A Novel Approach to Stethoscope Hygiene
Prof. Gabriele Messina, University of Siena, Italy
A Webber Training Teleclass

UNIVERSITY OF SIENA
DEPARTMENT OF MOLECULAR AND DEVELOPMENTAL MEDICINE

A novel approach to stethoscope hygiene:
a coat-pocket innovation

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Hosted by Prof. Emma Burnett
University of Dundee

Disclosure:

** Co-founder of the Startup egoHEALTH*

Hosted by Prof. Emma Burnett, University of Dundee
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Stethoscope is the most used medical device and symbol of medicine

Introduction Aim Materials & Methods. Results Discussions Conclusions

What is a stethoscope?

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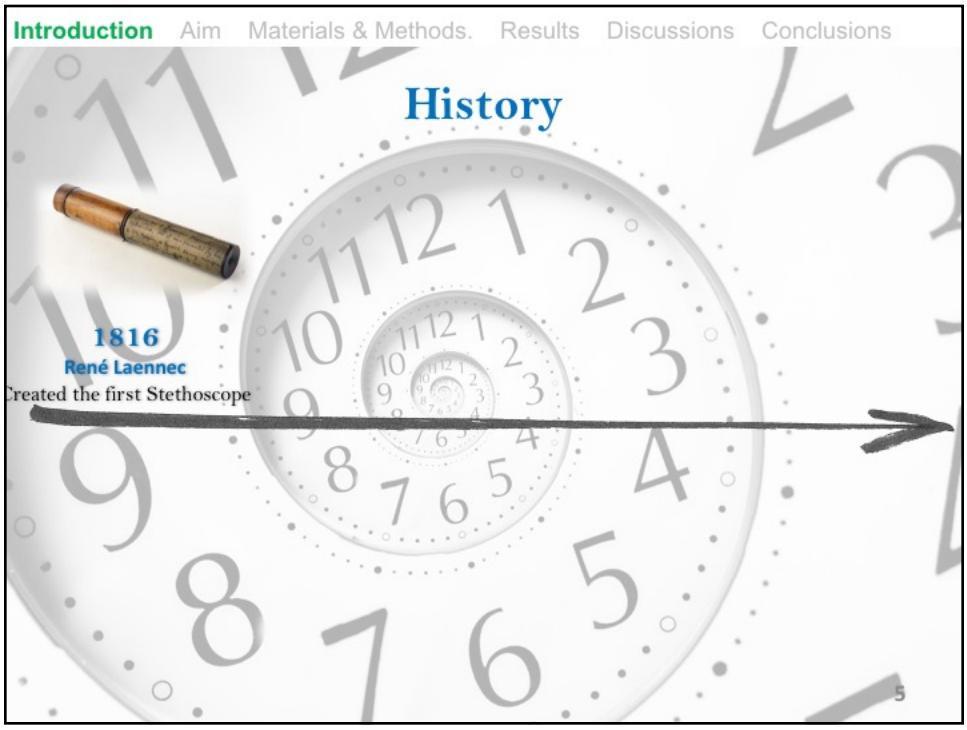
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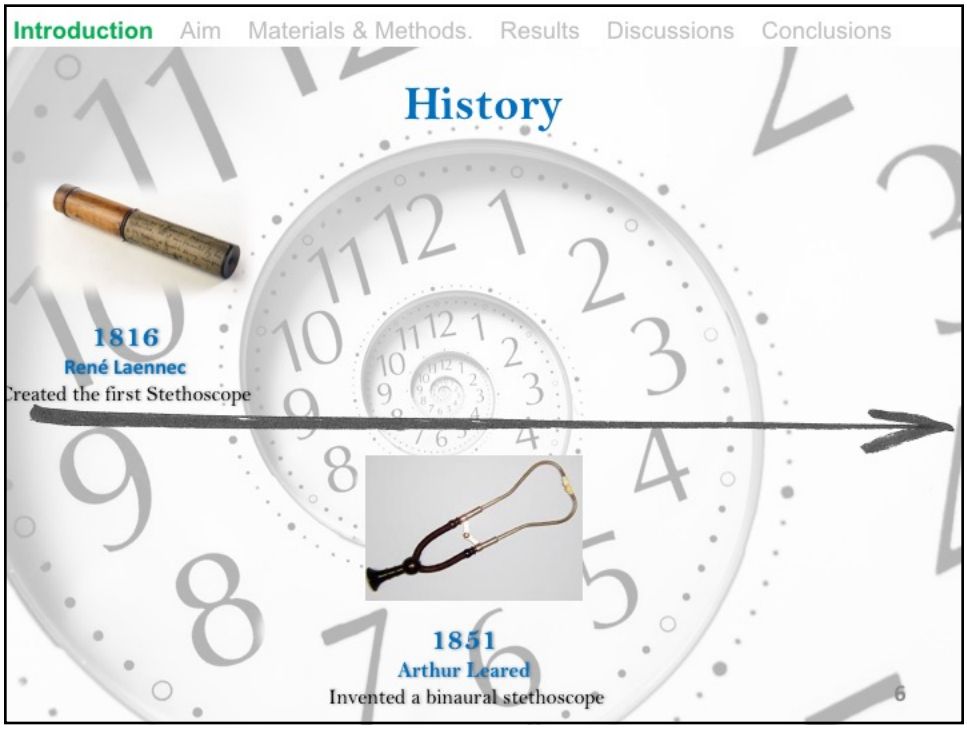
History
1816
René Laennec
Created the first Stethoscope
5


