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Health Clinics
for Ontario
Workers Inc.

Centres de
santé des
travailleurs (ses)
de l'Ontario Inc.

Economics of Ergonomics: How to Avoid Costly Mistakes

Trevor Schell, M.Sc, CCPE

Bottom Line Benefits of Ergonomics Applications



Ergonomics can:

- Result in a three to tenfold improvement in performance, throughput and savings, if done correctly
- Reduce the risk of future occupational injuries and productivity problems.
- Improve productivity, reduce lost time, absenteeism, and save dollars measured through standard measurement systems. In addition, they can lead to lower WSIB premiums and medical costs.



Hal Hendrick – Author & Researcher

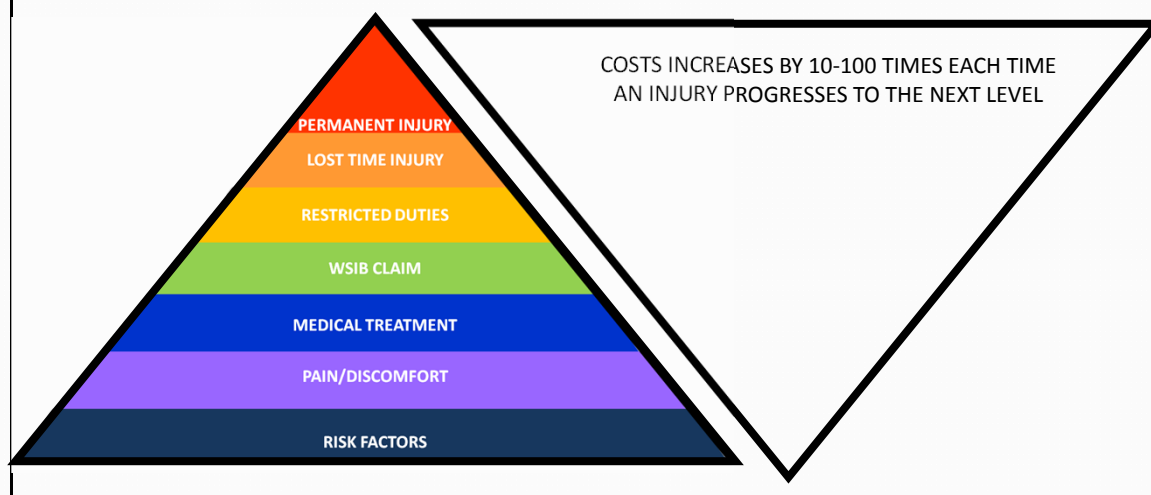
“... I know of no profession where so small a group of professionals has such a tremendous potential for truly making a difference.

In light of our potential, why is it, then, that more organizations, with their strong need to obtain employee commitment, reduce expenses, and increase productivity, are not banging down our doors for help, or creating human factors/ergonomics positions far beyond our capacity to fill them?”

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How much are you spending?



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Objective/Subjective Changes of Ergonomic Intervention



- Reduced risk of injury in the workplace.
- Reduced WSIB claims and payment.
- Reduction in premiums.
- Improved workplace morale.
- Improved workplace relations and worker accountability.
- Improvement in quality and productivity.

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Defining Ergonomics



“The Science of studying people at work, and then designing the working environment to ensure that they can be safe, healthy, effective and comfortable”.

Goal is **TO** fit the job to the worker **NOT TO** fit the worker to the job

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Common Mistakes When Purchasing

- Needs not considered
- Choosing price over quality
 - includes adjustable features
- Choosing looks over comfort
- Not all workers are the same
- Not testing equipment
- Not having central purchasing
- No after sales support
 - Warranty issues – is there one?
- Not consulting an ergonomist

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Needs not considered - Casters

- Caster material should align with floor surface: hard plastic for carpet, rubber for hard surfaces
- If purchase rubber at time of purchase - \$15/set
- If purchase rubber after purchase - \$25/set plus install time
 - \$50+labour

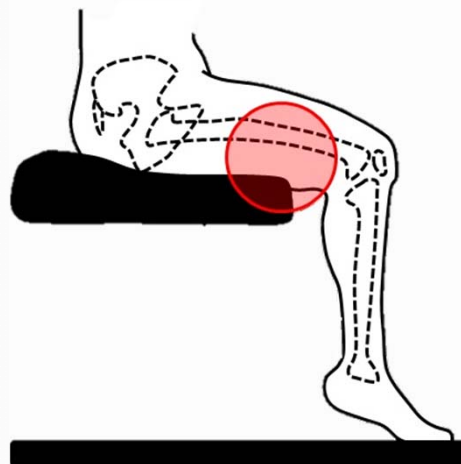


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Needs not considered – Seat Height

