

# The Importance of Human Factors and Ergonomic Principles in Computerized Cart Design

While computerized carts have become staples in healthcare settings to improve workflow, the importance of considering the human factors and ergonomics (HF&E) of their use is often not fully understood. When mobile workstations have the correct ergonomic standards, a user's risk of discomfort due to the effects of repetitive action is decreased, which might mean a reduction in worker's compensation claims and other expenses a facility might endure because of an employee's absence. Furthermore, the appropriate ergonomics increase staff satisfaction and productivity. These factors combined create substantial benefits not just for the healthcare facility, but its employees as well.

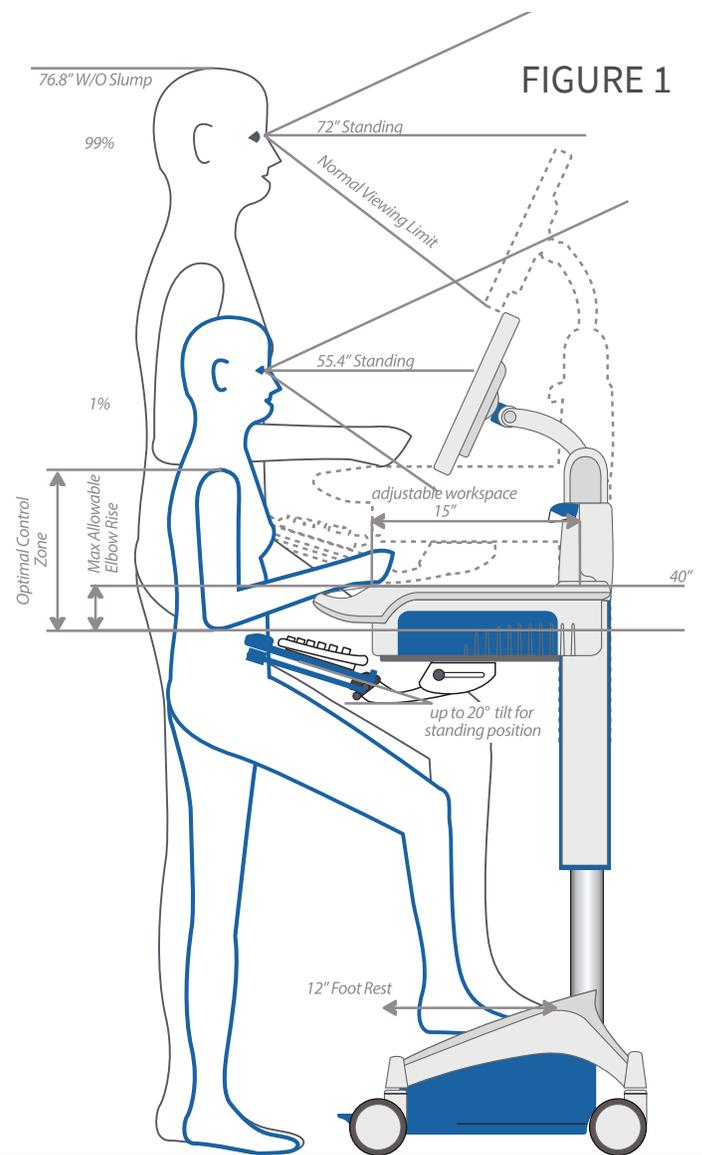
There are key ergonomic characteristics to consider when in the market for a mobile computer cart. These following key points will help you understand and guide you in the right direction.

## WORK SURFACES AND DATA INPUT

The cart should provide an adequate work surface platform and surface keyboard that can both be easily raised 48" from the floor to allow for the individual's proper geometry when in a standing position (Figure 1). While in a seated position, the work surface and keyboard should have the capability to be lowered 25" from the floor to be ergonomically correct. (Figure 2). In both instances, the keyboard should allow for tilt, so the wrists are not in an uncomfortable position. When typing, your wrists should not be bent outward toward your pinky nor inward toward your thumb. Keep your wrists straight and use the rest only for taking breaks from typing.

**In order to accommodate users from the one percentile to the 99 percentile of height while standing or sitting, the cart should include an angled footrest.** On average, nurses walk 6.5 miles per shift. Therefore, when standing while inputting information into the computer of a mobile cart, a footrest provides quick relief that might reduce fatigue or soreness of the feet. When in a sitting position, an adjustable chair by itself is insufficient because achieving the best height for working at the work surface might leave the feet uncomfortable. In the case where a low chair is used and the feet are close to the floor, an angled footrest is acceptable. With the chair adjusted to the correct working height, people with short legs can use the footrest to reduce discomfort on the underside of the thighs. There are varying types of footrests that can be used, but all must be easily adjustable.

