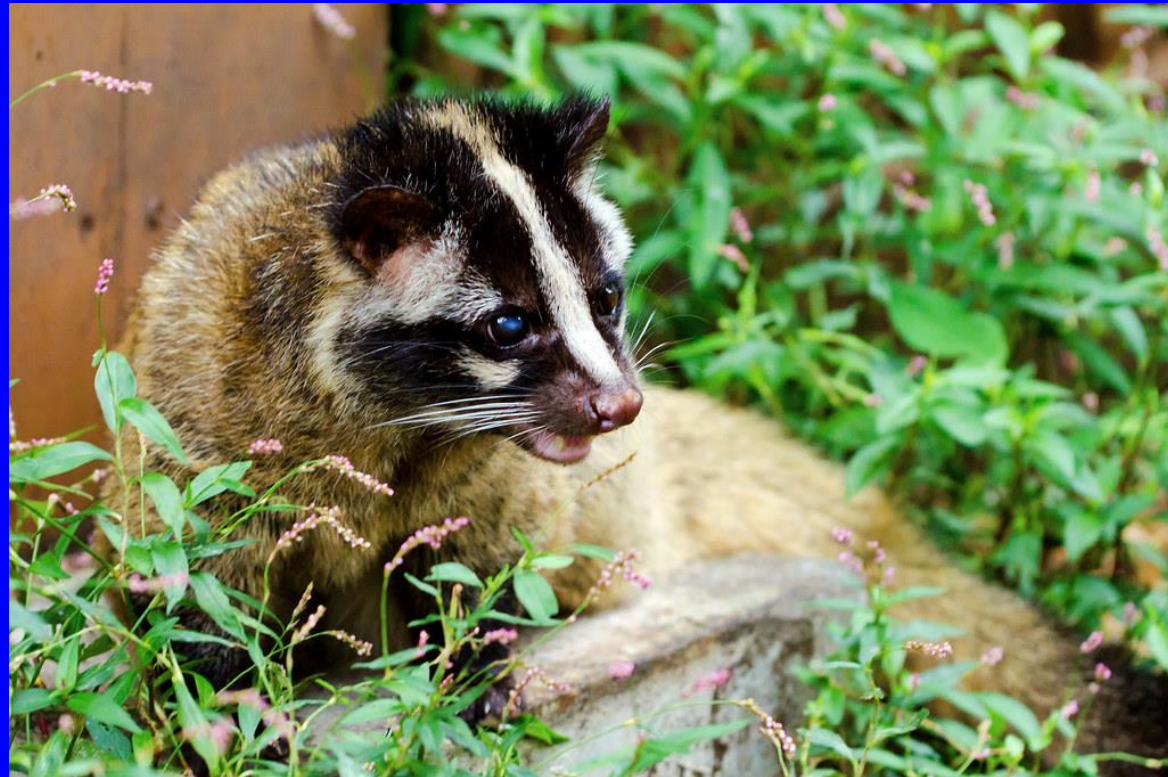
2019 n-CoV

BETACORONAVIRUS EPIDEMICS – ZOONOSIS

SARS is considered a zoonotic disease:

- believed to have originated in Chinese horseshoe bats;
- virus was then transmitted to civets, small cat-like mammals that are sometimes trapped and eaten in some parts of China.

*Humans may have first acquired SARS from civets through exposure to their blood or organs during butchering or food preparation. However, at some point the SARS virus became capable of being transmitted from human to human via **respiratory secretions**.*



BETACORONAVIRUS EPIDEMICS – ZOONOSIS

SARS is considered a zoonotic disease.

It is believed to have originated
in Chinese horseshoe bats.

Rhinolophus sinicus

Rufous Horseshoe Bat
(*Rhinolophus rouxii*)

Aditya Joshi 3.July 2012

https://commons.wikimedia.org/wiki/File:Rhinolophus_rouxii.jpg



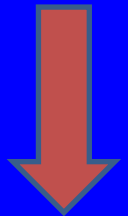
BETACORONAVIRUS EPIDEMICS – ZOONOSIS

MOLECULAR PHYLOGENICS of SARS

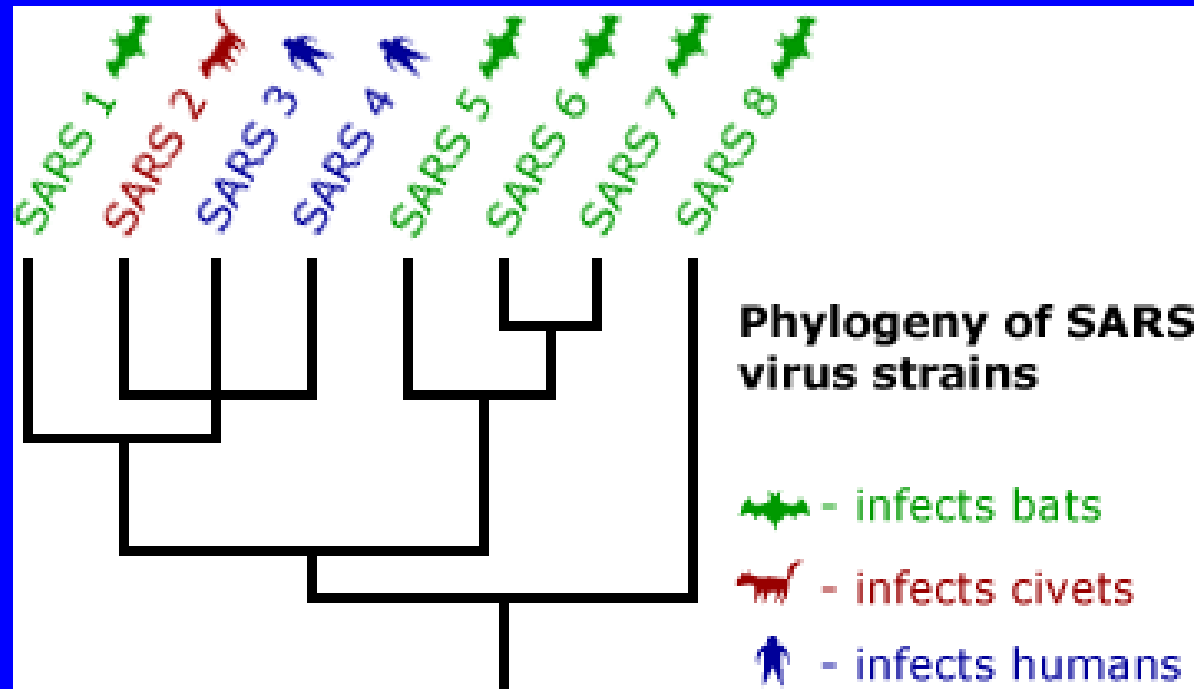
Biologists collected samples of the **SARS viral RNA** from different sources:

- infected humans
- infected civets
- different species of infected horseshoe bat

The RNA was then
copied,
sequenced,



used to build a phylogeny
or evolutionary tree.



Tracking SARS back to its source

https://evolution.berkeley.edu/evolibrary/news/060101_batsars

SARS = SEVERE ACUTE RESPIRATORY SYNDROME

Liver damage of patients with SARS usually occurs in the early stage of the disease with a high occurrence rate and a prolonged profile characterized by early, obvious decrease of albumin levels and slightly abnormal levels of ALT. The liver damage induced by SARS seems to be ***caused by SARS virus directly*** rather than by low SaO₂ or high fever.

Yang Z, Xu M, et.al.: Clinical characteristics and mechanism of liver damage in patients with severe acute respiratory syndrome. Hepatobiliary Pancreat Dis Int. 2005 Feb;4(1):60-3.
<https://www.ncbi.nlm.nih.gov/pubmed/15730921>

.....

cardiovascular complications including hypotension and tachycardia were common but usually self limiting.

Bradycardia and cardiomegaly were less common, while cardiac arrhythmia was rare.

No patient developed clinical features of heart failure and cardiomegaly was reversible.

C-M Yu, R S-M Wong, et.al.: Cardiovascular complications of severe acute respiratory syndrome; Postgrad Med J. 2006 Feb; 82(964): 140–144.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2596695/#__ffn_sectitle

SARS = SEVERE ACUTE RESPIRATORY SYNDROME & KIDNEY DAMAGE

Acute renal impairment is uncommon in SARS (36 of 536 patients = 6.7%) but carries a high mortality.

The acute renal impairment is likely to be related to ***multi-organ failure*** rather than the kidney tropism of the virus.

The development of acute renal impairment is an important ***negative prognostic indicator for survival*** with SARS.

.....
Chu KH, Tsang WK, et.al.: **Acute renal impairment in coronavirus-associated severe acute respiratory syndrome.** Kidney Int. 2005 Feb;67(2):698-705.

<https://www.ncbi.nlm.nih.gov/pubmed/15673319>

definition

ACUTE TUBULAR NECROSIS of the KIDNEYS =

Acute tubular necrosis (ATN) is a kidney disorder involving damage to the tubule cells of the kidneys – one of the most common causes of acute kidney failure (ARF). *- note: R for Renal in ARF*

Liver disease and kidney damage caused by diabetic nephropathy can predispose to development of ATN

 ***MORTALITY = 50 – 70% or up to 80% with ARDS***

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The pattern of injury that defines acute tubular necrosis includes renal tubular cell damage and death.