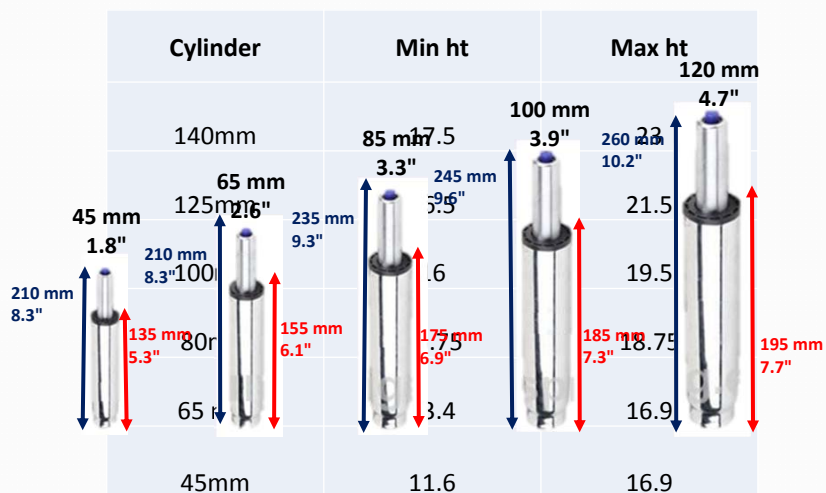
- Task chairs should have pneumatic seat-height adjustment for comfort and support as well as shock absorption and swivelling range of motion height range is important



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Needs not considered – Seat Height



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Needs not considered – Seat Height

- Seat height range varies with standard cylinder length
 - Height of base
 - Insert of cylinder
 - Thickness of seat

| Standard Cylinder | Corresponding Seat Height | Chair |
|-------------------|---------------------------|--|
| 5" | 16"-21" | Humanscale Freedom Chair |
| 5" | 18"-22" | Neutral Posture NPS5600 |
| 5" | 19"-24" | Gaming Chair ED-OM5-XT |
| 5" | 16"-21" | Gaming Chair ED-OM5-EX |

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Needs not considered – Seat Height

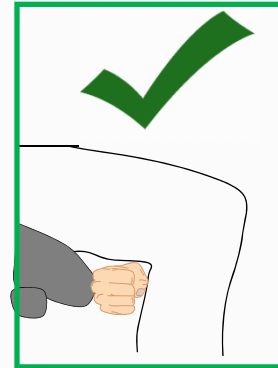
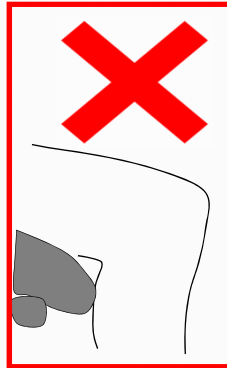
- No price difference if ordered upfront
- \$75 plus labour after purchase

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Needs not considered – Seat Depth



- Proper seat depth will allow user to sit against the backrest with approximately top fist to two-fingers of clearance between the back of the knees and front edge of the seat
- Larger seat pans are more expensive
- Depending on company replacement seat pan is \$150 plus labour

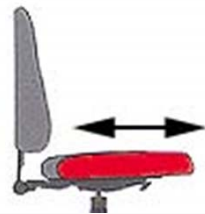


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Needs not considered – Seat Depth



- Depending on the chair/company a seat depth adjustable feature can be added
 - Cost - \$100
- Critical to note minimum depth of seat pan



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Needs not considered – Synchronized Back and Seat Tilt



- Multi-tilt is \$20 cheaper than synchronized



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Needs not considered – Seat Angle



- Seat should not dip inward in the centre (this adds pressure on legs, back and promotes a slouching posture) and should not rise up in the back middle portion (this adds pressure at the base of the spine, hips and thighs)



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Needs not considered – Back Rest - Angle



- Tilt 90-100°



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Needs not considered – Back Rest Height Control



