

# Protocol

## Spirometry

### Methods

#### Equipment

Spirometer for Power Lab, WinSpiro spirometer, filter, nose clip, sterile mouthpieces, disposable mouthpieces, Powerlab system

#### Procedure

##### PowerLab system:

1. Start program SPIROMETRY by double-clicking on the icon. Put the spirometric device on the table, in the 1st channel Flow choose Spirometry Pod item from the pop-up menu and press buttons Zero and then Ok.
2. Examined person sits on a chair with his/her back turned to PC monitor in order not to see the record. The nose clip is fixed on the nose and spirometer device with filter and sterile mouthpiece is placed into the mouth of experimental subject. The sensor must be held in horizontal position; the two white plastic tubes should be pointing upwards.
3. Click on the Start button. The 1st channel shows the speed of airflow through the sensor in ml/s, the 2nd channel shows the integral of flow, which is volume, in litres. If the recording is upside-down (inspiration down, expiration up), choose Spirometry Pod (in the 1st channel Flow), then choose Invert and then press Ok.
4. Record following situations:
  - **Resting breathing** for approx. 1 min and 20 seconds
  - **4 resting breathing cycles followed by 1 breathing cycle with maximal inspiration, 4 resting breathing cycles and 1 breathing cycle with maximal expiration** (and once again the whole procedure, without an interruption of recording)
  - **4 resting breathing cycles, then 1 breathing cycle with maximal inspiration followed by maximal expiration** (expire as much volume of the air as you can, speed does not matter in this task) and then 4 resting breathing cycles.
  - **Hyperventilation for about 15 sec**
5. In case the record is significantly shifted upwards or downwards, correct it: in the 2nd channel Volume mark resting breathing in the course of minimally 1 minute and choose Spirometry volume and Apply volume correction. Then press Ok.
6. Save the record under the name "spirometryXY", where XY are initials of the name of the experimental subject, file type is Data Chart File (\*.adicht).
7. In the 2nd channel Volume measure and calculate parameters given in Table 13. Measured values appear in miniwindow Volume, time difference in mini-window Rate/Time.
8. In the 2nd channel Volume choose the whole record. Zoom it by pressing Zoom View, in File choose Print Zoom View. Diminish the record by means of mouse to one third of original size by moving the picture upwards and print it by pressing Ok.

Name:

Numer:

Study group:

## Spirometer WinSpiro

1. Start the program winspiroPRO by double-clicking the icon.
2. Click on the icon Patient; new window called Patients will open
3. Click on the icon New; window for the input of data about the examined person pops-up
  - Click on the icon Auto number; program will now generate ID for examined person
  - Fill in the fields: Last name, First Name, Date of birth, choose Gender, from the scroll-bar, choose the Ethnic group to which examined persons belongs (Caucasian is preset since this is the ethnic group where most white people from Europe belongs)
  - After filling in all the data, click the button Save and the button Go to visit; window Patients may be closed now
4. New window called Insert new visit card appears.
  - Into the field Visit card valid from, fill today's date
  - Field Insert new details should be already chosen and marked with a dot
  - Fill in the Height and Weight of the examined person
  - Click on the icon Confirm new visit card
5. The active window is now called Clinical file of patient XY, where XY is the name of examined person
  - In the field Visit reason choose Control visit
  - Choose, whether the examined person is a smoker, non-smoker or ex-smoker; if he/she is a smoker, then fill, what does he/she smoke, how long and how much does he/she smoke.
  - Leave the other fields empty. Click on the icon Save and close the Clinical file of patient XY window

Note: All input data (gender, age, height, weight, smoking status) are used to place the patient into a group for which there are physiological values saved in the program. Software will further evaluate, how big is the difference (in percent %) in the results of spirometry of the examined person compared to population average.