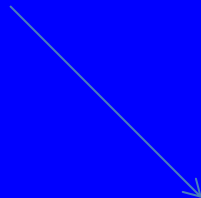
Intrarenal vasoconstriction or hypotension ≥ 30 min (ISCHEMIC ATN) or a direct effect of drug toxicity (NEPHROTOXIC ATN) is caused by an ischemic event, nephrotoxic mechanism, or a mixture of both

definition

CLADE /klād/(rhymes with blade) - **also known as monophyletic group**

- **a group of organisms that consists of a COMMON ANCESTOR and all its lineal descendants, and represents a "SINGLE BRANCH" ON the TREE OF LIFE.**

Rather than the English term, the equivalent Latin term "cladus" is often used in taxonomical literature



example: "the great ape and human clade"

MOLECULAR PHYLOGENICS of MERS

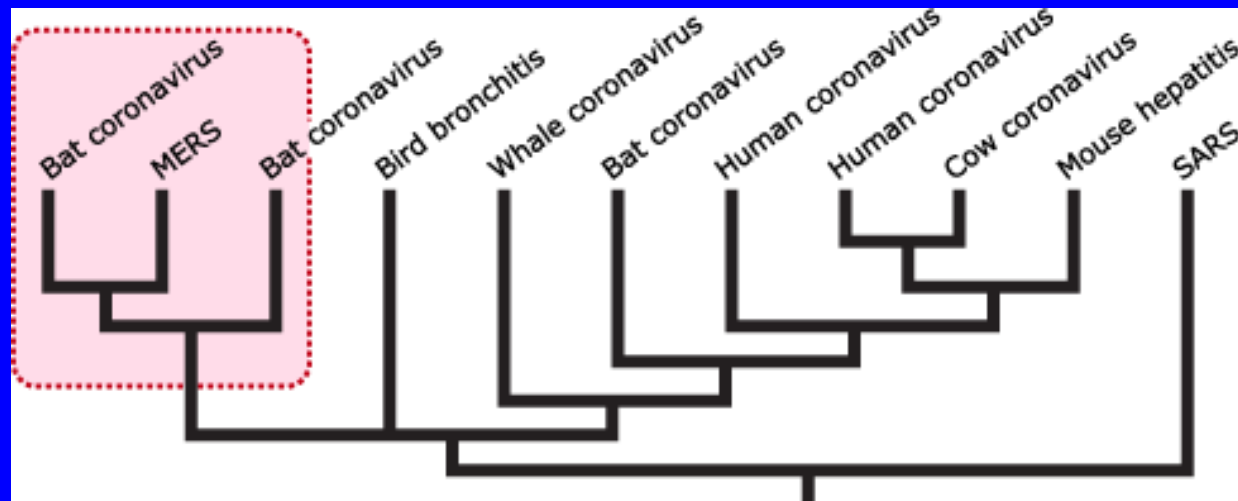
- sequenced part of a critical gene in the MERS genome,
- compared this with the corresponding sequence in other coronaviruses
- used the data to construct a tree showing how all the viruses are related.

MERS forms a tight knit CLADE with several coronaviruses native to BATS.

Some scientists suspect that people may have first been infected with MERS by eating dates that bats had contaminated ... that is far from certain.

Researchers have taken samples from more than 200 animals (including bats and other potential suspects such as cats and camels) but have not turned up any viruses that precisely match the MERS virus.

More research will be needed to confirm if bats are the original source of MERS



Tracking SARS back to its source

https://evolution.berkeley.edu/evolibrary/news/060101_batsars

CAMELS ARE SUSPECT in MERS

– a.k.a., „Camel Flu“

- yet, it still appears to have arisen originally from bats

WHO advises:

avoid contact with camels;
eat only fully cooked camel meat,
pasteurized camel milk;
avoid drinking camel urine.



*Camel urine is
considered a medicine
for various illnesses in the Middle East.*

BASIC REPRODUCTION NUMBER $R_0 \equiv$ „R-naught“

the expected number of secondary cases produced by a single (typical) infection in a completely susceptible population.

- critical pandemic threshold of $R_0 > 1$

$$R_0 \propto (\text{infection/contact}) \cdot (\text{contact/time}) \cdot (\text{time/infection})$$

or

$$R_0 = \tau \cdot \bar{c} \cdot d$$

τ = transmissibility

i.e., **probability of infection given contact between a susceptible and infected individual**

\bar{c} = **average rate of contact** between susceptible and infected individuals;

d = duration of infectiousness.

*- important note: R_0 is a dimensionless number
and NOT a rate, which would have units of time^{-1}*

BASIC REPRODUCTION NUMBER $R_0 \equiv$ „R-naught“

Highly contagious measles, in comparison, has

R_0 from 12 to 18

One kid with measles will on average, infect 12 to 18 other kids

1 in 20 with measles will get pneumonia = most common cause of DEATH;

3 in 1000 with measles die of respiratory or neurological complications

1 in 1000 with measles can get ENCEPHALITIS

– can cause permanent mental handicap

Measles can also cause permanent sensori-neural (inner ear) hearing loss.

Surely you would get a distemper shot for your dog.

Canine Distemper virus is a possible zoonotic origin of Measles.

Don't be a stubborn, misguided menace to society,

possibly to the regretful detriment of your own family.

Get your kids immunized.

R_0 and CASE FATALITY RATIOS (CFR)

<i>VIRUS</i>	cases	R_0	DEATHS
<i>SARS</i> <i>16.Nov 2002 Guangdong province, which borders Hong Kong</i> <i>Last known case 18.May 2004</i>	> 8000	2 - 5	774 14 – 15 %
<i>MERS</i> <i>April 2012 in Jordan</i> <i>spread is uncommon outside of hospitals</i> <i>Sporadic cases still occurring</i>	2494	≤ 1	858 up to 36%
<i>2019 n-CoV</i> (as of 31.Jan2020)	9,836	2.0 – 3.1	218
<u>SPANISH FLU</u> PANDEMIC of 1918	500 million (1 in 3 Earthlings)	1.4 - 2.8	50 million 8 – 10 %

Miscellaneous comments:

For 2019 n-CoV, SARS is probably the best previous model.

WHO continues to conclude that the current best estimate of the maximum incubation period is 10 days for **SARS**.

*CDC recommends health care providers taking care of contagious viruses such as 2019 n-CoV to wear clean gowns, gloves & mask **, with standard precautions including WASHING HANDS.*

An **N95 respirator mask** 
RESPIRATORY PROTECTIVE DEVICE
designed to achieve a very close facial fit
and very efficient filtration of airborne particles.

The '**N95**' designation
⇒ when subjected to careful testing,
the **respirator** blocks at least **95** percent
of very small (0.3 micron) test particles.



LUNG ANATOMY & FUNCTION

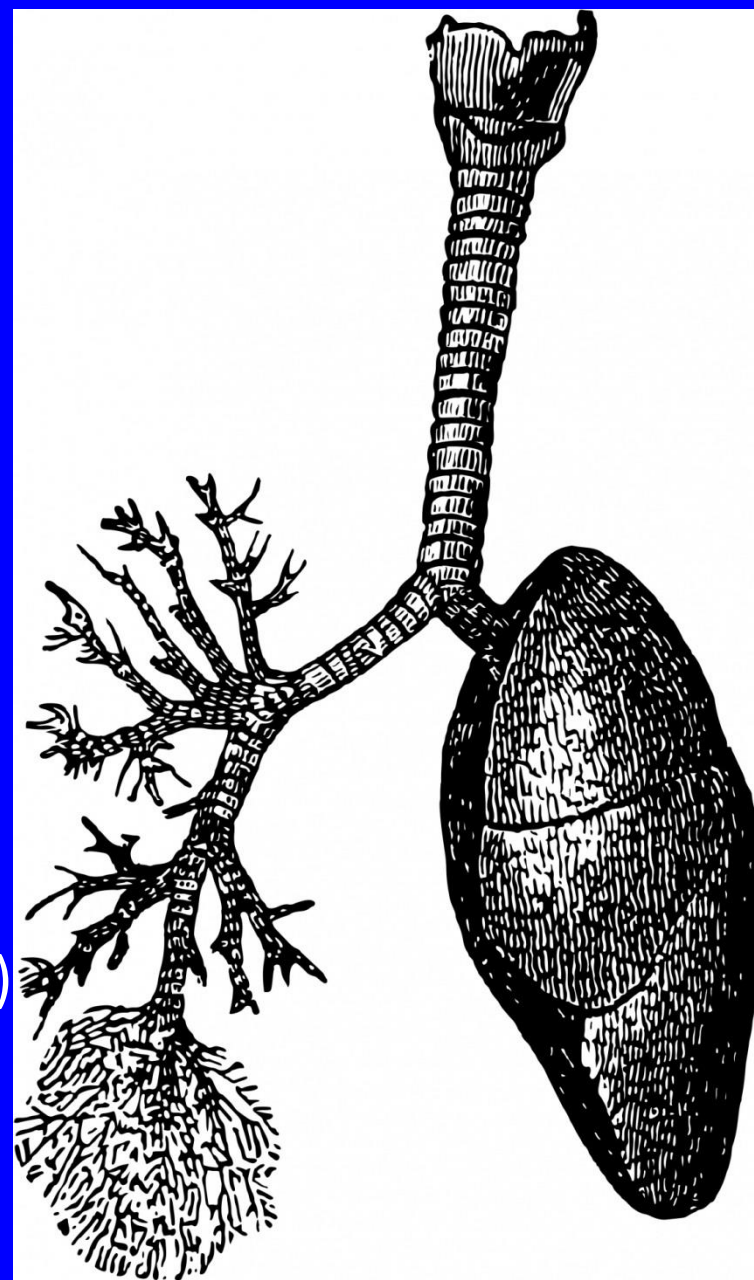
PAIRED ORGAN:

Right Lung has 3 lobes

Left Lung has 2 left lobes

- lined by respiratory cells
of *endodermal origin*
- *circulatory & smooth muscle*
components of mesodermal origin

*Similar to models of the respiratory tree
made using WOOD'S METAL*
a eutectic, fusible alloy with
melting point approximately 70 °C (158 °F)
consisting of: 50% bismuth, 26.7% lead,
13.3% tin, and 10% cadmium by weight).