Introduction Aim Materials & Methods. Results Discussions Conclusions
History
1816
René Laennec
Created the first Stethoscope
1851
Arthur Leared
Invented a binaural stethoscope
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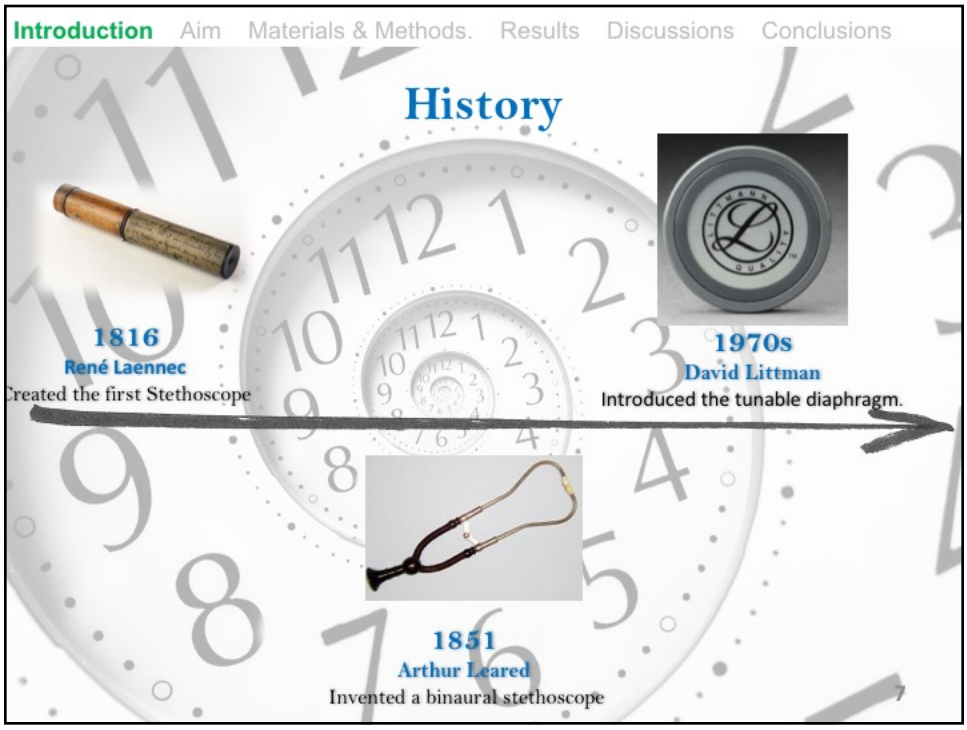
Introduction Aim Materials & Methods. Results Discussions Conclusions
History
1816
René Laennec
Created the first Stethoscope
1970s
David Littman
Introduced the tunable diaphragm.
1851
Arthur Leared
Invented a binaural stethoscope
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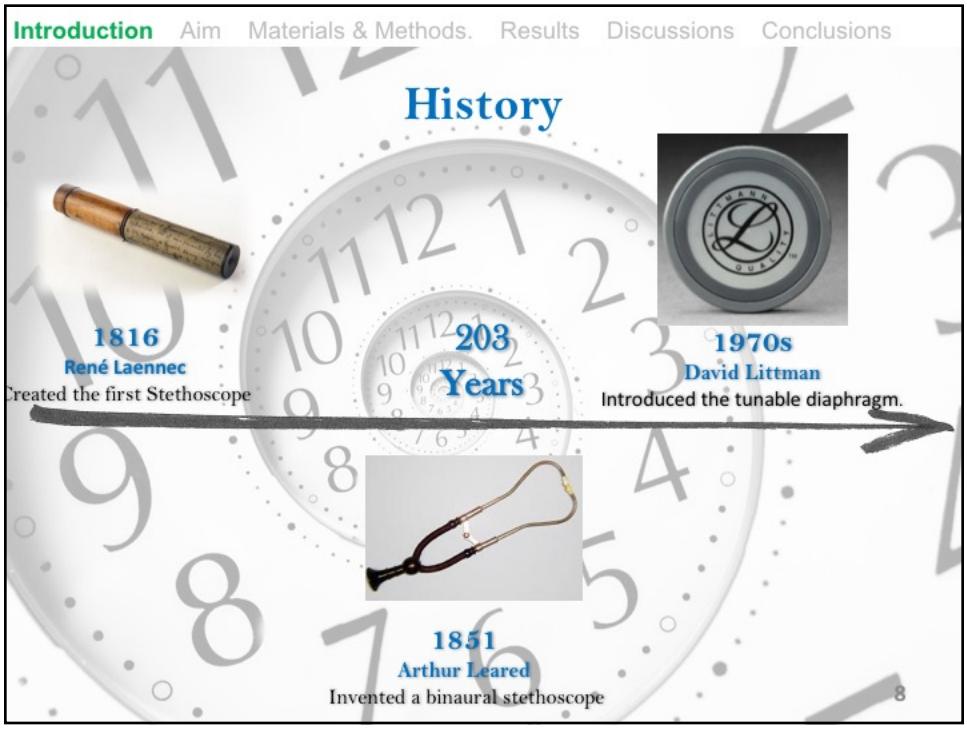
Introduction Aim Materials & Methods. Results Discussions Conclusions
History
1816
René Laennec
Created the first Stethoscope
203
Years
1970s
David Littman
Introduced the tunable diaphragm.
1851
Arthur Leared
Invented a binaural stethoscope
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Models