- Knob vs Ratchet
- Type dictated by chair/model

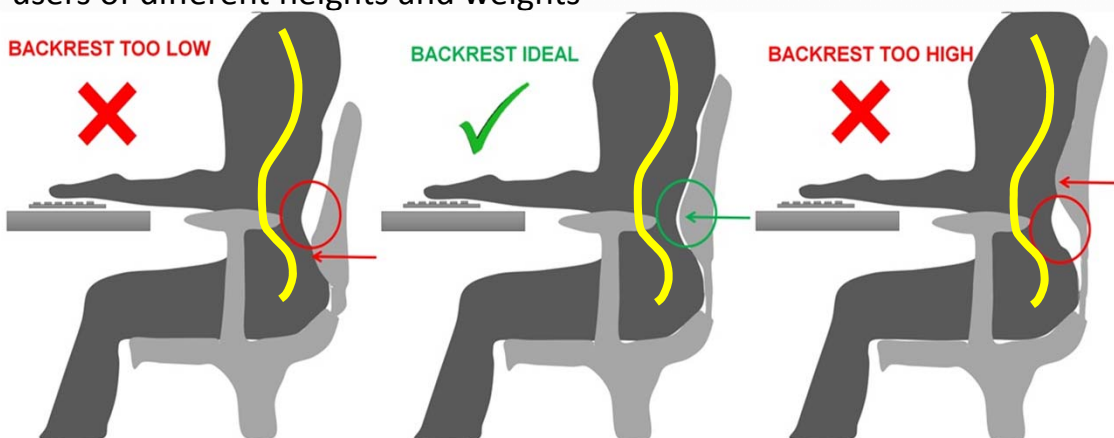


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Needs not considered – Lumbar Support

- The lumbar support should adjust up and down to accommodate users of different heights and weights



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Needs not considered – Armrests

- Are they needed?
- Common misuse
- Without armrests \$135.00 cheaper



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Needs not considered – Armrests

- Some companies have developed lower armrests
- No extra cost if ordered before purchase
- If after purchase ~\$125
- Lower Armrest – Labour Costs and Supplies



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Example – Office Chairs


- Average chair cost ~ \$370.00
- Bought 110 new chairs because changed location (\$40,700)
- Many of staff happy with old chairs
- OHCOW called in to present on office ergonomics after staff started to complain
- Presentation did not occur when ergonomist noted chairs did not fit the workers
- Review of staff was undertaken

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Measurements Taken




- Buttock-popliteal length




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Measurements Taken




- Seat Pan Depth




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Measurements Taken

- Popliteal Height




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Measurements Taken

- Seat Pan Height



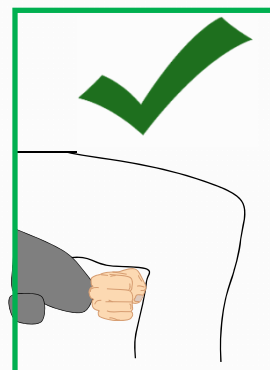
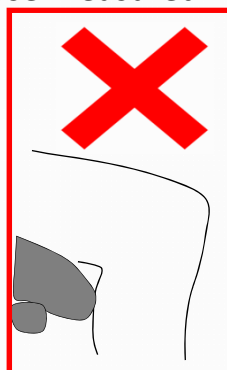
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Results – Seat Depth

- 92% staff were available to be measured
- Seat depth – 18.5”
- Staff buttock-popliteal length ranged from 17-20”
- Seats too deep for 64% of those measured

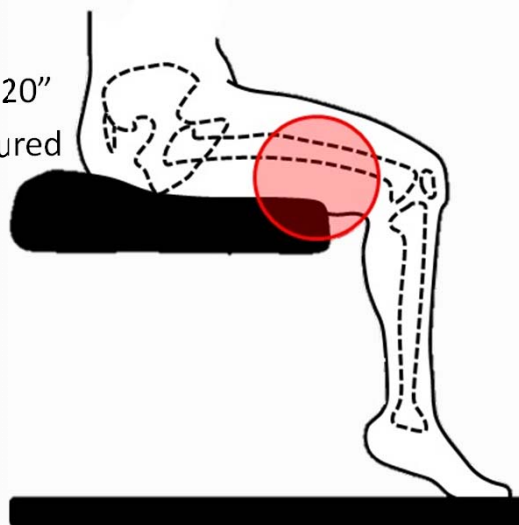


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Results - Seat Height

- 92% staff were available to be measured
- Lowest seat height – 19”
- Staff popliteal height ranged from 16-20”
- Seats too high for 76% of those measured



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Results – Supplier

- Willing to change seat depth to **18"** and offered a lower cylinder to reduce seat height to 16.5"
- Seats would still be too deep for 61% of the staff and too high for 5% of the staff
- If supplier had provided 17" seat pans all but 20% would be accommodated
- To purchase 52 new chairs with smaller seat pans would be an additional \$20,720
- Total cost of buying new chairs **\$61,420** compared to original \$40,700

