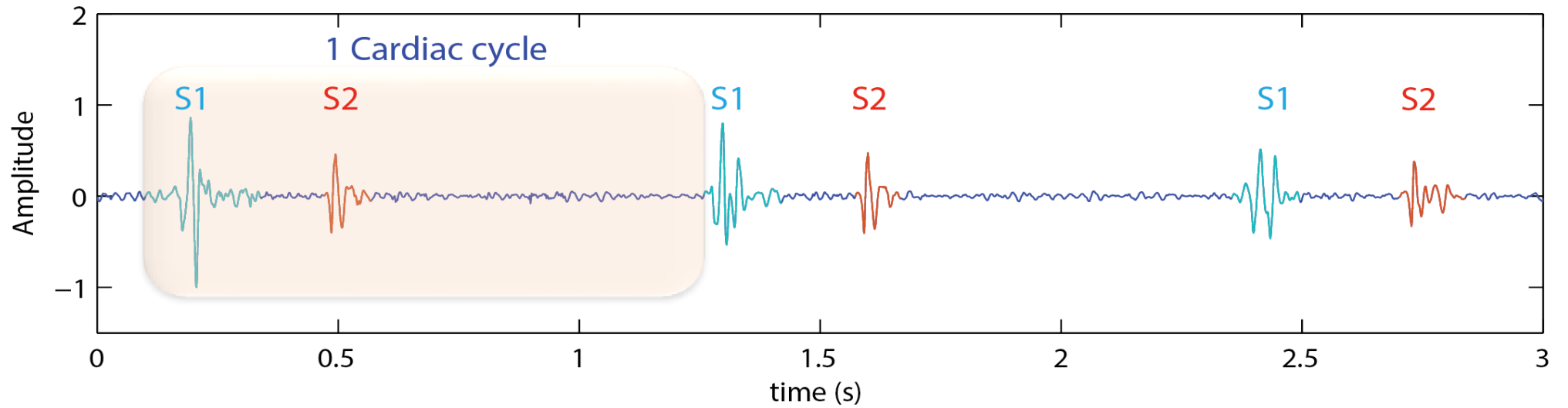# Heart Sound
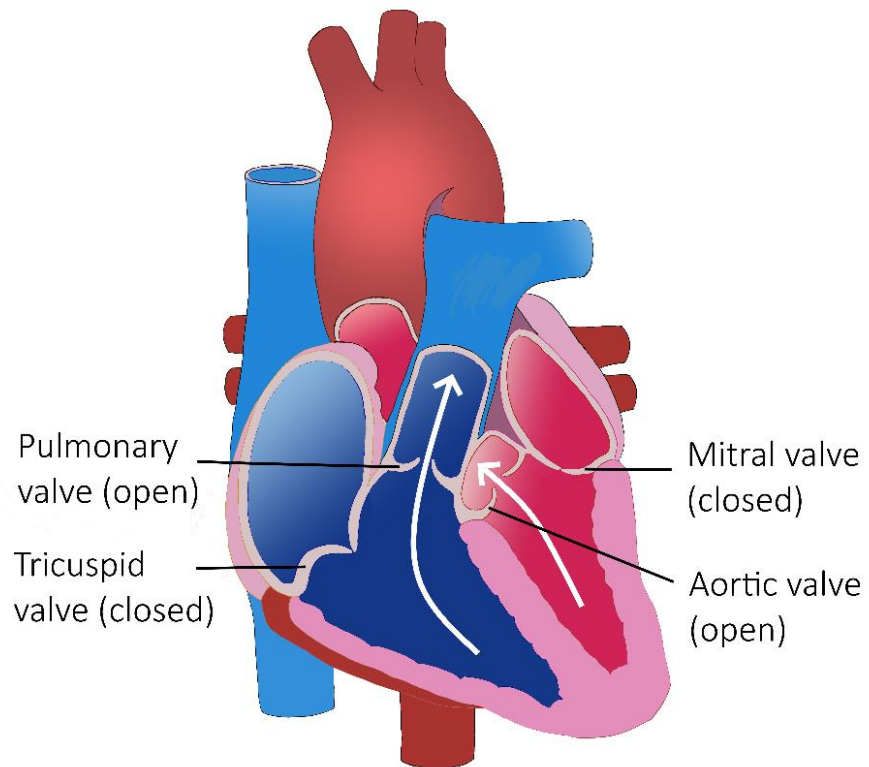
- Heart sounds - resulted from the snapped shut of atrio-ventricular valves.