CLASSIC

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Models

CLASSIC

CARDIOLOGICAL

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Introduction Aim Materials & Methods. Results Discussions Conclusions

Models

CLASSIC

CARDIOLOGICAL

PEDIATRIC

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Models

CLASSIC

CARDIOLOGICAL

PEDIATRIC

INFANT

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Models


CLASSIC


CARDIOLOGICAL


PEDIATRIC


INFANT


FETAL

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Models


CLASSIC


CARDIOLOGICAL


PEDIATRIC


INFANT


FETAL


ELECTRONIC

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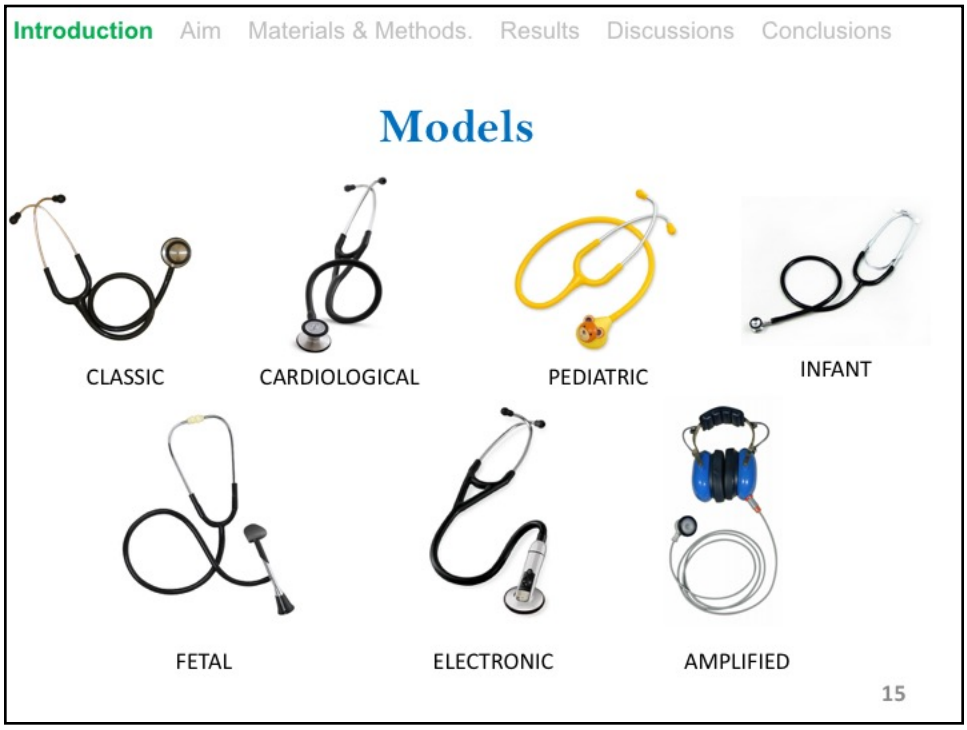
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Models
CLASSIC
CARDIOLOGICAL
PEDIATRIC
INFANT
FETAL
ELECTRONIC
AMPLIFIED
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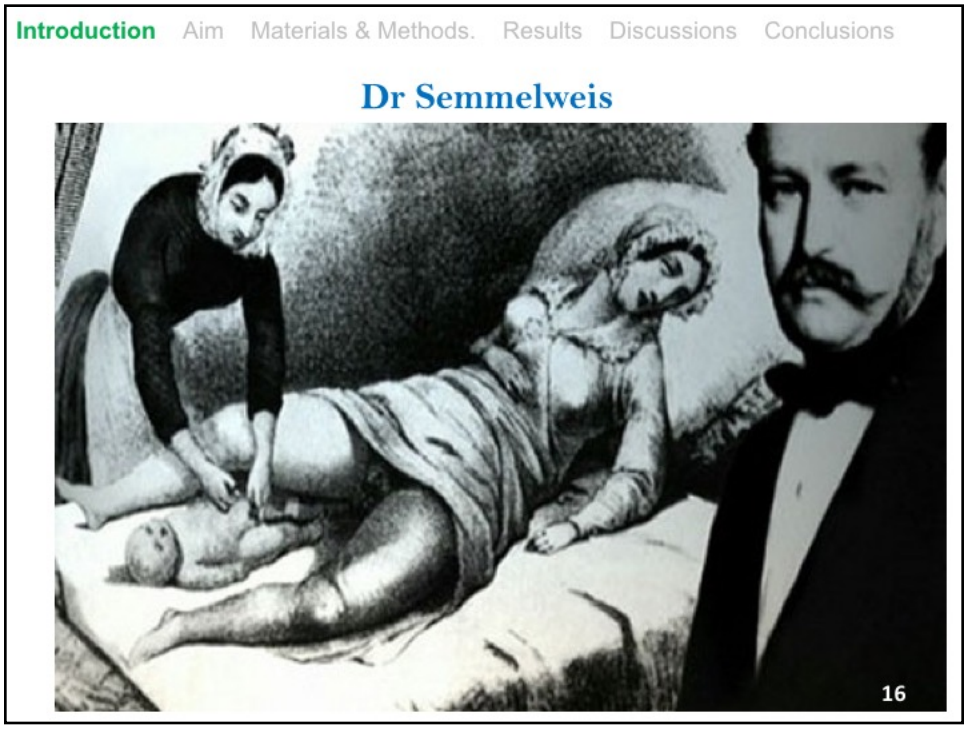
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Dr Semmelweis
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CDC Home

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives. Protecting People.™

Handwashing: Clean Hands Save Lives

Keeping hands clean through improved hand hygiene is one of the most important steps we can take to avoid getting sick and spreading germs to others. Many diseases and conditions are spread by not washing hands with soap and clean, running water. If clean, running water is not accessible, as is common in many parts of the world, use soap and available water. If soap and water are unavailable, use an alcohol-based hand sanitizer that contains at least 60% alcohol to clean hands. *http://www.cdc.gov/handwashing/when-how-handwashing.html*

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Contamination of Stethoscopes and Physicians' Hands After a Physical Examination
MAYO CLINIC
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How often does the doctor/nurse clean/disinfect the stethoscope …..?

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Introduction Aim Materials & Methods. Results Discussions Conclusions

How often does the doctor/nurse clean/disinnfect the stethoscope …..?