TRACHEO-BRONCHIAL TREE - from top down: Larynx;

trachea to bifurcation at carina;
left & right primary bronchi branch
to **SECONDARY BRONCHI** for

RIGHT

- superior, middle & inferior lobes

LEFT

- superior & middle lobes;

These branch into **tertiary bronchi**

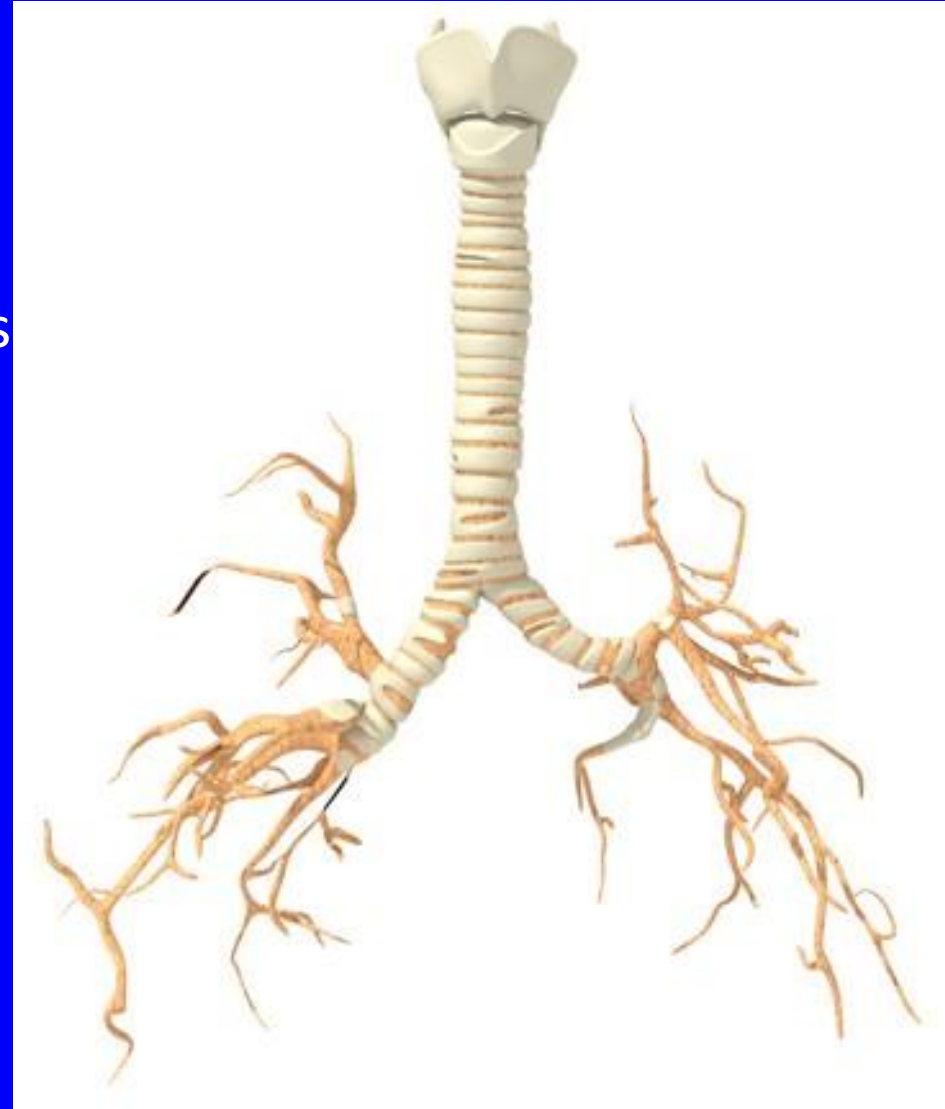
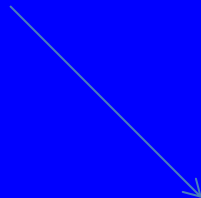


Illustration of the bronchial tubes with bronchial branches -

www.medicalgraphics.de

creative commons CC BY-ND 3.0

IF YOU WISH TO UNDERSTAND BETTER
HOW MAMMALIAN LUNGS ARE FORMED BEFORE BIRTH,
HERE ARE THREE EXCELLENT, SHORT VIDEOS ON **EMBRYOLOGY**:

The Process of Gastrulation in which the bilaminar embryonic disc undergoes reorganisation to form three primary germ layers.

- Primal Pictures - 3D Human Anatomy
- <https://www.youtube.com/watch?v=ADlYn0ImTNg>

Embryology of the Lungs (Easy to Understand) - Dr. Minass,
- Dr. Minas Mastrominas, MD, PhD., Embryogenesis IVF Unit Athens, Attica, Greece
<https://www.youtube.com/watch?v=cC2hWizvWa4>

The Five Stages of Fetal Lung Development

- Alison Falck, MD  [NICUniversity.org](https://www.nicuniversity.org)
- NICUniversity is a Web-based medical education center for Physicians, Nurse Practitioners, Nurses, Respiratory Therapists, and Pharmacists. We offer continuing education credits through the Accreditation Council for Continuing Medical Education (ACCME).

<https://www.youtube.com/watch?v=-jjvBNNMY0A>

LUNG ANATOMY & FUNCTION

BRONCHOPULMONARY SEGMENTS = the largest functional divisions of the anatomical lobes; each receiving their own air and blood supply.

There are 10 on the right & 8-9 on the left.


The left & right main bronchus (pl. bronchi)

RIGHT is *wider, shorter than the left*

LEFT is *thinner, longer and more oblique than the right*

The primary bronchi divide into two secondary bronchi or lobar bronchi, to deliver air to:

- two lobes (superior & inferior) of the left lung
- three lobes superior, inferior & middle lobe of the right lung.

The secondary bronchi divide further into tertiary bronchi, (also known as segmental bronchi), each of which supplies a bronchopulmonary segment.

Surfactant – Macromolecular complex of phospholipids and hydrophobic proteins present in alveoli that decreases surface tension and prevents alveolar collapse during exhalation. Largest lipid components are **phosphatidylcholine** (lecithin) and **phosphatidylglycerol**

Type I ALVEOLAR cell (pneumocyte) – found in the airways and alveoli

Type II ALVEOLAR cell (pneumocyte) – site of production of surfactant

Lamellar bodies – inclusions in Type II cells where surfactant is stored.
Also known as inclusion bodies