6. Now the main window „WinSpiroPRO 3.6“ should be active. Connect the disposable mouth piece to the spirometer, fix the nose-clip on the nose of examined person. Examined person sits with his/her back turned to the PC monitor in order not to see the recording.
7. Click on the icon FVC (**Forced Vital Capacity**)
  - Two windows called „FVC-PRE“ a „Incentive“ will open; you will work only with the „FVC-PRE“ window; in the „Incentive“ window, there is only a graphical visualization of the strength of the expiration (represented by opening and closing of the curtain, behind which the picture is hidden)
  - By clicking Start button, you will start the recording of the Flow-Volume loop
  - Examined person will perform 2-3 resting breathing cycles followed by maximal inspiration and maximal expiration that must be as fast as possible
  - After expiration, take the spirometer off the mouth; examined person breaths peacefully; click on the icon Accept to save the recording; if examined person starts coughing or anything else happens during the examination, by clicking the Stop/Delete icon it is possible to delete the recording and start it again using
  - the Start icon
  - Repeat the examination for 2 more times until you obtain properly performed Flow - Volume loop
  - After every successful recording of the Flow-Volume loop, click on the icon Accept in order to see the results

Name:

Numer:

Study group:

- From the part “Baseline spirometry” choose “Best values” for FVC, FEV1, PEF, FEV1/FVC, write them down to your protocol. Also redraw a Flow-Volume loop.
8. Click on the icon VC (**Vital Capacity**)
    - After a sound signal, examined person performs a few resting breathing cycles until approx. 20th second of the recording
    - After the second (long) sound signal, examined person will maximally inspire and maximally expire (does not matter how fast, the volume matters!) and then breaths peacefully
    - The recording will be stopped automatically after 1 minute
    - Repeat the test two more times and write down the values of the lung volumes obtained from the best measurement
  9. Click on the icon MVV (Maximal Minute Ventilation)
    - After a sound signal, examined person performs hyperventilation (i.e. maximal inspiration followed by maximal expiration with the highest possible frequency)
    - Recording will be stopped automatically after 15 seconds
    - Examined person is breathing peacefully for a few minutes, after calming down, repeat the test 2 more times
    - Write down the value of MMV from the best measurement
  10. Click on the icon Results. Into the field Conclusion/Medical report(Spirometry) fill in the suggested diagnosis (obstructive or restrictive lung disease; normal spirometry finding). Click on the icon Print, protocol with the results will be generated and it can be printed now.

Name:

Numer:

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## Results

Fill the table.

<b>respiratory parameter</b>	<b>abbreviation</b>		<b>units</b>	<b>physiological values</b>
<b>resting breathing</b>				
frequency	f		breaths/min	
tidal volume	$V_t$		litre (l)	
minute ventilation	$V_m = f \cdot V_t$		l/min	
Inspiratory reserve volume	IRV		l	
inspiratory capacity	$IC = IRV + V_t$		l	
expiratory reserve volume	ERV		l	
expiratory capacity	$EC = ERV + V_t$		l	
vital capacity	VC		l	
forced vital capacity	FVC		l	
forced expired volume in 1 s	$FEV_1$		l	
relative forced expired volume in 1 s	$FEV_1/FVC$			
<b>hyperventilation</b>				
maximal frequency	$f_{max}$		breaths/min	
maximal tidal volume	$max V_t$		l	
maximal minute ventilation	$max V_m = f_{max} \cdot max V_t$		l/min	

## Conclusion

Write into the conclusion whether the measured volumes correspond to physiological values. Is there any clinically significant respiratory disorder?

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# Protocol

## Pneumography

### Methods

#### Equipment

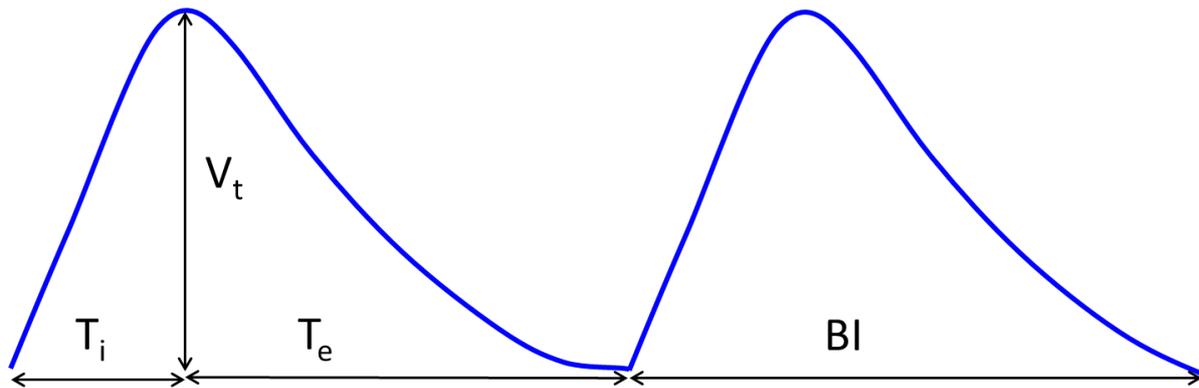
Two respiratory movement sensors, nose clip, sterile mouth piece, Krogh respirometer, PowerLab system