- Fundamental heart sounds (FHS):
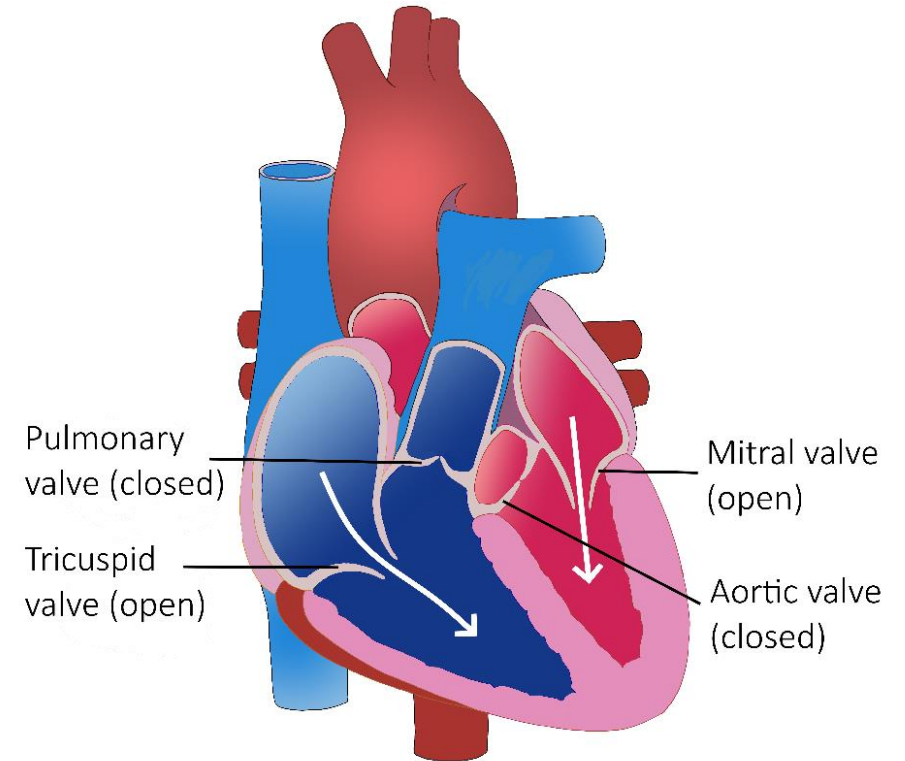
    - S1 or 'Lub'.

    - S2 or 'Dub'.

1. Kumar, D., et al. "Noise detection during heart sound recording." *2009 Annual International Conference of the IEEE Engineering in Medicine and Biology Society*. IEEE, 2009.

- Figure: S1 sound is produced due to closure of Mitral and Tricuspid valves [2, 3].

- Figure: S2 sound is produced due to closure of Aortic and Pulmonary valves [2, 3].

Pulmonary valve (open)

Tricuspid valve (closed)

Mitral valve (closed)

Aortic valve (open)

Pulmonary valve (closed)

Tricuspid valve (open)

Mitral valve (open)

Aortic valve (closed)

2. H. K. Walker, W. D. Hall, and J. W. Hurst, Clinical methods. Butterworths, 1990.
3. Waugh, Anne, and Allison Grant. Ross & Wilson anatomy and physiology in health and illness. Elsevier Health Sciences, 2014.

Key features of Heart Sounds

Durations

➡ S1 sound: 120 ± 22ms

➡ S2 sound: 92 ± 22ms

➡ Systole and diastole: depends on HCD $\propto \dfrac{1}{heart\ rate}$

Heart sound	Frequency ranges (Hz)
S3 and S4	15-65
S1 and S2	20-200
Mitral stenosis	40-80
Ejection murmurs	200-400
Regurgitation	250-700

4. Naseri, Hosein, and M. R. Homaeinezhad. "Detection and boundary identification of phonocardiogram sounds using an expert frequency-energy based metric." *Annals of biomedical engineering* 41.2 (2013): 279-292.

# Heart Sounds & Murmurs | Clinical Medicine

References:

- George B. Moody PhysioNet Challenge | George B. Moody PhysioNet Challenge

- The CirCor DigiScope Dataset: Oliveira, J., Renna, F., Costa, P. D., Nogueira, M., Oliveira, C., Ferreira, C., … & Coimbra, M. T. (2022). The CirCor DigiScope Dataset: From Murmur Detection to Murmur Classification. IEEE Journal of Biomedical and Health Informatics, doi: 10.1109/JBHI.2021.3137048.

Lung Sound

- ▶ Normal Lung/Breath/Respiratory sounds – turbulent airflow in upper airways and large airways of the lungs (100 – 2000 Hz.

- ▶ As the sound is transmitted to the lungs, it gets dampened, higher frequencies are lost and softer lower pitched sound is heard (100 - 400 Hz).