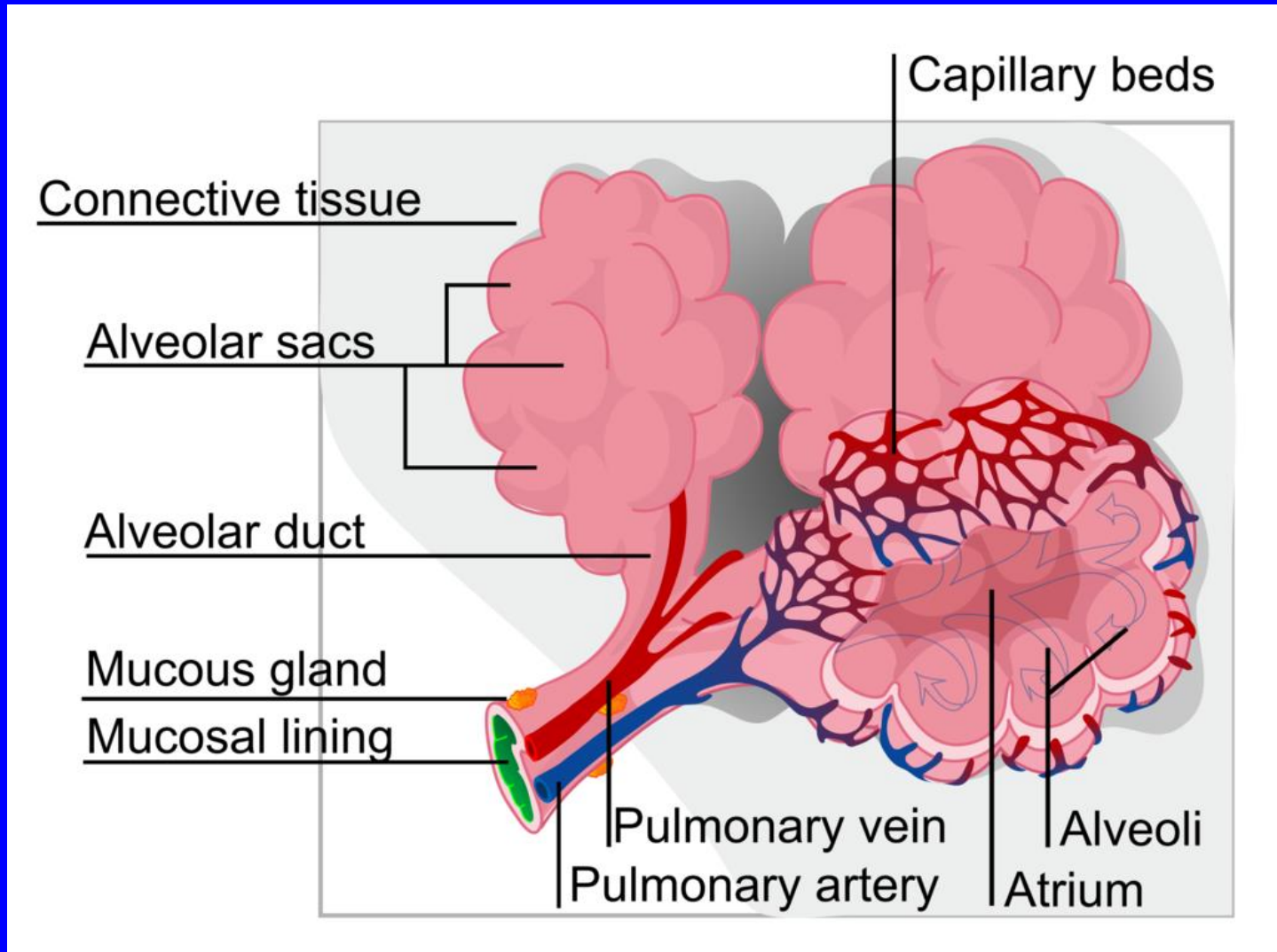
Conducting airways – trachea, mainstem bronchi, terminal bronchioles

Acinus – the unit of respiratory function distal to the terminal bronchioles (BRONCHOPULMONARY SEGMENTS),
comprising the respiratory bronchioli, the alveolar ducts and the alveoli

.....
Peter Rothstein, MD: LUNG DEVELOPMENT - GLOSSARY

<http://www.columbia.edu/itc/hs/medical/humandev/2004/Chpt12-LungDev.pdf>

ALVEOLUS (plural: alveoli, from Latin alveus, "little cavity"), is an anatomical structure that has the form of a hollow cavity. Mainly found in the lung, the pulmonary alveoli are spherical outcroppings of the respiratory bronchioles and are the primary sites of gas exchange with the blood.



NORMAL ALVEOLAR SPACES:

The typical representation of the acinus as a “bunch of grapes” bears no resemblance to its real anatomy; the alveoli are not independent little balloons.

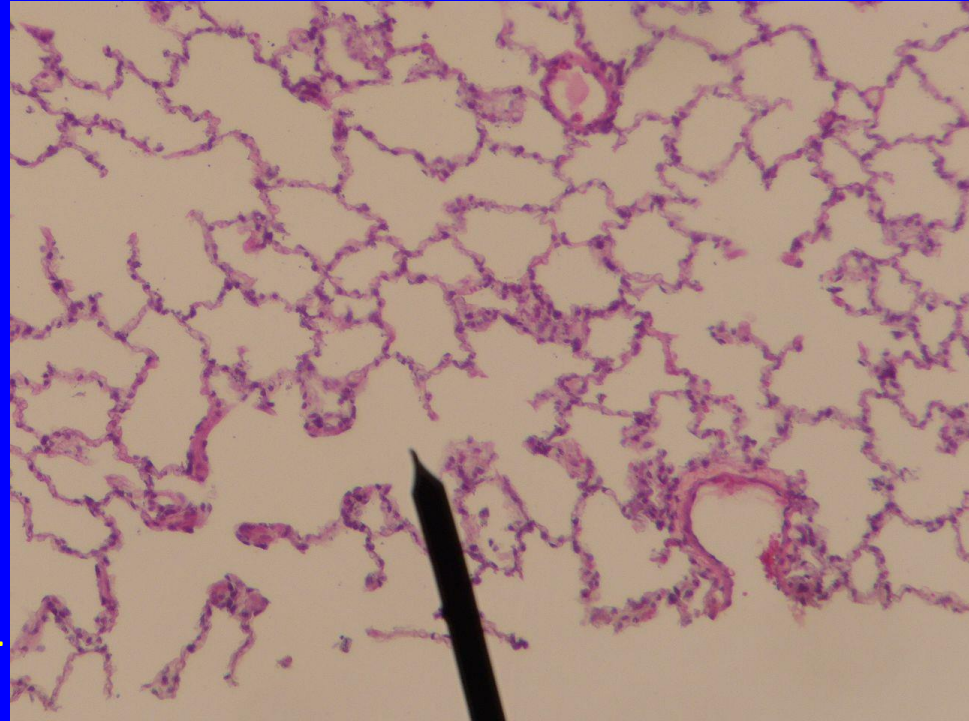
Alveoli are *prismatic or polygonal* in shape, i.e., their walls are flat.

Laplace law considerations in their inflation apply only to the very small curved region in the fluid where these walls intersect.

Alveoli do not readily collapse

into one another because they are suspended in a matrix of connective tissue “cables”

and share common, inter-alveolar perforations in their walls, so there can be no pressure differential across them.



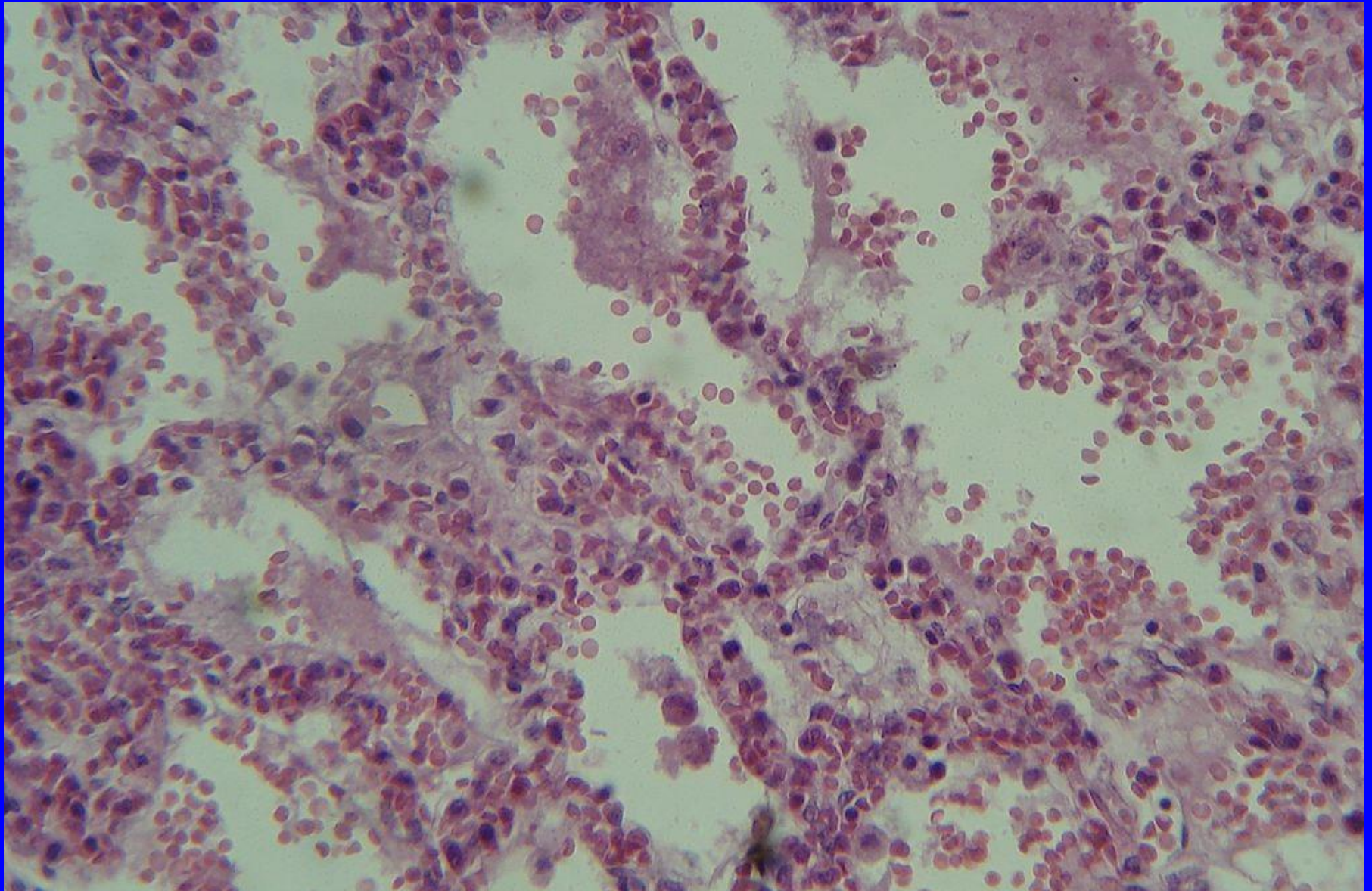
Henry D. Prange (Indiana University):
LAPLACE'S LAW AND THE ALVEOLUS: A
MISCONCEPTION OF ANATOMY AND A
MISAPPLICATION OF PHYSICS;