48% every day or week*

22% "…regularly.. "*(…after each visit ??*)**

10 - 24% after each use BUT…. ***

*J.S. Jones, D. Hoerle, and R. Riekse, "Stethoscopes: a potential vector of infection?," *Ann Emerg Med*, vol. 26, no. 3, pp. 296-9, 1995.
**L. Bernard, A. Kereveur, D. Durandet al., "Bacterial contamination of hospital physicians' stethoscopes," *Infect Control Hosp Epidemiol*, vol. 20, no. 9, pp. 626-8, 1999.
***J. Muniz, R.K. Sethi, J. Zaghi, S.I. Ziniel, and T.J. Sandora, "Predictors of stethoscope disinfection among pediatric health care providers," *Am J Infect Control*, vol. no., 2012.

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How often does the doctor/nurse clean/disinnfect the stethoscope .....?

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How often a doctor/operator during an emergency .....?

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Operative Healthcare Reality

- Focus on treatment
- Rush between patients
- Cleaning requires extra steps

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Introduction Aim Materials & Methods. Results Discussions Conclusions
STETHOSCOPE
CAN BE A HEALTH HAZARD?
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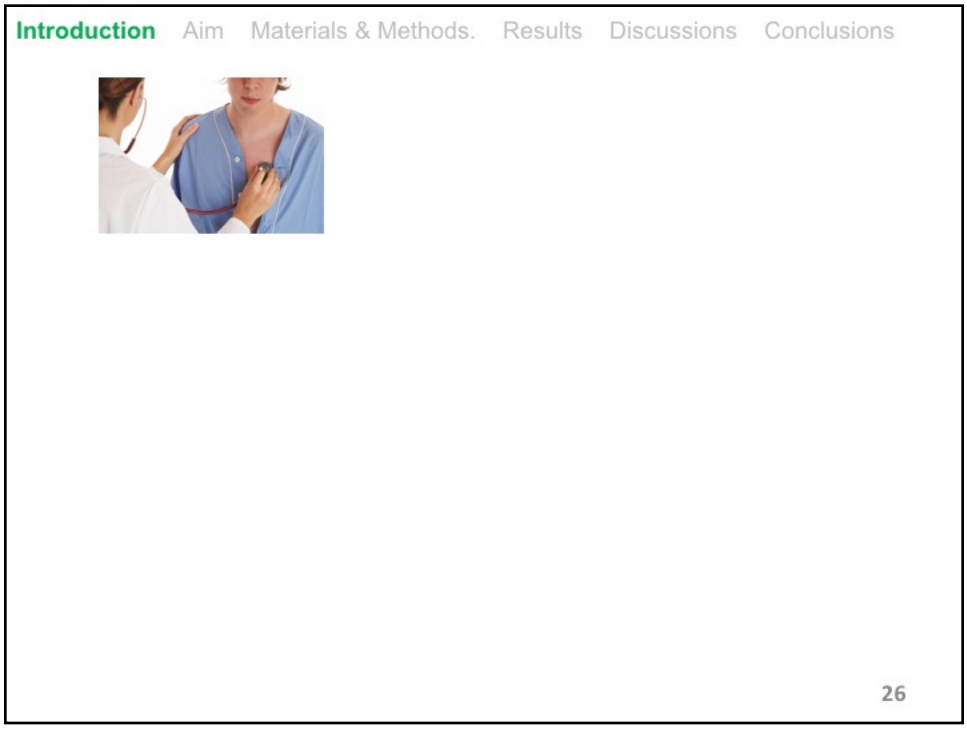
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Introduction Aim Materials & Methods. Results Discussions Conclusions

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Bacterial contamination of the Stethoscope

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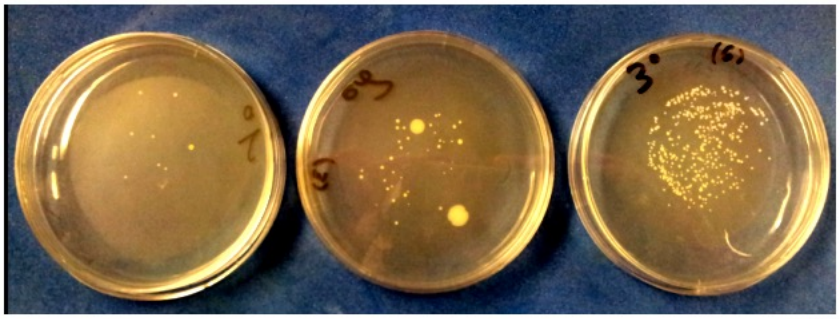
Bacterial contamination of the Stethoscope



