Executive Summary

GE DINAMAP SuperSTAT Non-invasive Blood Pressure Algorithm in the CARESCAPE V100 Monitor

Enhancing Patient Comfort and Non-invasive Blood Pressure Performance in Challenging Areas

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Introduction
Care providers today face an ever-changing and increasingly more challenging environment in which to provide patient care. What has not changed is the importance of obtaining quick and reliable patient data from which to make critical healthcare decisions. GE DINAMAP® SuperSTAT™ Non-invasive Blood Pressure (NIBP) algorithm, an advanced NIBP algorithm from GE Healthcare, can increase the overall speed and comfort of NIBP determinations, while maintaining a high standard of accuracy. The SuperSTAT NIBP algorithm can be found in the CARESCAPE™ V100 monitor.

How is the SuperSTAT NIBP algorithm different from the previous NIBP algorithms?
Traditional oscillometric automatic NIBP devices use a number of signal processing techniques to obtain accurate readings during a determination. These devices generally recognize pulses if they are equivalent in size at a cuff pressure and occur regularly in time. Additionally, the algorithms contained within these devices generally use a large number of deflation steps (typically 10-12 deflation steps) to help ensure accuracy. As a result, the traditional devices typically take some time to process the signals in order to determine the blood pressure (BP), particularly in the presence of motion. The SuperSTAT NIBP algorithm uses advanced, patented signal processing to address these deficiencies and can provide an accurate NIBP determination in as few as four pressure steps (however, as noted below, the initial SuperSTAT NIBP algorithm determination on a given patient will be very similar to a standard GE DINAMAP determination). A faster determination may result in a more comfortable determination for the patient. The SuperSTAT NIBP algorithm has been documented to improve speed, comfort and artifact rejection, while retaining the classic GE DINAMAP accuracy.

What are the enhancements in the SuperSTAT NIBP algorithm?
Accelerated determinations
SuperSTAT NIBP algorithm uses “smart cuff” pressure control to face the challenge of providing accurate readings in a timely manner. The oscillometric method of determining NIBP is accomplished by a sensitive transducer, which measures cuff pressure and small pressure oscillations within the cuff (Figure 1). A traditional determination (such as with the GE DINAMAP Classic algorithm) typically takes 10-12 deflation steps, while an accelerated determination with SuperSTAT NIBP algorithm can take as few as four deflation steps -- which can result in a quicker determination.

The initial SuperSTAT NIBP algorithm determination will typically be as long as a traditional GE DINAMAP determination; this initial determination is called a learning determination because the algorithm is establishing the shape of the patient’s oscillometric envelope and storing the pattern of the patient’s oscillation (size) as a function of pressure. On each subsequent determination, SuperSTAT NIBP algorithm can use information from the previous determination to perform smart cuff pressure control and select optimal pressure steps. During these subsequent determinations, SuperSTAT NIBP algorithm constantly evaluates data in an attempt to perform the determination in the shortest possible time. As a result, subsequent determinations with SuperSTAT NIBP algorithm will generally be shorter in length (accelerated determinations) unless the oscillometric data are found to be “noisy” or the patient’s BP has changed significantly.

Figure 1
Typical oscillometric envelope used to measure NIBP

Lower initial inflation pressures for Neonates
Higher acuity in the Neonatal Intensive Care Unit (NICU) typically results in more neonates with low BP. In the CARESCAPE V100 monitor, the neonatal target inflation pressure for SuperSTAT NIBP algorithm can be set below the default target inflation pressure of 100 mmHg. With SuperSTAT NIBP algorithm, the clinician can set the neonatal target cuff inflation pressure to a minimum of 70 mmHg, which can provide more individualized NIBP inflation for the neonate with lower systolic BP, which may be more comfortable for the neonate with lower systolic BP.

Motion artifact rejection
Motion artifact has always been an obstacle to obtaining accurate NIBP readings. In post-anesthesia care, the patient is often still under the influence of anesthetic drugs that may cause unexpected movements. In addition, motion also presents an inherent challenge when monitoring Neonates, especially when BP signals are small, as is often the case in the NICU. SuperSTAT NIBP algorithm assesses the presence and level of motion artifact by measuring the consistency of the pulse using several patented algorithms. Measuring the consistency of the pulse contributes to determining accurate NIBP values, even in the presence of motion artifact.
Larger performance range

Higher acuity hospitalized patients means greater variability in vital signs and greater challenges to obtaining NIBP values. For example, the pulse signals from patients with poor perfusion and small Neonates (premature infants weighing less than 1000 g) may be low and sometimes more difficult to measure with traditional BP technology. SuperSTAT’s NIBP algorithm digital signal processing algorithms provide enhanced sensitivity (when compared to traditional BP technology) and as a result, can generally detect NIBP values on much smaller signals, such as in patients with low perfusion pressures.