Advances in Physiology Education Vol. 27, No. 1;
<https://www.physiology.org/doi/full/10.1152/advan.00024.2002>

Image above:
NORMAL PULMONARY HISTOLOGY
by Jpogi 29.November 2006

https://commons.wikimedia.org/wiki/File:Alveolar_duct2.JPG

PATHOLOGY of ACUTE RESPIRATORY DISTRESS SYNDROME:



Micrograph of diffuse alveolar damage, the histologic finding of **acute respiratory distress syndrome (ARDS)**. Original magnification 400x

by Strolch 2.December 2006 https://commons.wikimedia.org/wiki/File:Alveolar_duct2.JPG

“there is no question that some forms of Laplace’s law and the properties of pulmonary surfactant are important for understanding the mechanics of the lung.

However, the suggestion that alveolar mechanics is related at all to Laplace’s law of elastic spheres is simply wrong.

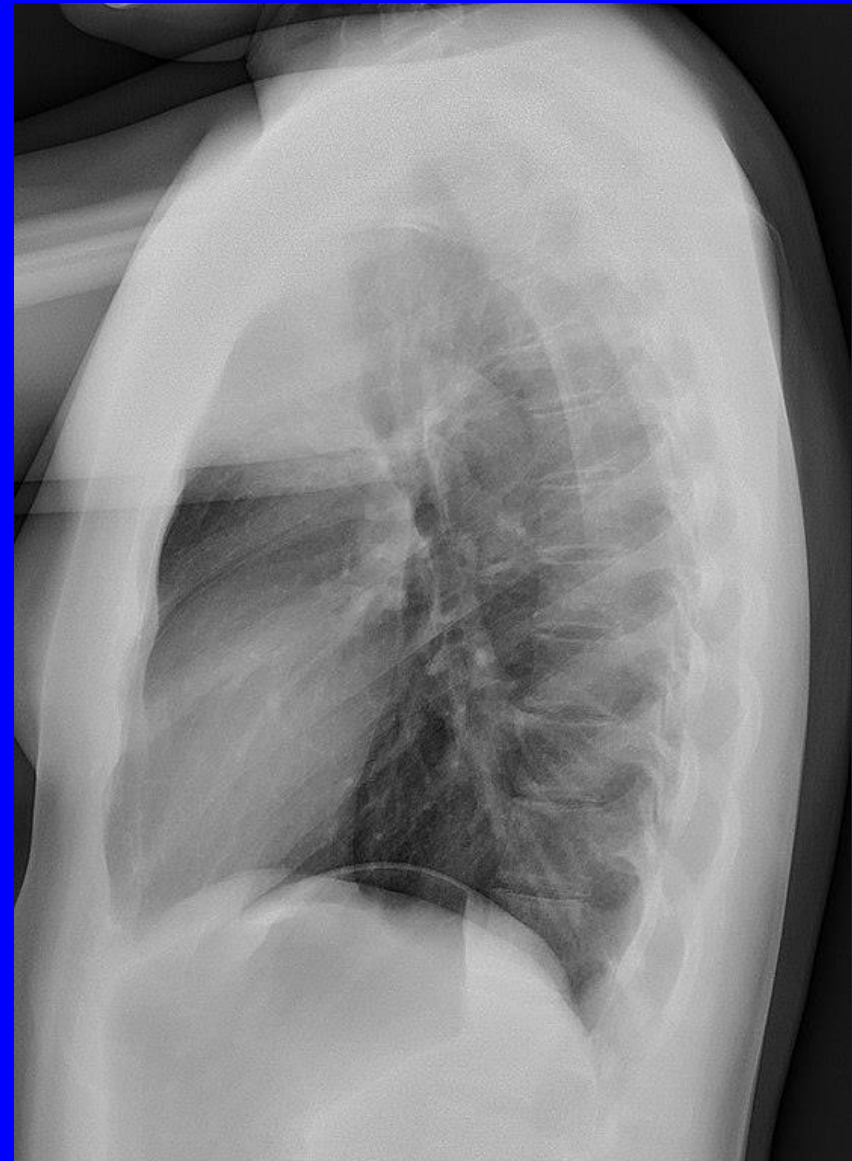
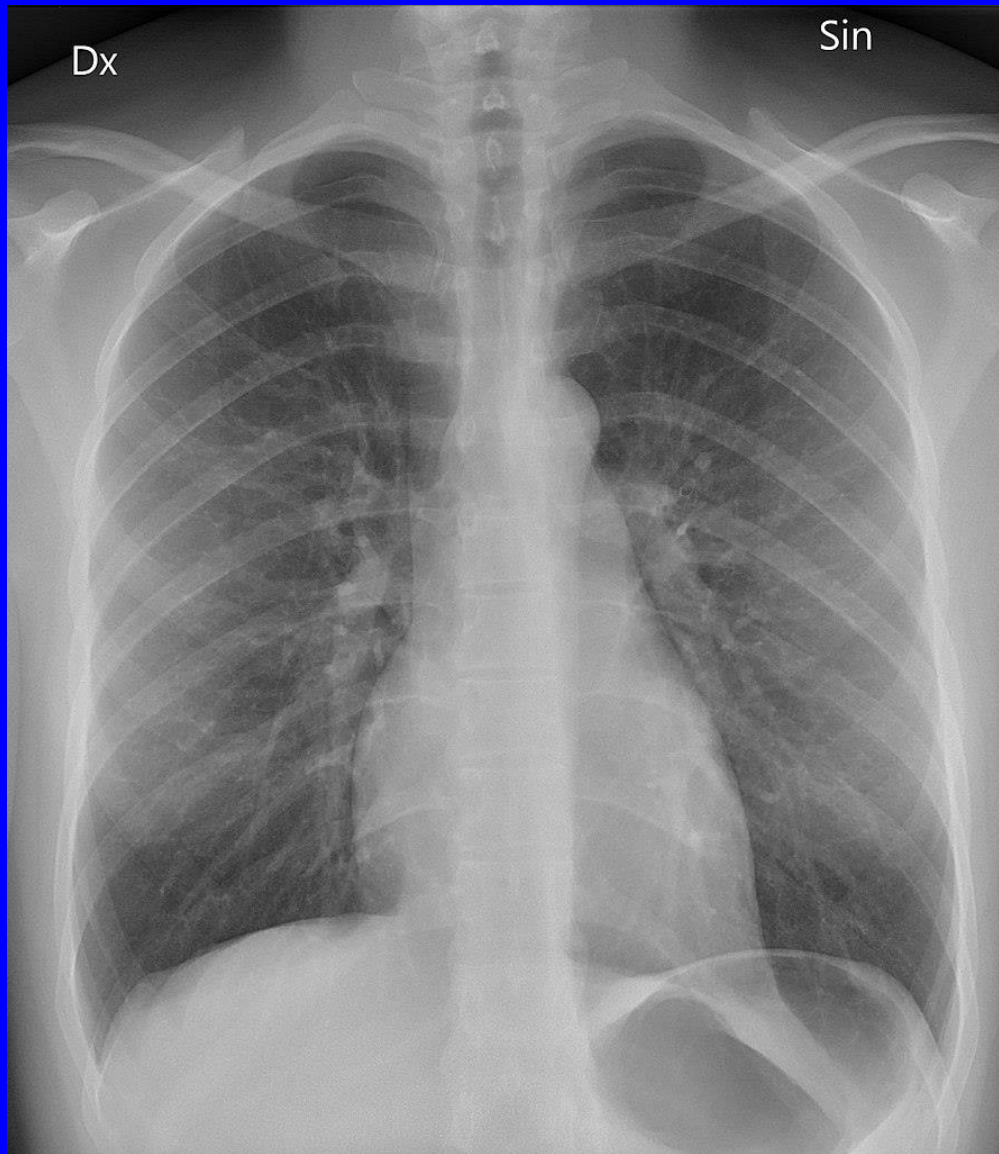
The opening and closing of the small airways account for many of the properties of whole lung mechanics that were once attributed to opening and closing of alveoli.

It is time we understood that the Y-tube model of the alveolar inflation and the bunch-of-grapes model of alveolar anatomy deserve a place, not in our minds and textbooks, but in the museum of wrong ideas.”

