

# Sonography Tech

Essentials of Physics & Sound, Image Interpretation, Tools, Techniques, Equipment & Terminology

## OVERVIEW

### Scope of Practice

- **Ultrasound** (a.k.a., **ultrasonography** and/or **sonography**) involves the following aspects of skills, practice and technology:
  - patient care
  - quality control
  - diagnostic procedures
  - computer data acquisition & processing
- **Ultrasound technology is a multidisciplinary field, in which medicine is linked to mathematics and quantitative sciences, including:**
  - **geometry**
  - **physics**
  - **computer technology**
- **Ultrasound diagnostic imaging technique is used to visualize subcutaneous body structures, for possible pathology or lesions.**
  - structures best suited to sonographic imaging include:
    - tendons
    - muscles
    - joints
    - vessels
    - internal organs
- In physics, the term "**ultrasound**" applies to all acoustic energy with a **frequency above human hearing (20,000 hertz [Hz] or 20 kilohertz [kHz])**
  - **Typical diagnostic sonographic scanners operate in the frequency range of 2-18 megahertz [MHz], hundreds of times greater than the limit of human hearing.**
- However, the choice of frequency is a trade-off between spatial resolution of the image and imaging depth.
  - **lower frequencies produce less resolution, but image deeper into the body**

(NOTE: See page 6 for a Glossary of Sonographic Terminology)

### How Ultrasound Works

- Sonography is effective for imaging soft tissues of the body
  - **superficial structures** such as muscles, tendons, testes, breast and the neonatal brain are imaged at a **higher frequency (7-18 MHz)**, which provides **better axial and lateral resolution**
  - **deeper structures** such as liver and kidney are imaged at a **lower frequency (1-6 MHz)**, which provides **less axial and lateral resolution but greater penetration** (i.e., increased imaging depth)
- A **general-purpose sonographic machine** may be used for most imaging purposes; specialty applications may be imaged by use of a **specialty transducer**
  - Most ultrasound procedures are done using a transducer on the surface of the body, but **improved diagnostic procedures** are often possible if a transducer can be placed **inside the body**
    - for this purpose, **specialty transducers** (including endorectal, endorectal and transesophageal transducers) are commonly employed

## PHYSICS & SOUND

### Understanding Sound Waves

- In physics, all waves carry energy from one location to another
- **Sound is a mechanical wave** in which particles move (i.e., the molecules vibrate back and forth from a fixed position)
- Sound travels in a straight line and sound waves are **longitudinal waves**
- Sound waves are identified by the following acoustic variables: pressure, particle displacement, density and temperature
- In diagnostic ultrasound, **pulses** (i.e., sound) travel through tissue
- **Reflections** arising from structures in the body return to the transducer and are processed into images
- To understand exactly how that happens, let's review how sound waves work

#### Pressure

- The ratio of force acting on a surface object
- If there were no forces, or pressure, everything would be in a state of constant rest
- The **Law of Inertia** explains that a body in motion will remain in motion; likewise, a body at rest will stay at rest until acted upon by an outside force
- **Ultrasound moves human soft tissue out of its state of rest.**

#### FORMULA

Pressure = Force/Area OR  $P = F/A$   
 Units of measure: Newtons/Area or  $N/m^2$

#### Particle Displacement

- The distance the body has moved after being impinged upon by a force (i.e., how far the particles moved from their equilibrium positions)

#### Density

- The property common to all matter and the one property that makes each type of matter unique
- Density is defined as **mass per unit volume**; the more mass confined to a given volume, the greater the density
- In ultrasound, density is referred to as **mass density**, which can be defined as the mass of the object divided by its volume

#### FORMULA

Density = Mass/Volume OR  $D = M/V$   
 Units of measure:  $Kg/M^3$ ,  $g/cm^3$

#### Temperature

- The measurement of relative coolness or warmth of an object
- temperature in ultrasound becomes important because the **speed of sound varies with the temperature of the tissue that is being scanned**

### 7 Parameters of Sound Waves

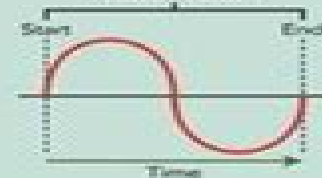
- The seven parameters of sound waves are: period, frequency, amplitude, power, intensity, wavelength and speed
- Period and frequency describe the speed of the wave
- Amplitude, power and intensity describe the strength of the wave (a.k.a., magnitude); these parameters tend to be directly related; when intensity increases so do power and amplitude