Management of re-pumps and search capability

If, after an initial inflation and deflation, there are not enough data to determine an NIBP, the system re-inflates the cuff, typically to a higher cuff pressure. This process of re-inflating the cuff is known as a “re-pump” and the search process is known as its “search capability”. During the process of stepped deflation with SuperSTAT NIBP algorithm, the oscillations at each of the pressure steps are stored. Unlike traditional oscillometric automatic NIBP devices, SuperSTAT NIBP algorithm does a “smart search” by using previously stored oscillations to selectively “re-pump” as may be required, sometimes only to a single cuff pressure, to make an NIBP determination.

Frequently Asked Questions

Why does SuperSTAT NIBP algorithm work well in Neonates?

Some of the keys to getting accurate BP determinations in the Neonatal population include minimizing the cuff inflation time and rejecting motion artifact. SuperSTAT NIBP algorithm incorporates these features to increase the likelihood of delivering reliable NIBP values. In addition, because of its enhanced sensitivity, SuperSTAT NIBP algorithm is able to obtain BP in Neonates who have very low perfusion pressures.

How can baseline inflation pressure on the CARESCAPE V100 monitor be changed so the monitor does not pump higher than needed and the cuff does not squeeze tighter than needed?

It takes only 2 steps to adjust the INFLATE PRESSURE for adult/pediatrics and neonates. The default SuperSTAT NIBP algorithm inflation pressure is 135 mmHg for adult/pediatrics, which is much lower than the default inflation pressure for other GE DINAMAP NIBP algorithms. The default SuperSTAT NIBP algorithm inflation pressure for neonates is 100 mmHg. To customize the initial inflation pressure to your patient’s typical systolic reading follow the 2 steps below.

1. Press the Menu button until INFLATE PRESSURE (lower left screen) flashes for the appropriate patient type, adult or neonate (upper right screen).

2. Press the ± button to increase (+)/decrease (–) the inflation pressure value.

After 7 seconds of not pressing the Menu button, the menu mode is automatically exited. Otherwise, you can exit by cycling through all menu options. Upon exiting menu mode, the main monitoring screen is displayed. INFLATE PRESSURE is reset to its configured default after power-off.

What validation was done on the SuperSTAT NIBP algorithm?

Accuracy of the SuperSTAT NIBP algorithm was validated in adult/pediatric, and neonatal/infant subjects with the criteria of a national standard (ANSI/AAMI SP 10, 2002). The Adult, Pediatric, and Infant studies were performed in cardiac catheterization lab areas and the Neonatal studies were performed in NICUs. The reference standard of intra-arterial BP (IBP) was compared to the SuperSTAT NIBP algorithm values. The differences between the SuperSTAT NIBP algorithm readings and the IBP readings for systolic, diastolic, and mean arterial pressure (MAP) were analyzed. SuperSTAT NIBP algorithm readings were well within the national standard accuracy specifications of ±5 mmHg mean difference and less than or equal to 8 mmHg standard deviations for the adult/pediatric, and neonatal/infant populations. The results of another Neonatal study using SuperSTAT NIBP algorithm can be found in the peer review publication by Nelson, et al (2002).
References

Patents
US 5,704,362 Method for oscillometric blood pressure determination employing curve fitting
US 5,579,776 Oscillometric blood pressure monitor with enhanced cuff pressure control
US 6,358,213 Calculation of quality and its use in determination of indirect noninvasive blood pressure
US 6,423,010 Oscillometric blood pressure monitor with improved performance in the presence of arrhythmias
US 6,746,403 Physiological-signal-analysis device for measuring a blood pressure and method
US 7,074,192 Method and apparatus for measuring blood pressure using relaxed matching criteria
US 7,070,566 Artifact rejection using pulse quality values
US 6,893,403 Oscillometric determination of blood pressure
US 5,680,870 Oscillometric blood pressure monitor which acquires blood pressure signals from composite arterial pulse signal