- Henry D. Prange

Henry D. Prange (Indiana University): LAPLACE’S LAW AND THE ALVEOLUS: A MISCONCEPTION OF ANATOMY AND A MISAPPLICATION OF PHYSICS; Advances in Physiology Education Vol. 27, No. 1; <https://www.physiology.org/doi/full/10.1152/advan.00024.2002>

NORMAL CHEST RÖNTGENGRAPH: CXR posterior-anterior & lateral

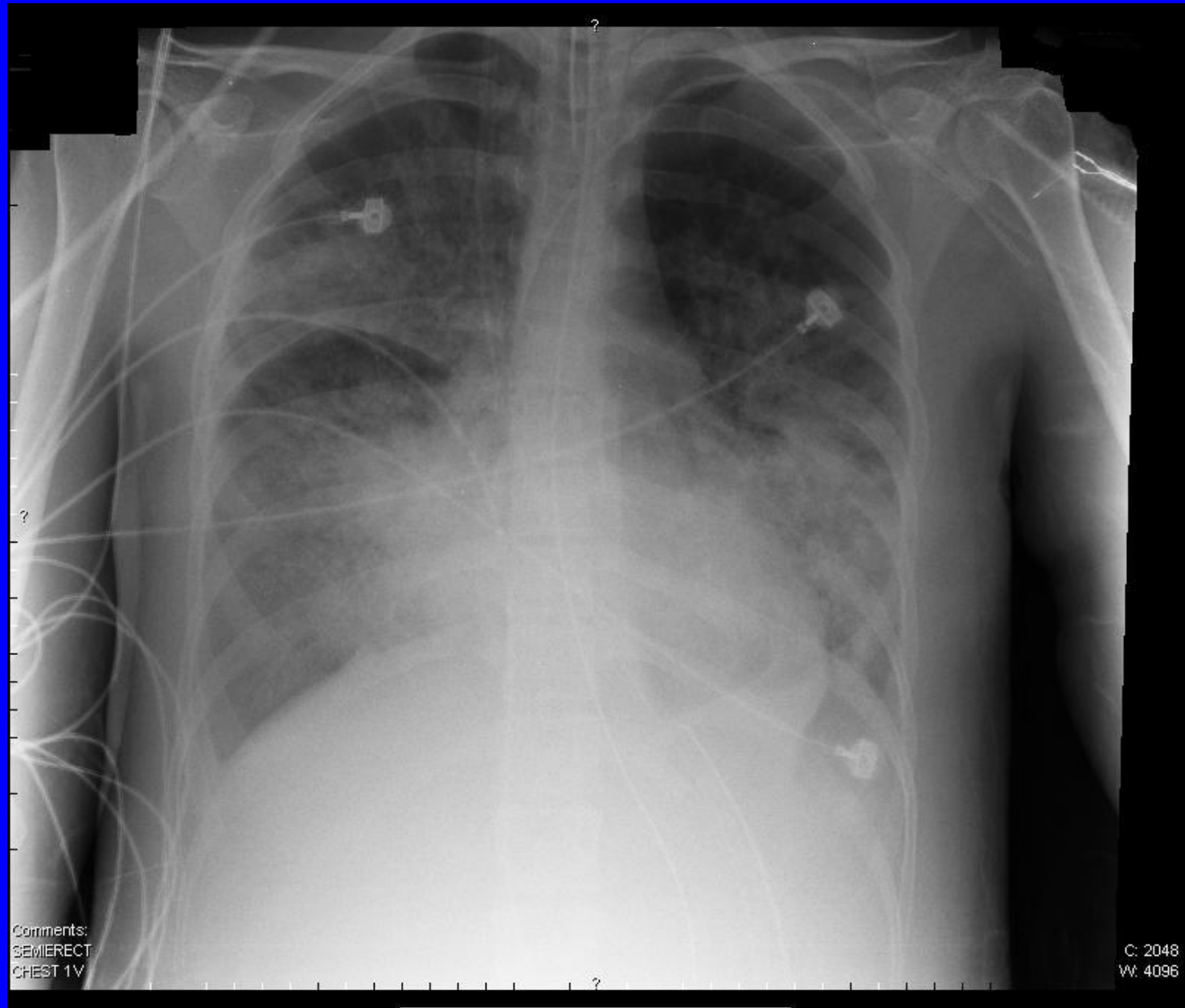


21-year-old woman with left-sided pain in thorax after colliding with another player during soccer game. It shows a normal chest without any signs of injury.

Dx and Sin stand for "right" and "left" respectively (28.June 2017) Mikael Häggström

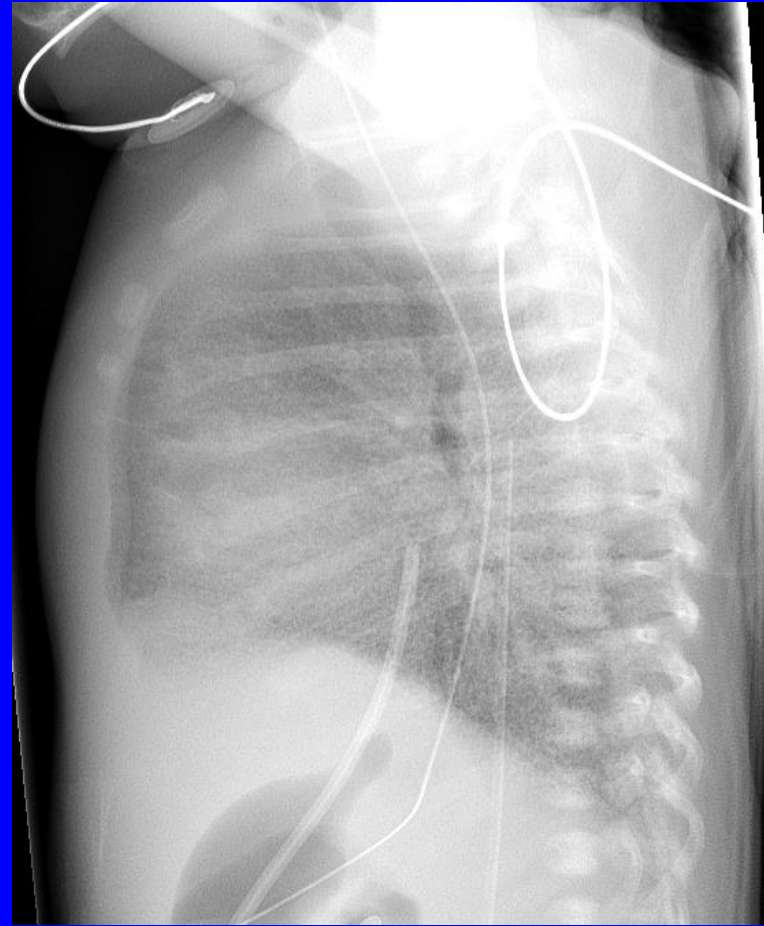
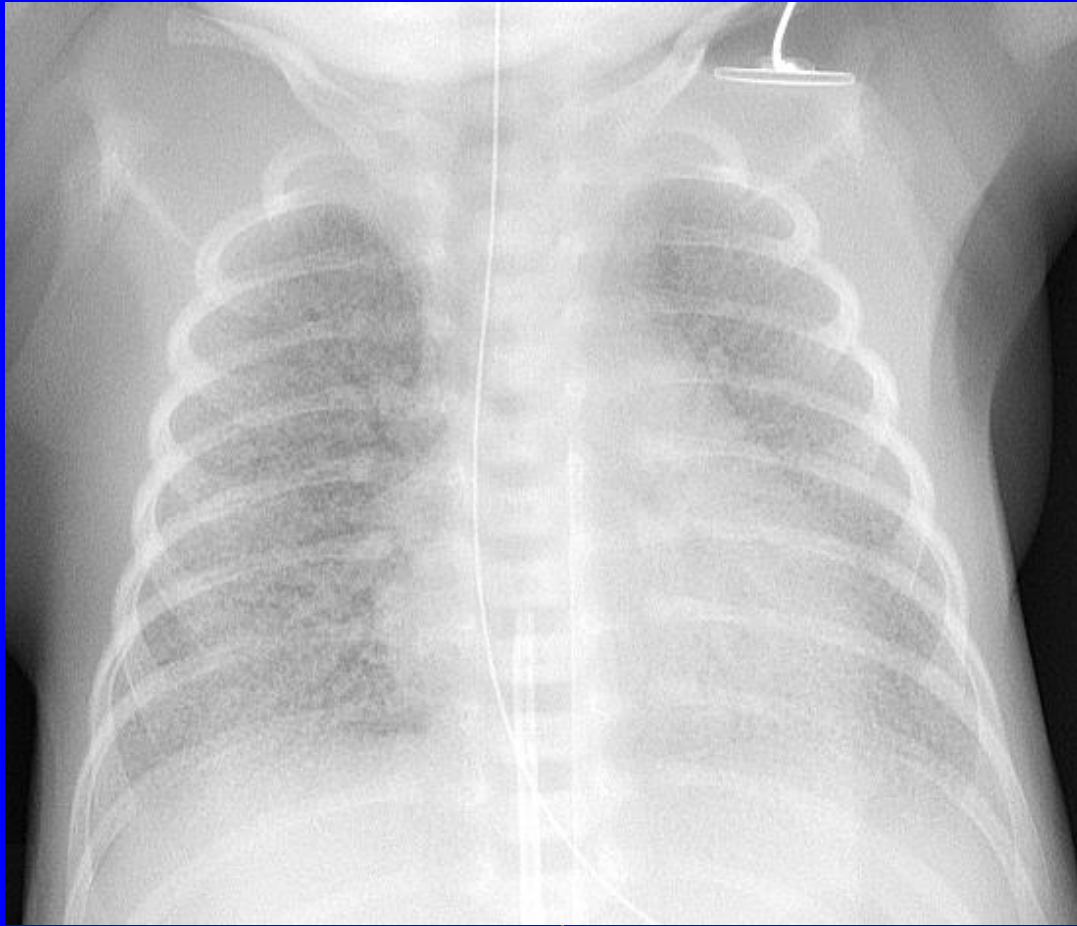
[https://commons.wikimedia.org/wiki/File:Normal_posteroanterior \(PA\) chest radiograph \(X-ray\).jpg](https://commons.wikimedia.org/wiki/File:Normal_posteroanterior_(PA)_chest_radiograph_(X-ray).jpg)