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Example – Height Adjustable Desks

- What is the price
 - Varies greatly based on supplier
 - Separate frame/desktop
 - Combine package
 - Size
 - Extra features

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Lets Find a Height Adjustable Desk



- Searched for :
 - 3 –legged desk
 - Electric
 - Memory pre-set
 - Frame and desktop combined
 - Desk dimensions 24”x48”x60”



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Costs



- Cost using above criteria was \$2,665.63 CDN funds
 - Height range was 24”-51”
- Just the 3-legged frame was \$1200 CDN funds
- Price similar for standard vs extended range
 - Extended range 22.5”- 48.5”
- Motor
 - Single \$800
 - Dual \$1200

Note with searching found desks at half the price

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Height Ranges

- Standard is 24"-51"
- Read the fine print
 - Height Range single base: 22.8" to 48.3" (not including work surface thickness)
- Likely need dual stage base
- Some suppliers may not sell just the base
 - Whole unit to replace
- Be specific to supplier more information is better
 - Max/min heights needed with desktop

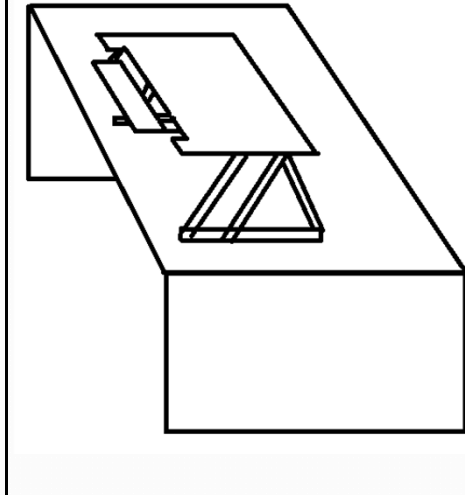
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Alternate Stations

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Desk Surface System



Benefits

- Cost-effective ~ \$670
- Fits in small spaces and on any work surface

Risks

- Awkward posture when lifting to stand position
- Force required to lift to stand position
- In the seated position, the keyboard is above desk height

Best Use

- Standing only

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Desk Surface System



Average Desk Height = 75cm

Male Anthropometric Data – Seated Elbow Height

| Mean | 5 th percentile | 95 th percentile |
|---------------|----------------------------|-----------------------------|
| 68.8cm (-6.2) | 59.4cm (-15.6) | 78.2cm (3.2) |

Female Anthropometric Data – Seated Elbow Height

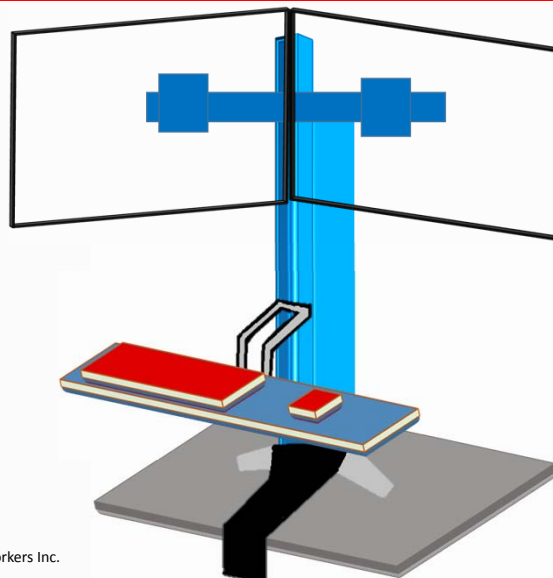
| Mean | 5 th percentile | 95 th percentile |
|----------------|----------------------------|-----------------------------|
| 64.3cm (-10.7) | 56.0cm (-19) | 72.1cm (-2.9) |

So unit on desk = 78 cm at lowest setting

- 9.2 cm too high for average male
- 13.7 cm too high for average female

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Desk-Mount Workstations



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Desk-Mount Workstations



Benefits

- Cost-effective ~ \$680
- Easy to maneuver
- Fits in small spaces and on any work surface
- Keyboard sits below desk height