#### Procedure

1. Experimental subject is standing with his/her back turned to PC monitor in order not to see the screen and record. Fix the respiratory belts on chest (1st channel) and abdomen (2nd channel). They must be fixed tightly enough in order to register the respiratory movements but not too tightly to prevent them being damaged!!!
2. Start program PNEUMOGRAPHY by double-clicking on the icon.
3. Set the sensitivity of the amplifier for recording of respiratory movements in the 1st and the 2nd channel. Upper trace corresponds to the recording from the chest; lower trace corresponds to the recording from the abdomen.
4. Record following situations:
  - **Resting respiration** – record for one minute.
  - **Respiration after a mild exertion** – examined person performs 5 squats. Record at least 10 breathing cycles immediately thereafter.
  - **Respiration after an intensive exertion** – examined person performs 30 squats. Record at least 10 breathing cycles immediately thereafter.
  - **Respiration after re-breathing of the expired air** – connect experimental subject to Krogh respirometer which is filled with 5 litres of oxygen (for details, see practical exercise No. XXII; briefly: experimental person exhales; after exhaling turn the side valve on the Krogh respirometer in order to connect experimental person to the tank with oxygen; after closing the valve, experimental person can inhale and he/she is now inhaling the oxygen from the Krogh respirometer). A nose clip prevents mixing of the respired air with the atmospheric air. Since there is CO<sub>2</sub> in the expired air and there is no CO<sub>2</sub> absorber in the Krogh respirometer, its concentration in the respirometer gradually increases which leads to an increase of pCO<sub>2</sub> in the body and to changes in respiration. After reaching observable changes in respiration (approx. after 2–3 min), open the side valve on the respirometer (experimental person is now breathing the atmospheric air). Record at least 20 consecutive breathing cycles and observe how respiration gradually recovers. For further evaluation, choose only the first six breathing cycles after disconnection from the respirometer.
5. Insert comments about all performed situations in the record.
6. Save the record under the name „pneumographyXY“, where XY are initials of the name of the experimental subject, file type is Data Chart File (\*.adicht). Do not print the record.

## Evaluation

Choose one of the channels and measure following parameters in 6 chosen breathing cycles for all situations: duration of inspiration ( $T_i$ ), duration of expiration ( $T_e$ ), breathing interval (BI) and amplitude  $V_t$  (see figure). Measured values will appear in mini-window Rate/Time. Write down obtained values in the table.



$$\bar{x} = \frac{\sum_{i=1}^6 x_i}{6} = \frac{(x_1 + x_2 + \dots + x_6)}{6}$$

$$SD = \sqrt{\frac{\sum_{i=1}^6 (x_i - \bar{x})^2}{5}} = \sqrt{\frac{[(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \dots + (x_6 - \bar{x})^2]}{5}}$$

$x$ :  $T_i$ ,  $T_e$ ,  $V_t$ , BI

$\bar{x}$ : mean  $x$

SD: standard deviation

Name:

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## Results

	cycle	1	2	3	4	5	6	mean	SD
<b>Resting respiration</b>	<b>T<sub>i</sub></b>								
	<b>T<sub>e</sub></b>								
	<b>BI</b>								
	<b>V<sub>t</sub></b>								
<b>After a mild exertion</b>	<b>T<sub>i</sub></b>								
	<b>T<sub>e</sub></b>								
	<b>BI</b>								
	<b>V<sub>t</sub></b>								
<b>After an intensive exertion</b>	<b>T<sub>i</sub></b>								
	<b>T<sub>e</sub></b>								
	<b>BI</b>								
	<b>V<sub>t</sub></b>								
<b>After re-breathing of the expired air</b>	<b>T<sub>i</sub></b>								
	<b>T<sub>e</sub></b>								
	<b>BI</b>								
	<b>V<sub>t</sub></b>								

## Conclusion

Summarise the results of measurement and compare how the measured values of  $T_i$ ,  $T_e$ , BI and  $A_m$  differ at rest, on a mild exertion and on intensive exertion. Evaluate in which way the values of  $T_e$ , BI and  $A_m$  change when breathing into a bag.

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