CHEST RÖNTGENGRAPH: ADULT RESPIRATORY DISTRESS SYNDROME (ARDS)



Chest X-ray of a patient with ARDS (NON-CARDIOGENIC PULMONARY EDEMA) – Samir 17.September 2007
https://commons.wikimedia.org/wiki/File:ARDS_X-Ray.jpg

CHEST RÖNTGENGRAPH: CXR - INFANT RESPIRATORY DISTRESS SYNDROME (IRDS)



Chest radiograph one day after birth of a boy after 29 weeks and 3 days of gestational age who developed respiratory distress. It shows signs of infant respiratory distress syndrome (IRDS), in the form of a generalized fine granular opacities that creates air bronchograms. The thorax is bell-shaped due to decreased lung volume. In addition, there are both arterial and venous umbilical lines, a nasogastric tube and electrocardiography electrodes. (16.Aug 2018) Mikael Häggström

[https://zh.wikipedia.org/wiki/File:X-ray_of_infant_respiratory_distress_syndrome_\(IRDS\).png](https://zh.wikipedia.org/wiki/File:X-ray_of_infant_respiratory_distress_syndrome_(IRDS).png)

CHEST RÖNTGENGRAPH: CXR – HANTAVIRUS PULMONARY SYNDROME (HPS)

Hantavirus Pulmonary Syndrome (HPS) is a severe, sometimes fatal, respiratory disease in humans caused by infection with hantaviruses.

Anyone who comes into contact with rodents that carry hantaviruses is at risk of HPS. **Rodent infestation** in and around the home remains the primary risk for hantavirus exposure.

Even healthy individuals are at risk for HPS infection if exposed to the virus.

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May **1993 outbreak**: Southwestern United States area of Arizona, New Mexico, Colorado, Utah
“The Four Corners”

A young, physically fit Navajo man suffering from shortness of breath was rushed to a hospital in New Mexico and died very rapidly.

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NOTE: Andes virus: type of **hantavirus**
Found in rodents in South America.
People can become ill with Andes virus if they come in contact with infected rodents or their droppings while in South America.



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Severe **HPS**. Image courtesy D. Loren Ketai, M.D. <https://www.cdc.gov/hantavirus/hps/index.html>

Regarding PNEUMONITIS from VAPING

e-cigs have the potential for inducing inflammation, albeit much less than smoking

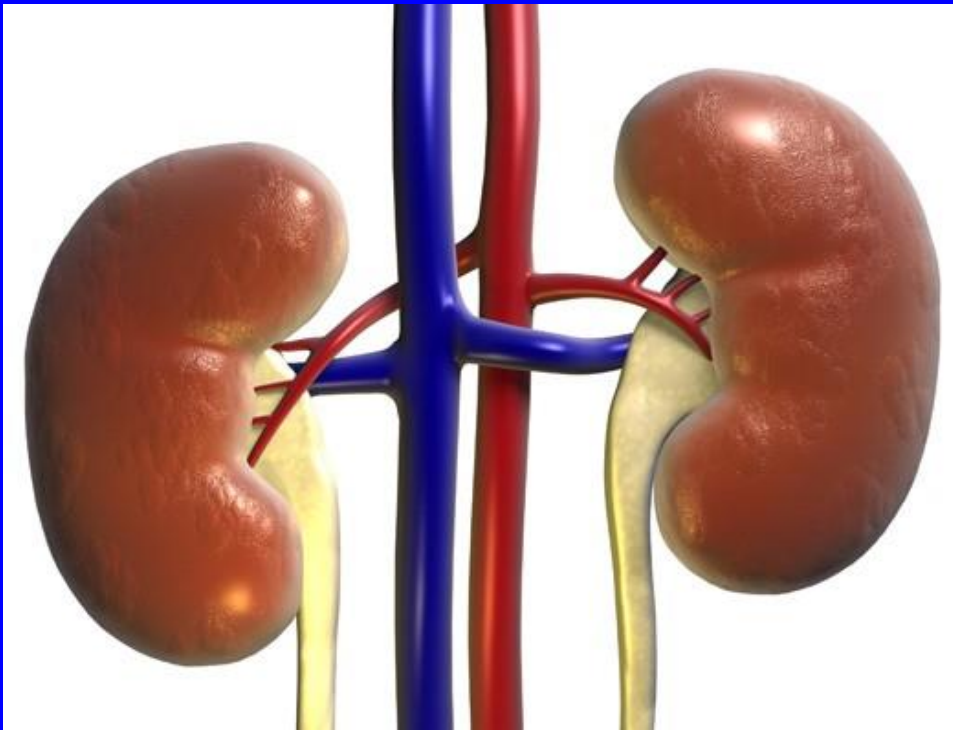
Cigarette smoking is the major cause of lung cancer and COPD,
(accounting for about 90% of all cases).

- smoke contains numerous toxicants that promote inflammatory responses that contribute to the risk for these diseases:
- ***Inflammation is considered a hallmark of cancer and COPD***

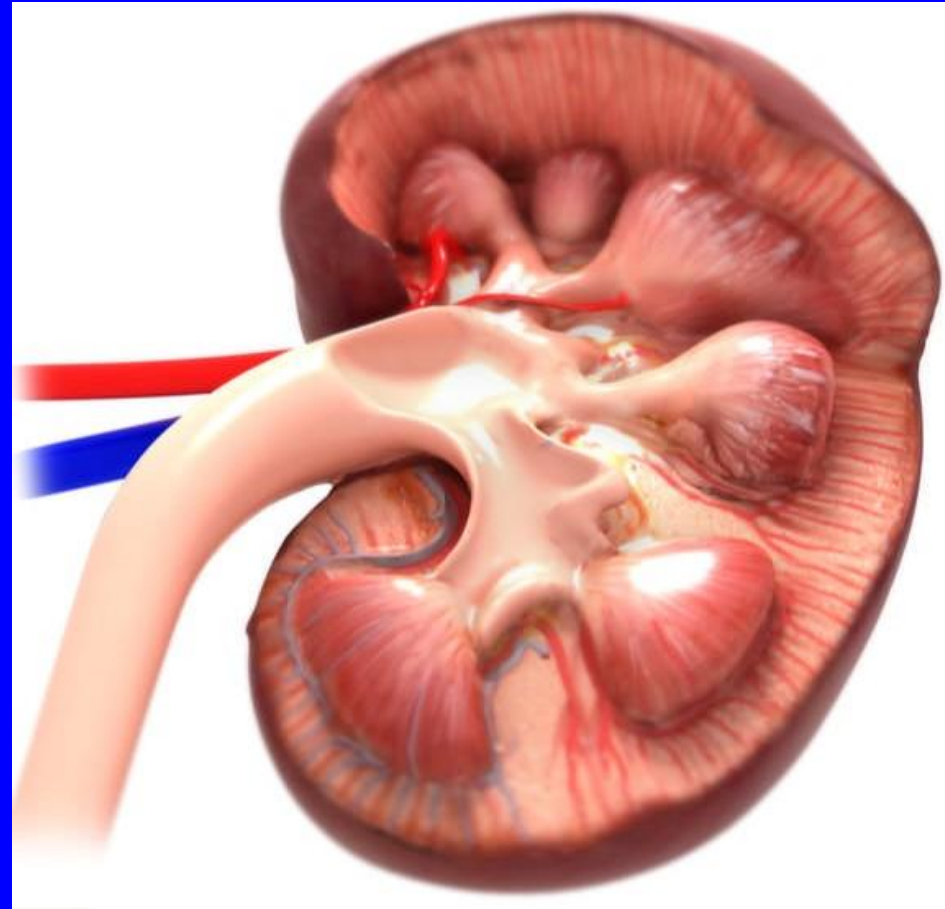
e-cig aerosols to also indicate a pro-inflammatory effect given the toxicant and *irritant constituents in carrier liquids* that usually contain nicotine, including **vegetable glycerol (VG)** and/or **propylene glycol (PG)** in e-cig aerosols.