* Tray must extend below desk

Downfall

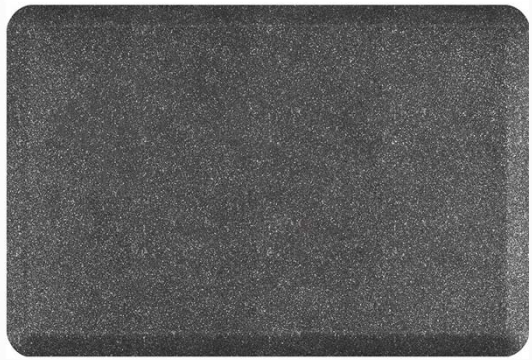
- No memory
- Keyboard too high for shorter individuals
- Can't adjust distance of monitors
- No height-adjustable work surface

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Additional Costs

3' x 2' Anti-Fatigue Mat
• \$70



*** Denotes highly recommended**

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Additional Costs

Footrest
• \$40



*** Denotes highly recommended**

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Additional Costs

Monitor arm **if** monitor not height adjustable

- Single - \$150
- Dual - \$250



*** Denotes highly recommended**

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Additional Costs

Wrist Rest

- \$20



*** Denotes highly recommended**

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Additional Costs



Mouse Rest

- \$15



*** Denotes highly recommended**

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Additional Costs



Memory Preset

- \$90



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Additional Costs

CPU Holder
• \$70



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Additional Costs

Wire Management Kit
• \$90 - \$180



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Additional Costs

Half Circle Desk Drawer

- \$65



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Additional Costs

Desk Wire Grommet

- \$10/each



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Additional Costs



Desk Casters

- \$85



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Additional Costs



Laptop Stand

- \$150



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Additional Costs



Tablet Stand

- \$150



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Additional Costs



2 Drawer Filing Cabinet 20" high

- \$275



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Additional Costs

Highly Recommended

| | |
|--------------------------------------|--------------------|
| Anti-Fatigue Mat | \$70 |
| Footrest | \$40 |
| Wrist Rest | \$20 |
| Mouse Rest | \$15 |
| Cost | \$145 |
| Monitor arm if not height adjustable | \$150 |
| Single | \$250 |
| Dual | |
| Cost | \$295 - 395 |

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Additional Costs

Suggested by Supplier

| | |
|-------------------------|-------------------------|
| Memory Preset | \$90 |
| CPU Holder | \$70 |
| Wire Management Kit | \$90 - \$180 |
| Half Circle Desk Drawer | \$65 |
| Desk Wire Grommet (2) | \$20 |
| Wheels | \$85 |
| Laptop Stand | \$150 |
| Tablet Stand | \$150 |
| Total | -\$995 - \$1 085 |

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Total Costs

| Ergo Recommended \$145 | | Single Monitor Arm + Ergo Recommended \$295 | | Dual Monitor Arm + Ergo Recommended \$395 | |
|------------------------------|-------------------|---|-------------------|---|-------------------|
| Supplier Suggestions | \$1 085 | Supplier Suggestions | \$1 085 | Supplier Suggestions | \$1 085 |
| Desk Price | \$2 665.63 | Desk Price \$ | \$2 665.63 | Desk Price | \$2 665.63 |
| | \$3 895.63 | | \$4 045.63 | | \$4 145.63 |
| Without Supplier Suggestions | \$2 810.63 | Without Supplier Suggestions | \$2 960.63 | Without Supplier Suggestions | \$3 060.63 |

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Example – Height Adjustable Desks

- Government Office
- Bought 166 new chairs and height adjustable desks
- OHCOW asked to come in to train 10 staff to perform ergonomic measurements so workers could be fit to new desks and chairs
- Minimum desk height was 24.5”

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Chairs



| | |
|--|----------------------------|
| | Cost to fix chairs |
| • Chairs too deep for 8% of staff | \$1950 |
| • Chairs too high for 20.5% of staff | \$2625 |
| • Chairs too deep and too high for 5.4% of staff | \$1800 |
| • Chairs did not match 33.9% of the staff | |
| | Total cost - \$6375 |

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Height Adjustable Desks



- Desk at lowest setting too high for 57% of staff when sitting (24.5")
- If had purchased desks with a minimum height of 22" all but 1.2% would be accommodated
 - **IF** supplier sold just the frame \$~1400 (**\$133, 000**)
 - **BUT** some suppliers only sell full unit \$2665.63 (**\$253, 234.85**)
- Lower desks are no more expensive than standard desks (\$100 difference)

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Height Adjustable Desks



- Only other cost effective process was to purchase keyboard trays for the desks
\$214.99
= **\$20425**

If correct the trays and mechanisms are purchased



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Total Cost



- Chairs - \$6375
- Replace frame (\$133, 000)
- Buy new full unit (\$253, 234.85)
- Buy keyboard tray \$20425