Each computerized cart should provide features that can be quickly and simply modified based on a user's biomedical needs. This way, he or she can work and perform daily tasks comfortably and efficiently.



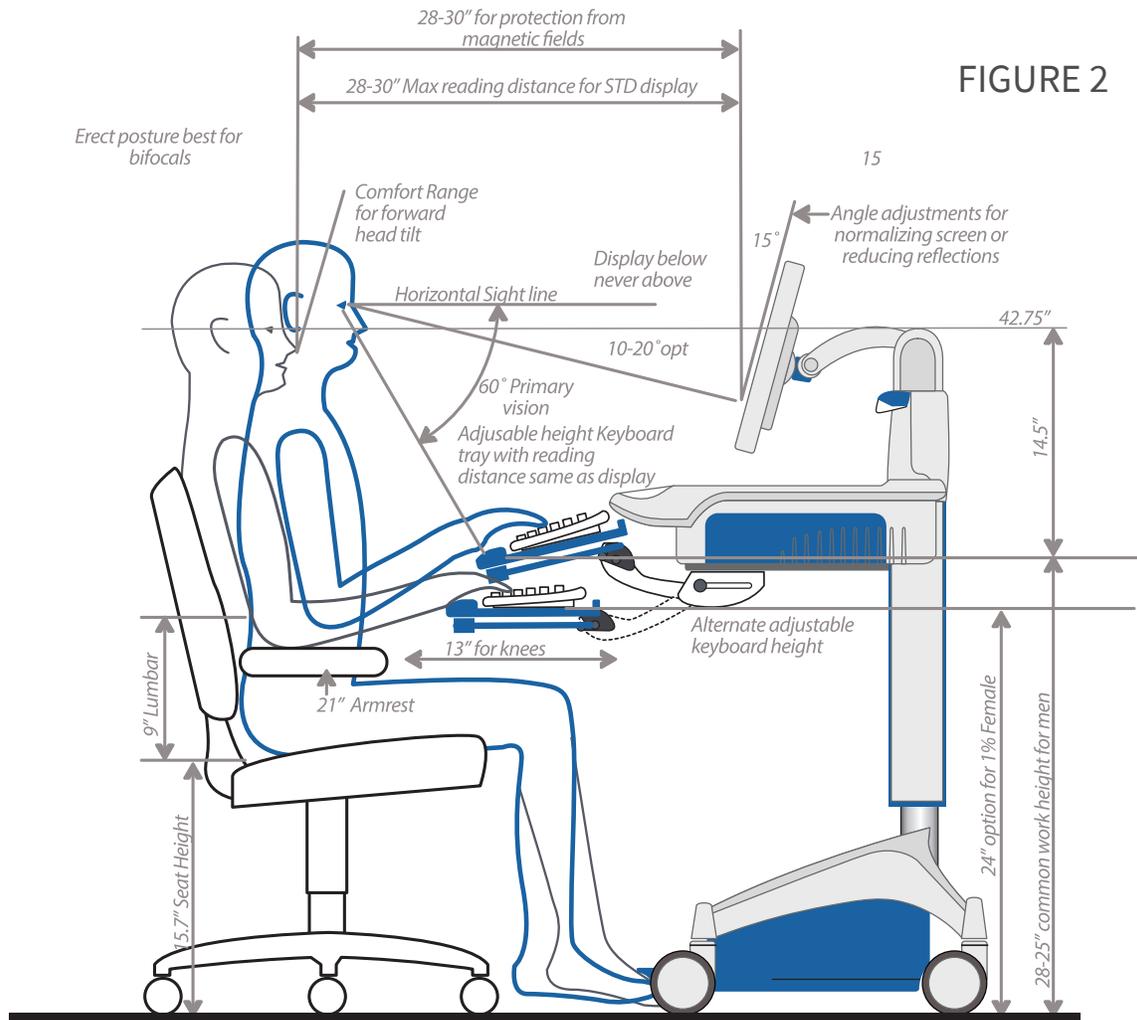


FIGURE 2

## CART MANEUVERING

According to the HF&E experts at Cornell University, who have thoroughly studied ergonomics for computerized workstations, it is important that the cart handles can be adjusted to a comfortable height for best maneuverability. They also suggest to ensure the unit can be easily pushed or pulled with minimal force.