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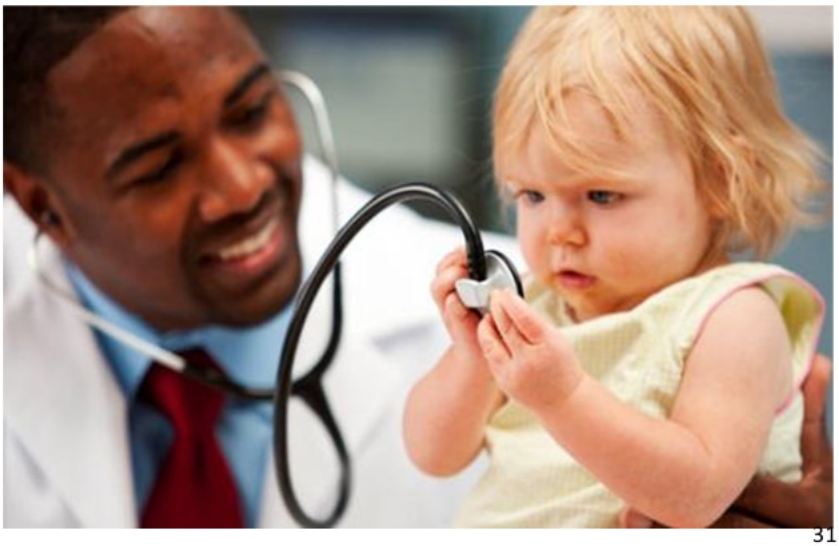
«Next patient, please!...»