Frame

- \$153, 425

New Units

- \$259, 609

Trays

- \$26, 800

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Anthropometrics

Sit-stand desk without extended range = 62 cm / 24.5"

Male Anthropometric Data – Seated Elbow Height

| Mean | | 5 th percentile | | 95 th percentile | |
|--------|-------|----------------------------|--------|-----------------------------|-------|
| 66.9cm | 26.3" | 55.9cm | 22" | 73.5cm | 28.9" |
| (4.9) | (1.8) | (-6.1) | (-2.5) | (11.5) | (4.4) |

Female Anthropometric Data – Seated Elbow Height

| Mean | | 5 th percentile | | 95 th percentile | |
|--------|--------|----------------------------|--------|-----------------------------|-------|
| 59.9cm | 23.6" | 51.6cm | 20.3" | 68.9cm | 27.1" |
| (-2.1) | (-0.9) | (-10.4) | (-4.2) | (6.9) | (2.6) |

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SP10



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SP10 title?

Sheila Patterson, 12/02/2018



OHCOW Tools to Help You

- Office Calculator - <https://goo.gl/xhXzpD>
- Purchasing Policy

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Office Ergonomics Calculator

About your workstation

| | | | |
|--|--|---|---|
| <p>Seat Pan Height (from floor)</p> <p>Enter in CM</p> | <p>Arm Rest Height (from floor)</p> <p>Enter in CM</p> | <p>Seat Pan Depth (from floor)</p> <p>Enter in CM</p> | <p>Workstation Height (from floor)</p> <p>Enter in CM</p> |
| <p>Screen Height (from floor)</p> <p>Enter in CM</p> | <p>Keyboard Height (from floor)</p> <p>Enter in CM</p> | <p>Mouse Height (from floor)</p> <p>Enter in CM</p> | |

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Office Ergonomics Calculator



| Current Position vs. Ideal | | | |
|----------------------------|--------|-----------------|-------|
| Desk Height | -13 cm | Seat Height | -2 cm |
| Seat Pan Depth | -6 cm | Screen Height | 3 cm |
| Arm Rest Height | -7 cm | Keyboard Height | -3 cm |
| Mouse Height | -3 cm | | |
| Proper Office Set Up | | | |
| Seat Pan Height | 44 cm | Arm Rest Height | 60 cm |
| Seat Pan Depth | 44 cm | Desk Height | 62 cm |
| Screen Height | 117 cm | Keyboard Height | 62 cm |
| Mouse Height | 62 cm | | |
| Try Again? | | | |

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How Does it Help With Buying Equipment?



- Calculator can be used for more than determining when/how equipment should be adjusted
- Let's assume a 5' tall female
- Company looking at getting new equipment including a sit/stand desk

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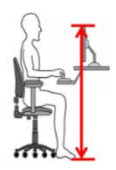


Scenario – 5' Tall Female

- With calculator all fields must be filled in to get the proper information.

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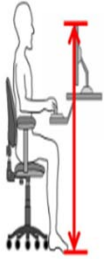


Date Inputted

| | | | |
|---|---|---|---------------------------------|
| Seat Pan Height (from floor) | Arm Rest Height (from floor) | Seat Pan Depth (from back rest) | Workstation Height (from floor) |
| Screen Height (from floor) | Keyboard Height (from floor) | Mouse Height (from floor) | |
|  |  |  | |
| 123 | 76 | 76 | |
| 45 | 56 | 46 | 73 |

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Date Inputted








| Screen Height (from floor) | Keyboard Height (from floor) | Mouse Height (from floor) |
|--|---|---|
|  123 |  76 |  76 |

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Date Inputted



| Seated Buttock-Popliteal Length | Seated Popliteal Height | Seated Knee Height |
|---|---|---|
|  44 |  39 |  49 |
| Seated Elbow Height | Seated Eye Height | |
|  56 |  70 | |

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Date Inputted



Do you use a sit-stand desk?


