



# Questions and Answers

## ProSim Vital Signs Simulators – NIBP FAQ

**Question:** Why do ProSim NIBP simulated readings not match BP Pump 2 or CuffLink readings on patient monitors?

**Answer:** There are many factors such as tubing, cuff size, and motion, which may affect NIBP readings. This is why all NIBP standards emphasize dynamic pressure repeatability rather than absolute accuracy. BP Pump 2 and CuffLink have a default pulse volume ranging from 0.5 to 0.75ml, while ProSim defaults at 1 ml. Depending on type of monitors, if you change the pulse volume, cuff size (mandrel blocks or 500 ml rigid chamber) or tubing, the absolute NIP readings may change accordingly, but repeatability should stay the same.

**Question:** Why is an oscillometric NIBP reading higher than an auscultatory NIBP reading?

**Answer:** The auscultatory technique is based on the sounds caused by the blood flow through the artery that is surrounded by the cuff. These sounds are known as Korotkoff (K) sounds. In manual blood pressure measurement, these sounds are detected by a human observer using a stethoscope.

The oscillometric technique does not use K sounds to determine blood pressure. The oscillometric technique monitors the changes/vibrations in cuff pressure caused by the flow of blood through the artery. The monitor inflates the cuff to a pressure that occludes the artery.

Variability between auscultatory and oscillometric blood pressure readings may be due to many factors including human observer's skill and hearing sensitivity. The main reason an oscillometric reading is typically higher is that the human ear can only pick up sound, not vibrations. Vibrations in the artery occur before any sounds have appeared, so by the time the human ear hears the Korotkoff sounds, systolic may have already occurred.

**Question:** Can a cuff size affect an NIBP reading on patient monitors?

**Answer:** Improper cuff size has been considered one of the most common errors with blood pressure measurements. It is well documented that readings can be falsely elevated, sometimes to the extreme with a cuff that is too small. The rule established by the American Heart Association (AHA) suggests cuff width should be at least 40 % of the greatest arm circumference.

**Question:** Why do NIBP readings on patient monitors vary from brand to brand?

**Answer:** Each individual manufacturer utilizes their proprietary algorithm for identification of the systolic and diastolic points. Some may use the height of the pressure waveform to mark these points; others may use the slope of the pressure signal.



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**Given that algorithms vary, it is difficult to compare between different blood pressure monitors from different manufacturers.**

**Question:** Why do monitor my monitor’s BP determinations vary? Example below:  
“I connected the Tester to my Critikon DINAMAP monitor and used the preset blood pressure of 120/80 (93) with a pulse rate of 80 beats per minute. I performed three blood pressure determinations with the following results:

Trial #	Systolic	Mean	Diastolic	Pulse Rate
1	123	97	82	79
2	126	93	81	81
3	123	97	83	78

**Answer:** Some variance is normal and acceptable. ProSim generates a very repeatable simulation. For this simulation, an ideal NIBP monitor would show a variation of less than 2 mmHg from one simulation to the next. Most of the variation seen here originates in the DINAMAP. This is normal and accepted.

**Section 3.4.3 of the ANSI Standard for Electronic or Automated Sphygmomanometers specifies the required efficacy of the blood pressure determination:**

**“The mean difference of the paired measurements of the test system and the comparison system shall be ± 5 mmHg or less with a standard deviation of 8 mmHg or less.”**

**This means variations in individual readings of 5, 6, or even 10 mmHg are normal and do not indicate either the DINAMAP or the Tester are malfunctioning. Some monitors are more repeatable than others, and repeatability is one measure of the overall quality of the monitor.**

**Question:** What are the major standards for NIBP monitoring?

**Answer:** The design of the NIBP parameter of a patient monitor is required to be proven to be safe and effective for use in the diagnosis, and treatment of disease states and underlying chronic conditions, and in the prescribing of medications and other therapies. This testing is governed by national and international standards including AAMI/ANSI SP10 and IEC 80601-1-2-30 for minimum performance and safety. The performance of NIBP monitors are required to be evaluated or tested during scheduled maintenance by the manufacturer.

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**Question:** How is human blood pressure generated?

**Answer:** When the heart pumps blood into the arteries, the blood flows with a force pushing against the walls of the arteries. Blood pressure is the product of the flow of blood times the resistance in the blood vessels.

**Question:** How is blood pressure measured?

**Answer:** Blood pressure can be measured using a variety of techniques, which can be classified into two major categories: invasive and non-invasive. The invasive approach inserts a catheter into an artery of a test subject. The catheter may contain a pressure transducer at its tip or it may be fluid-filled and couple the blood pressure through the fluid to an external transducer. The change of fluid pressure (blood pressure) in the subject's artery is measured invasively. This technique is also referred to as a direct measurement, because the parameter being measured is directly coupled to the transducer. Non-invasive blood pressure measurement usually involves the use of an inflatable cuff wrapped around the limb of a test subject. The cuff is inflated and deflated at a controlled rate and physical parameters are observed. The auscultatory and oscillometric techniques are well known non-invasive methods. These methods are indirect because they do not couple directly to the artery. ProSim 8 and 4 simulates oscillometric technique since modern NIBP monitors now use oscillometric technique to measure pressure.

**Question:** How are blood pressure readings interpreted?

**Answer:** Blood pressure is measured with a blood pressure cuff and recorded as two numbers, such as 120/80 mm Hg (millimeters of mercury). The top, larger number is called the systolic pressure. This is the pressure generated when the heart contracts (pumps). It reflects the pressure of the blood against arterial walls. The bottom, smaller number is called the diastolic pressure. This reflects the pressure in the arteries while the heart is filling and resting between heartbeats.

**Question:** How does a doctor determine a patient has a normal or abnormal blood pressure?

**Answer:** Doctors have determined a normal range for both systolic and diastolic blood pressure after examining the blood pressure of many people. The following figures can be used as a guide for adult blood pressure:

1. Normal blood pressure: less than 120/80 mmHg
2. High/Normal: between 120/80 and 140/90 mmHg
3. High: equal to or more than 140/90 mmHg
4. Very high: equal to or more than 180/110

Individuals whose blood pressure is consistently higher than this norm are said to have high blood pressure, or hypertension. Uncontrolled high blood pressure is indirectly responsible for many deaths and disability resulting from heart attack, stroke, and kidney failure.