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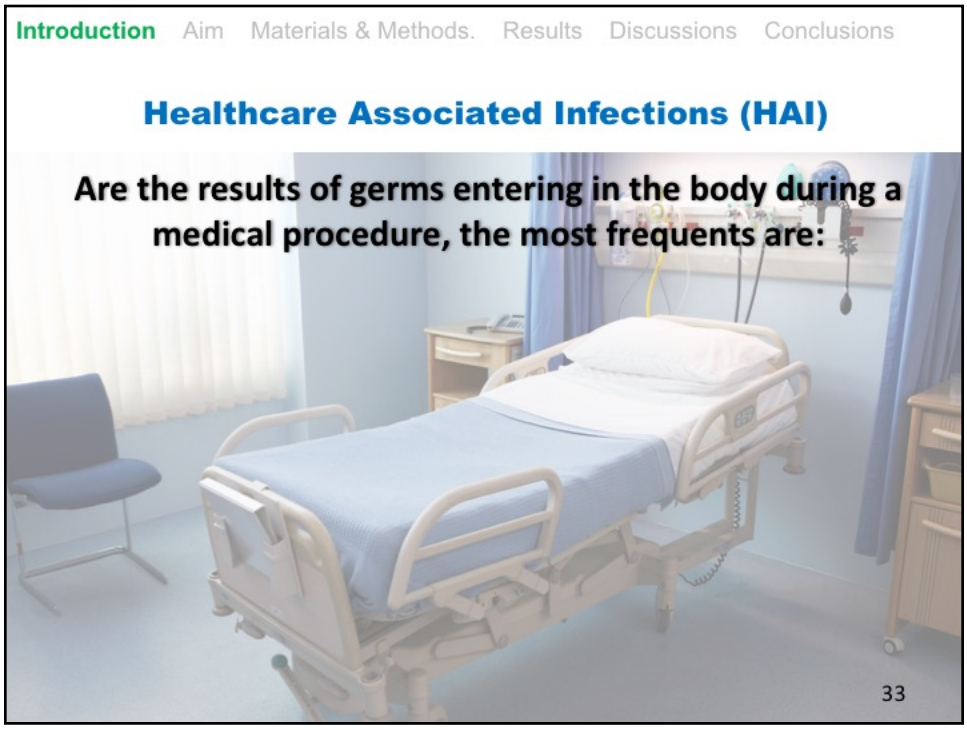
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Healthcare Associated Infections (HAI)
Are the results of germs entering in the body during a medical procedure, the most frequents are:
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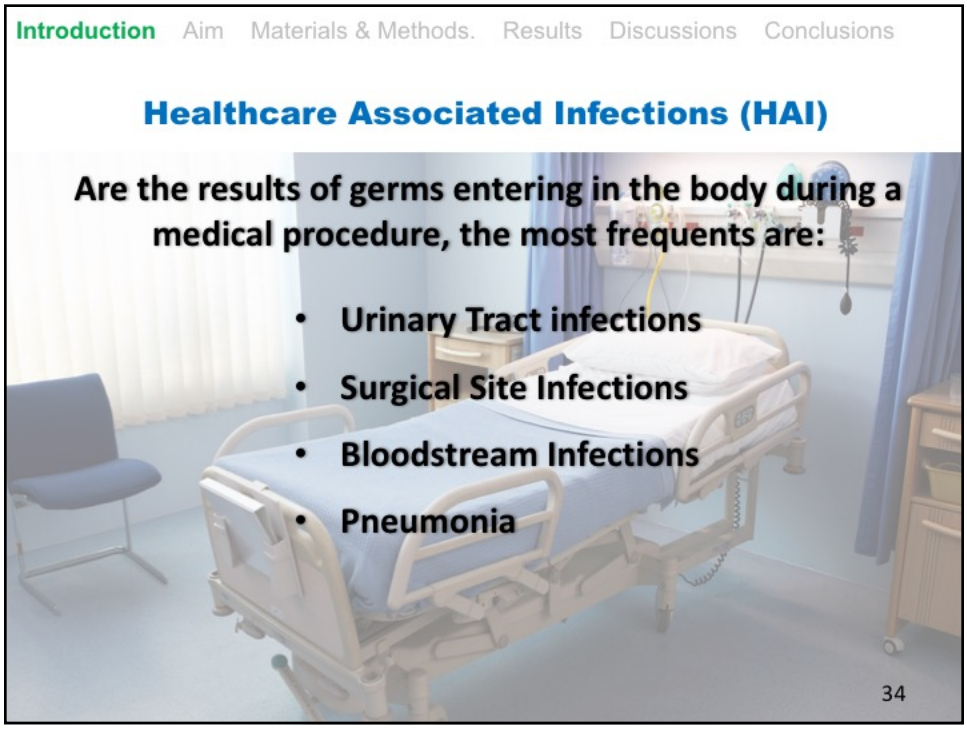
Introduction Aim Materials & Methods. Results Discussions Conclusions
Healthcare Associated Infections (HAI)
Are the results of germs entering in the body during a medical procedure, the most frequents are:
• Urinary Tract infections
• Surgical Site Infections
• Bloodstream Infections
• Pneumonia
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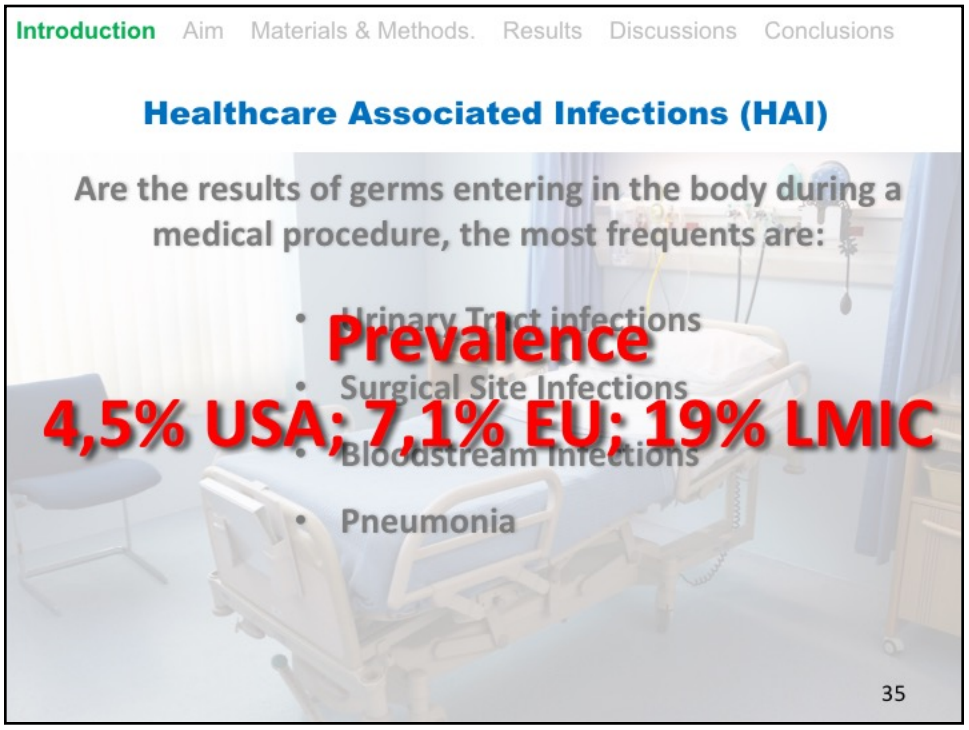
Introduction Aim Materials & Methods. Results Discussions Conclusions
Healthcare Associated Infections (HAI)
Are the results of germs entering in the body during a medical procedure, the most frequents are:
Urinary Tract infections
Surgical Site Infections
Bloodstream Infections
Pneumonia
Prevalence
4,5% USA; 7,1% EU; 19% LMIC
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Introduction Aim Materials & Methods. Results Discussions Conclusions
Adverse outcomes HAI:
a worldwide problem
World Health Organization
CDC
Centers for Disease Control and Prevention
Costs
US $ 35 - 45
EU € 7
Billion/year
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Adverse outcomes HAI: a worldwide problem