Yes

Standing Eye Height



141


Standing Elbow Height



95

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Results



Current Position vs. Ideal

| | | | |
|-----------------|--------|-----------------|--------|
| Desk Height | -17 cm | Seat Height | 0 cm |
| Seat Pan Depth | -2 cm | Screen Height | -53 cm |
| Arm Rest Height | -10 cm | Keyboard Height | -20 cm |
| Mouse Height | -20 cm | | |

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Results



| Proper Office Set Up | | | |
|-----------------------------|-------------|-------------------------|---------------|
| Seat Pan Height | 39 cm 15.4" | Arm Rest Height | 54 cm 21.3" |
| Seat Pan Depth | 41 cm 16.1" | Desk Height | 54 cm 21.3" * |
| Screen Height | 70 cm 27.6" | Keyboard Height | 56 cm 22" |
| Mouse Height | 56 cm 22" | | |
| Standing Desk Set up | | | |
| Desk Height | 92 cm 36.2" | Standing Monitor Height | 141 cm 55.6" |

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Only Option



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Purchasing Policy



- Limits multiple people purchasing
- Standardization of equipment
 - Not size - type



Occupational Health

Rationale:

Previously, staff selected equipment from a catalogue only to discover afterwards that it was not specific to their body dimensions or that the equipment was not as described. In consultation with a Certified Ergonomist, this plan has been implemented to ensure the safety of all staff and for the procurement of equipment that is truly *ergonomic*.

All equipment used in this facility will be standardized to ensure that all furniture meets current ergonomic standards and will meet the ergonomic needs of all staff to ensure they may be safe, healthy, effective and comfortable.

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Purchasing Policy



Equipment Purchasing Procedure

Any employee requesting office equipment must complete the "Equipment Request Form" and submit this to their immediate supervisor.

Employee:

- 1) Obtain "Equipment Request Form"
- 2) If requesting a new chair, the employee shall provide the following measurements in centimeters (cm) :
 - a. Buttock-Popliteal Length (Sitting)
 - b. Popliteal Height (Sitting)
 - c. Knee Height (Sitting)
 - d. Elbow Height (Sitting)
 - e. Eye Height (Sitting)

Note: If these measurements are not provided at the time the request is submitted, the request form will be returned to the employee so that the appropriate information may be completed.

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Purchasing Policy

Immediate Supervisor:

Upon receiving an employee's "Equipment Request Form":

- a) Ensure that all required information has been completed by the employee
- b) Authorize/deny employee request
- c) Upon authorizing request, forward to purchasing department for processing and ordering

Purchasing Department:

- 1) Upon receiving an employee's authorized "Equipment Request Form", order the requested equipment from a supplier that has been approved by a "Certified Ergonomist".
- 2) Utilize existing ordering procedure

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Equipment Request Form

Requested By: _____
Department: _____
Date Requested: _____

| Item Requested: (Check all that apply) | Required Measurements: (provide the following personal measurements to be used for the purchase of new equipment). |
|--|--|
| <input type="checkbox"/> Chair | Buttock-Popliteal Length: _____ cm - 3 cm = _____ cm seat pan depth Popliteal Height: _____ cm Seated Elbow Seated: _____ cm |
| <input type="checkbox"/> Desk | Seated Elbow Seated: _____ cm Seated Knee Height: _____ cm |
| <input type="checkbox"/> Keyboard/Mouse Tray | Seated Elbow Seated: _____ cm |
| <input type="checkbox"/> Monitor | Seated Eye Height: _____ cm |
| <input type="checkbox"/> Monitor Arm | Seated Eye Height: _____ cm |
| <input type="checkbox"/> Head set | |
| <input type="checkbox"/> Footrest | |
| <input type="checkbox"/> Document Holder | |
| <input type="checkbox"/> Wrist rest | |
| <input type="checkbox"/> Mouse rest | |

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Authorized By: _____ Date: _____
Account #: _____





Purchasing Policy

- The Office Calculator – can even eliminate some of these steps

Office Ergo Calculator

Enter the Assessment identifier from a previous assessment to review the report:

Your Unique Assessment ID

cecalculator.php **1518202427f6ec0bd6**

Retrieve Office Calculator Assessment

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Results

| Proper Office Set Up | | | |
|-----------------------------|-------------|-----------------|-------------|
| Seat Pan Height | 39 cm 15.4" | Arm Rest Height | 54 cm 21.3" |
| Seat Pan Depth | 41 cm 16.1" | Desk Height | 54 cm 21.3" |
| Screen Height | 70 cm 27.6" | Keyboard Height | 56 cm 22" |
| Mouse Height | 56 cm 22" | | |

| Standing Desk Set up | | | |
|-----------------------------|-------------|-------------------------|--------------|
| Desk Height | 92 cm 36.2" | Standing Monitor Height | 141 cm 55.6" |