Since some carts are pushed more than they are pulled, the handles should be placed so they straddle the load's center of gravity, but at a height that permits comfortable posture. Handle height should range from 35"-44". The higher the center of gravity of the loaded cart, the higher the handle. Handles lower than 35" are not recommended because that forces taller people to stoop.

Handle type is determined by cart dimensions and handling needs. It might be oriented vertically or horizontally and for one- or two-handed operation. Adequate clearance for the gloved hand is needed whether the handle is part of the cart structure, such as a vertical support or attached. Bar handles, oriented horizontally, permit the user to vary hand

Handle height should range from 35-44 inches.

location to fit the task and accommodate his or her own size and strength needs. For non-adjustable handles that are mounted flush on the cart's surface, horizontal separations in excess of 18" are not recommended unless cart width or depth exceed 35". Vertical bars for handles resolve handle height problems by permitting the operator to choose the most

comfortable position for the hands according to his or her biomechanical needs and the nature of the handling being done. Further, handles should be between 1" to 1.25" in diameter to reduce hand fatigue. While pushing the cart the handles should be curved to keep the wrist in a straight and natural position.

When handles are at a comfortable height, an individual using the cart will have maximum control when steering and can avoid collisions with other carts, staff, and patients in hallways and passing areas. Furthermore, an easy-to-navigate mobile workstation does not take a lot of force to maneuver, so the user has less of a chance of becoming tired or risking muscle strain.

## SCREEN AND DOCUMENT READING

Similar to work surfaces and keyboards, the professionals at Cornell University suggest a mobile workstation’s screen should be able to be adjusted independently for standing and sitting.

**When standing, the top of a 22-24" LCD screen should have the ability to be raised to 71" from the floor, and for sitting, the bottom of the screen at 32".** These dimensions are designed to accommodate all percentiles of individuals by considering the postural implications, as well as the visual needs of the task. Additionally, the user should have the capability to swivel and tilt the computer screen to a comfortable viewing position. This capability helps accommodate bifocal users. Figures 1 and 2 demonstrate the correct neck positioning when standing or sitting in front of a cart. These recommended dimensions will allow the user to work productively without fatigue build-up from awkward head postures.

## STORAGE, ACCESSORIES AND POWER

While maneuvering a mobile workstation, the user should not have to worry about carrying additional items in his or her arms. This is not only a safety risk to the user, but to others in hallways or patient rooms. Therefore, the unit needs to provide sufficient storage for task requirements, accommodate the required accessories to complete tasks and be equipped with security measures to prevent equipment from theft.

Because a cart’s battery power means the difference between being usable and unusable, it’s very important that an easy-to-read display of a battery power icon is present on the workstation screen. **To further protect against loss of work progress, the cart should provide visual and audible warnings for impending low power.** To make sure the unit’s battery can last multiple shifts, the professionals at Cornell University recommend using a battery that is sufficient enough for the day’s tasks and doesn’t take long to recharge.

## HYGIENE

Due to the sterile environment of healthcare settings, the mobile workstation should have a mechanism other than a fan to cool the battery, so contaminants aren’t blown into the air. Also, the cart should be made from materials that are **antimicrobial or easy to clean and sterilize**. To protect users and patients from cuts or scrapes, the edges of the unit should not be sharp, but rather rounded or padded.

## IN SUMMARY

The study of ergonomics uses the knowledge of human capacities and capabilities to assist in the design of safe and productive jobs, workplaces, equipment and products. Therefore, when you adhere to the proper ergonomic standards of computerized carts, worker productivity might be improved because unnecessary effort and discomfort to perform tasks is minimized, the development of fatigue over a shift is curtailed, and the healthcare facility will be able to use its staff’s skills optimally, which leads to increased job satisfaction. **Therefore, when deciding which mobile workstation to purchase, insist that the manufacturer’s representative answer any questions you might have and/or demonstrate the unit’s ergonomic features before a final decision is made.** Being informed and knowledgeable increases the potential of a worthwhile return on your investment, not just financially, but also when it comes to positive employee relations.

## MOBILE COMPUTING WORKSTATION ERGONOMIC EVALUATION TOOL

Before purchasing a mobile workstation, it’s best to have the manufacturer demonstrate the ergonomic design principles of the following:

	Excellent	Good	Fair	Poor	Notes
WORK SURFACES AND DATA INPUT					
CART MANEUVERING					
SCREEN AND DOCUMENT READING					
STORAGE, ACCESSORIES AND POWER					
HYGIENE					

For a comprehensive list of ergonomic features to consider, please consult the Cornell University Healthcare Computer Cart Ergonomic Checklist.

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WORKS CITED:

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