So in theory, **OILS** may be the direct cause of the **lung inflammation & injury** because some of these patients have been diagnosed with **LIPOID PNEUMONIA** (lung inflammation associated with oil inhalation). However, it increasingly looks like a chemical formed from ***vitamin E acetate*** may be causing the toxicity

kidneys with blood vessels



proximal view – capsule, cortex & medulla

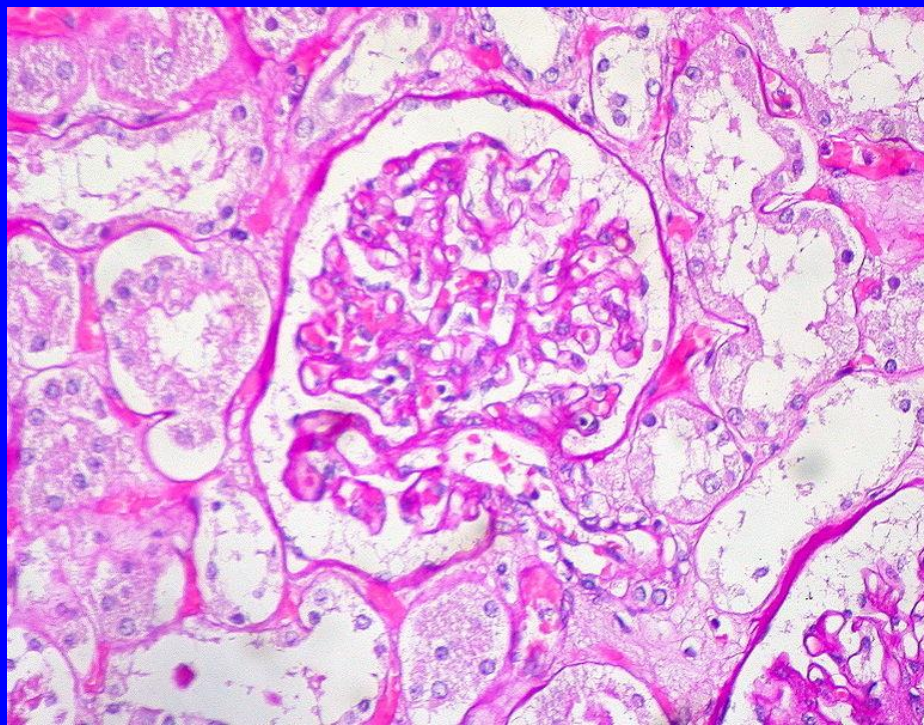


LEFT: Illustration of the kidneys with blood vessels;

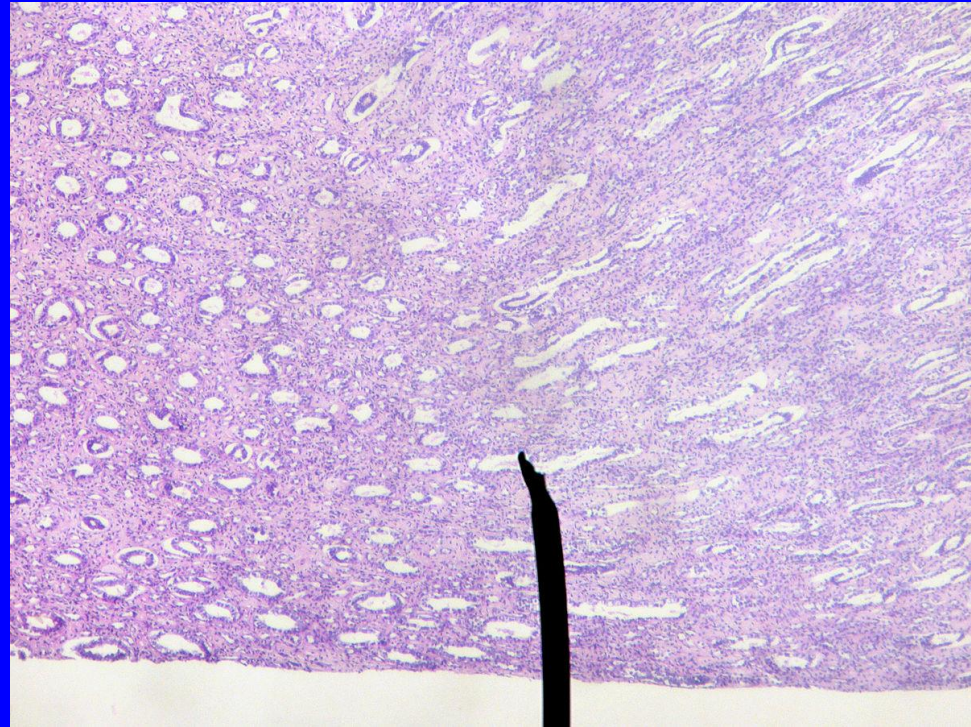
RIGHT: Proximal view of the anatomy of the human kidney on white background with partially removed parts.

- www.medicalgraphics.de creative commons CC BY-ND 3.0

Left: Renal corpuscle (Glomerulus)



Right: Medulla of kidney

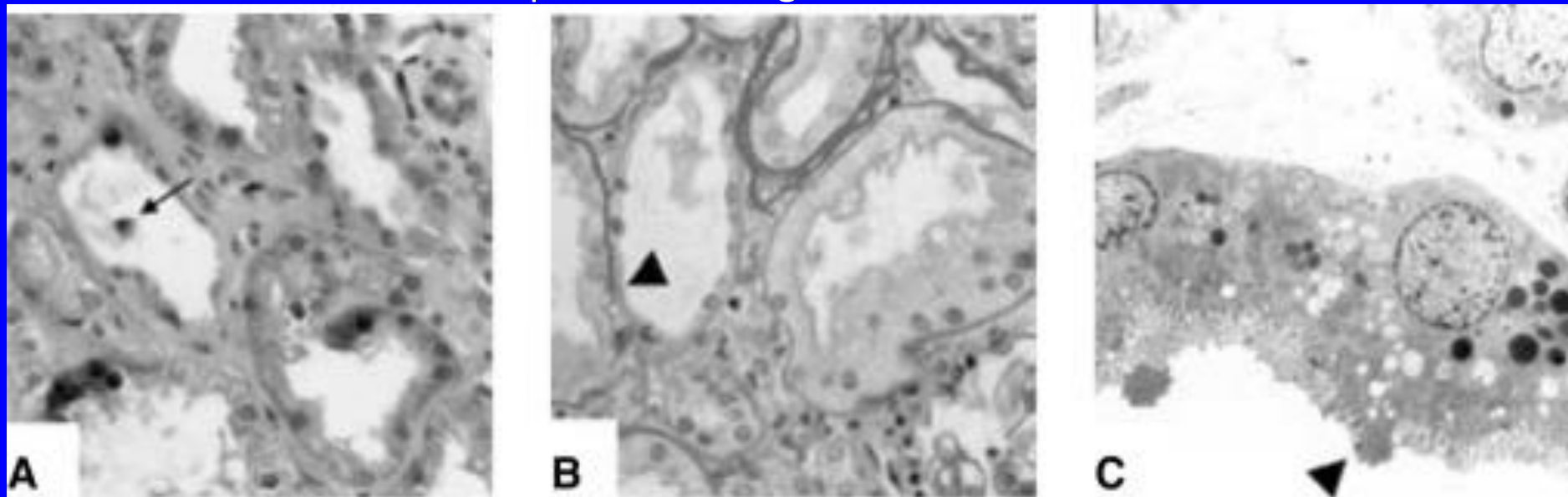


LEFT: Renal corpuscle (Glomerulus), Periodic Acid-Schiff Stain (PAS).
The PAS stain lights up basement membranes - very nice for appreciating the skeleton of the glomerulus of the kidney.; (30.March2009) - Ed Uthman, Pathologist
https://commons.wikimedia.org/wiki/File:Renal_corpuscle.jpg

RIGHT: Human Kidney (Medulla) – Jpogi
<https://commons.wikimedia.org/wiki/File:Kidney-medulla.JPG>

Histologic diagnosis of **ACUTE TUBULAR NECROSIS (ATN)**

- characterized in humans by activation of the alternative pathway of complement.
- pattern of activation is similar to that seen in animal models, in which abrogation of complement activation has ameliorated ischemic ARF.
- Decades of research have convinced many nephrologists that complement inhibition would benefit patients with glomerular disease



ATN biopsies demonstrated:

loss of brush border,

epithelial sloughing (arrows),

tubular dilatation,

epithelial simplification (arrowhead),

and cast formation.

All had acute rises in the serum creatinine before biopsy, and all had clinical data consistent with a diagnosis of ATN.

(A) is stained with trichrome, and

(B) is stained with periodic acid Schiff.

(C) The epithelial cells were characterized by vacuolization, apical blebbing (arrowhead), reduced apical brush border, and basal infoldings (C).

Original magnification was $\times 200$ for (A) and (B).

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Joshua M.Thurman, M.Scott Lucia, DanicaLjubanovic, V.Michael Holers: Acute tubular necrosis is characterized by activation of the alternative pathway of complement. Kidney International Vol 67, No. 2, Feb 2005, Pages 524-530.

Histologic diagnosis of **ACUTE TUBULAR NECROSIS (ATN)**

FOR FURTHER CONSIDERATION (for those who use the PDF of this presentation) is a well-labeled, microscopic image demonstrating and explaining the histopathology of **ACUTE TUBULAR NECROSIS** via the link at the bottom.

This is not shown here due to copyright concerns.

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TUBULAR NECROSIS by:

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<https://emedicine.medscape.com/article/238064-overview>