Key features of Lung Sounds
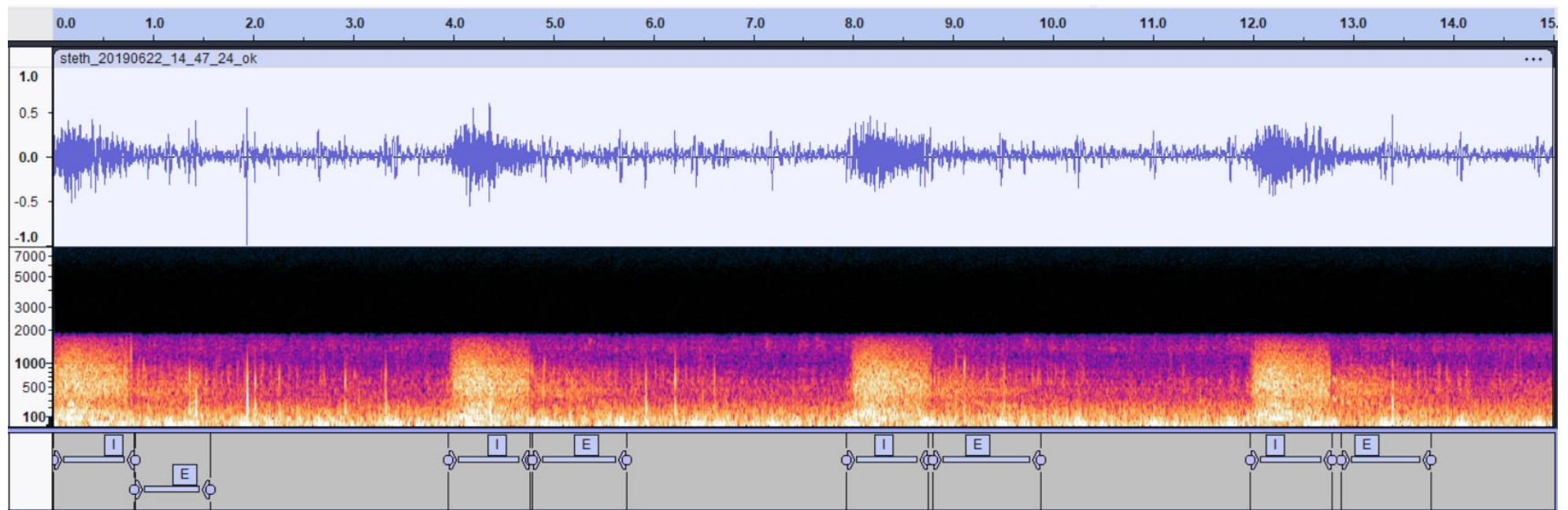
Vesicular Breath Sounds:

▶ Characteristics:

    ▶ Intensity of inspiration (I) more than expiration (E)

    ▶ Longer duration of inspiration

    ▶ Lower pitch in expiration

Heart sound	Frequency ranges (Hz)
Normal Breath Sounds	100 – 2000 Hz
Adventitious Sounds - Wheeze	Anywhere between 400 Hz and 2kH
Adventitious Sounds - Crackles	< 200 Hz
Adventitious Sounds - Ronchi	< 300
Cough Sound	50-3000 Hz

4. Approach to Lung sounds | PPT

Vesicular Breath Sounds
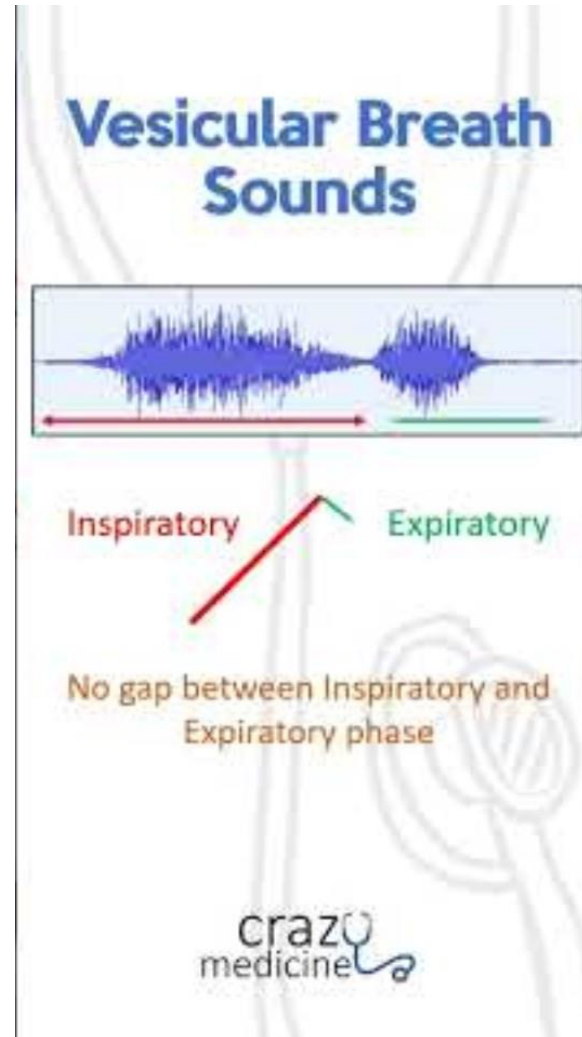
[Abnormal Breath Sounds | Respiratory System](#)

References:

- [Benchmarking of eight recurrent neural network variants for breath phase and adventitious sound detection on a self-developed open-access lung sound database—HF_Lung_V1 | PLOS ONE](#)

- [Lung and Heart Sounds Analysis: State-of-the-Art and Future Trends - Critical Reviews™ in Biomedical Engineering, Volume 46, 2018, Issue 1 - Begell House Digital Library](#)