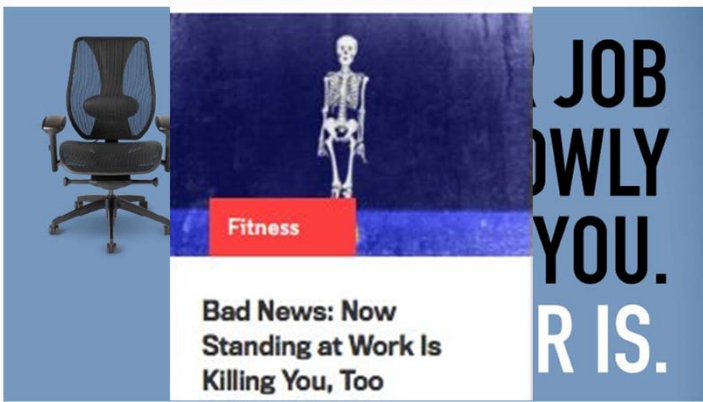
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Tip – Watch out for the media - 2015



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Tip – Watch out for the media - 2018



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Tip



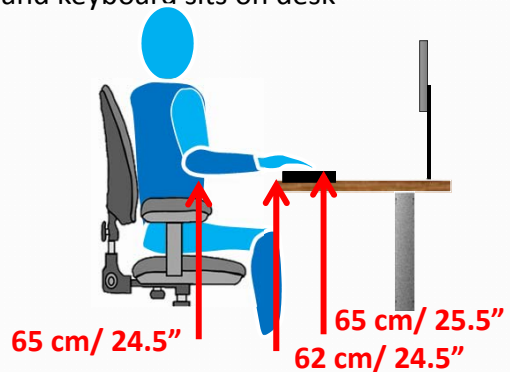
- No legislation on the use of the word ergonomics
- Often a catchphrase used by designers and companies
- Try before you buy
- Consult an ergonomist before purchasing
 - OHCOW is a prepaid service
 - Even private consulting fee is much less costly than a \$692,900 error

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Tips



- Sales people are not ergonomists
- Sit/stand desks do not need a keyboard tray in most cases
- Need to remember the height of keyboard and mouse as well (~3 cm 1" thick)
 - If seated elbow of worker is 65 cm (25.5") and keyboard sits on desk then desk height needs to be 62cm or 24.5"



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Other Hurdles to Overcome

- Do guidelines work?
 - 2007 Ergonomic Guidelines
 - 2018 Ergonomic Guidelines
 - If not legislated how many would use it?
- Government Agencies (Provincial/Federal)
 - CSA Standard
 - HSA resources and tools
 - Are injury rates really on the decline?
 - Only based on accepted WSIB claims
 - What about unaccepted claims?
 - Review of products?
 - Especially internally
 - List of approved/endorsed equipment

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Other Hurdles to Overcome

- Research
 - Many research projects duplicate each other
 - Many lack any real world applications
 - Review of products?
 - Do they do what they say?

Google Scholar search for "carpal tunnel syndrome hypothyroidism" showing approximately 17,000 results. The search results include:

- Article 1:** [Prevalence of carpal tunnel syndrome in a general population](#) by I Atroshi, C Gummesson, R Johnsson, E Ornstein... - *Jama*, 1999 - jamanetwork.com. Abstract: "... 3,4 Carpal tunnel syndrome constitutes a major part of the occupational upper-extremity disorders and is associated with considerable ... were randomly selected from the responders who reported no hand symptoms, diabetes, rheumatic disease, thyroid disorder, previous wrist ...". Cited by 1361. Related articles. All 12 versions.
- Article 2:** [Prevalence of smoking, obesity, diabetes mellitus, and thyroid disease in patients with carpal tunnel syndrome](#) by Y Karpitskaya, CB Novak... - *Annals of plastic surgery*, 2002 - journals.lww.com. Abstract: "Materials and Methods The charts of 514 patients with CTS who had a surgical decompression of the carpal tunnel between August 1991 and August 1999 were reviewed. The control group included patients seen for general reconstructive surgery or those with ...". Cited by 144. Related articles. All 6 versions.

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Other Hurdles to Overcome

- Association of Canadian Ergonomists
 - Review of products?
 - Do they do what they say?
- Delay of Assessments
 - Many workplaces require a Physician's note first
 - By the time employee seeks medical attention problem may be irreversible
 - Workers need to report problems
 - Working through pain in hopes it gets better - does not work

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Other Hurdles to Overcome

- RSI Day 2019
 - 20th year
 - What have we accomplished?
 - MSDs are more understood
 - Equipment design has improved
 - Where is the Ergonomics Legislation?
 - Guidelines introduced in 2007 and in 2018
 - What can we do going forward?

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