#### Period

- **Time it takes for a wave to vibrate a single cycle** (i.e., from the start of one cycle to the start of the next cycle)

- Reported in units of time (seconds, milliseconds, hours, days)
- The value of **period in diagnostic ultrasound is one tenth to one half of a millionth of one second**
- **period determined by the sound source only, not by the tissue being scanned**
- **period is NOT adjustable** by the sonographer (ultrasound tech) with a particular transducer

#### Wave Period



#### Frequency

- **Number of events that occur in a specific duration of time**
- In **diagnostic ultrasound**, the frequency of a wave is described as the **number of cycles occurring in one second**
- **Frequency is important in diagnostic ultrasound because it affects penetration and image quality**
- Measured in units per second or Hz (1 cycle/second = 1 Hz)
- Frequency ranges are from 2MHz to 10 MHz (2 million to 10 million per second)
- **frequency determined by the sound source only, not by the tissue being scanned**
- **frequency is NOT adjustable** by the sonographer with a particular transducer

#### Frequency Spectrum of Sound

infrasonic: less than 20 Hz  
 audible: sound between 20 Hz and 20 kHz  
 ultrasound: greater than 20 kHz

#### Wave Frequency



#### Amplitude

- Defined as the "**bigness**" of the wave, it is the difference between the minimum value and the average value of the acoustic variable
- Measured in units of **pressure (pascals), density (g/cm)** and particle motion (any distance)
- **Amplitude is determined by the sound source, but amplitude decreases as it travels through the body**
- **decrease in sound depends on the characteristic of the sound and the body tissue the wave is traveling through**
- the sonographer can alter the initial amplitude on an ultrasound machine
- **Amplitude is measured from the middle value to the maximum value**

# Medical Terminology Study Guide Ultrasound

**Judi L. Nath**



## **Medical Terminology Study Guide Ultrasound:**

**Medical Terminology: An Illustrated Guide** Barbara Janson Cohen, Shirley A Jones, 2020-02-04 Medical Terminology An Illustrated Guide Ninth Edition helps readers develop a fundamental knowledge of the medical terminology necessary for a career in any health care setting Veterinary Medical Terminology E-Book Dawn E. Christenson, 2019-11-06 Reader friendly and organized by body system Veterinary Medical Terminology 3rd Edition helps you quickly gain a solid understanding of veterinary terminology Essential word parts and terms are presented in the context of basic anatomy physiology and disease conditions giving you the tools to immediately apply new terminology to practical clinical situations This new edition features learning exercises at the end of each chapter to reinforce content and test your knowledge challenging you to go beyond simple memorization and become fluent in the language of veterinary medicine Updated coverage includes advancements in the vet tech field new medications treatments of today's most prevalent diseases and the latest procedures in orthopedics This third edition is an essential resource for learning the medical terms and basic principles of veterinary medicine A logical body systems approach and consistent chapter format help students find information quickly and learn more effectively UNIQUE Goals and objectives at the beginning of each chapter help students focus their study time and check their recall and understanding of key facts and terminology Over 200 illustrations clearly demonstrate key anatomy and physiology concepts and terminology Helpful appendices in text provide information on chemical symbols and elements and common veterinary medical abbreviations A complete glossary of word parts gives students quick access to the spelling and meaning of every prefix suffix root and combining form covered in the book Presentation of anatomic physiologic and or pathophysiologic concepts and principles in all chapters enhances your students ability to quickly apply newly learned terms Self test exercises at the end of each chapter allow students to thoroughly review content NEW Coverage of the latest advancements in the vet tech field include all new drugs today's most prevalent diseases and state of the art procedures in orthopedics NEW and UNIQUE Learning exercises at the end of each chapter test your students knowledge and challenge them to use newly learned terms **Medical Terminology** Marjorie Canfield Willis, 2007-05-01 This medical terminology text uses a Programmed Learning approach that is ideal for classroom use self paced study or distance learning It is broken down into concise self instruction frames followed by review frames for immediate feedback and reinforcement Actual medical records and medical record analysis activities are used extensively throughout the book Highlights of this edition include a more engaging design additional illustrations more detailed coverage of term components chapter objectives checklists and acronyms and abbreviations charts A free bound in CD ROM contains Stedman's audio pronunciations and interactive exercises LiveAdvise Medical Terminology an online student tutoring and faculty support service is free with the book A fully customizable online course created specifically for this text is available as an additional purchase Study Guide for Clinical Procedures for Medical Assistants - E-Book Kathy

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