World Health Organization

CDC Centers for Disease Control and Prevention

Costs

US $ 35 - 45
EU € 7
Billion/year

Health Problems

EU 16 milions
Extra days/year

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Introduction Aim Materials & Methods. Results Discussions Conclusions

Adverse outcomes HAI: a worldwide problem

World Health Organization

CDC Centers for Disease Control and Prevention

Costs

US $ 35 - 45
EU € 7
Billion/year

Health Problems

EU 16 milions
Extra days/year

Death

140.000/year
(USA+EU)

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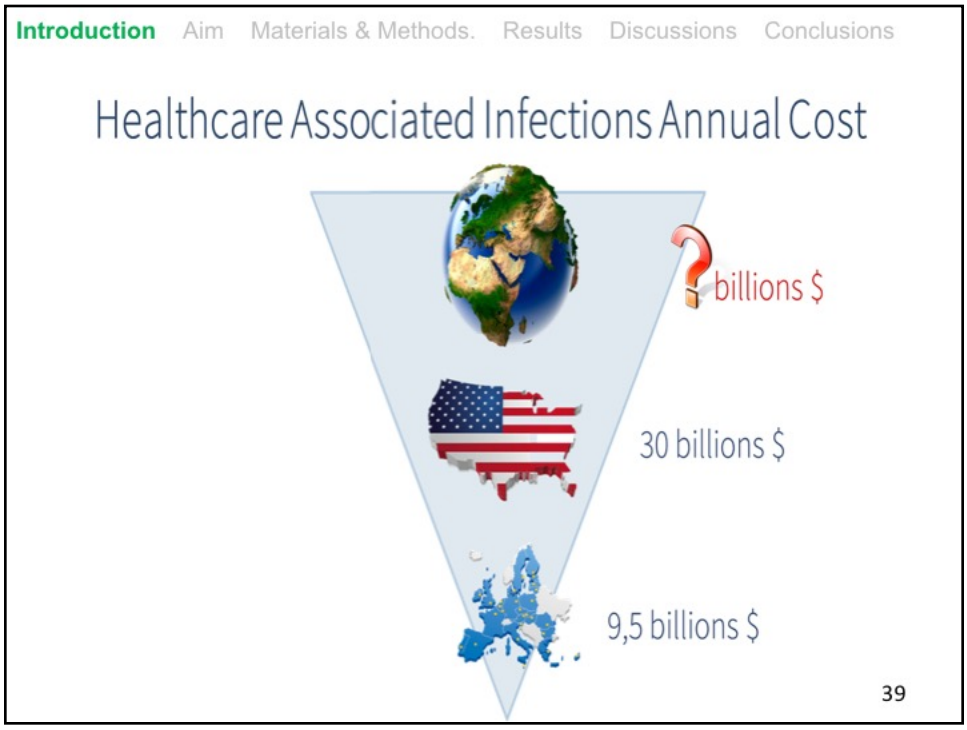
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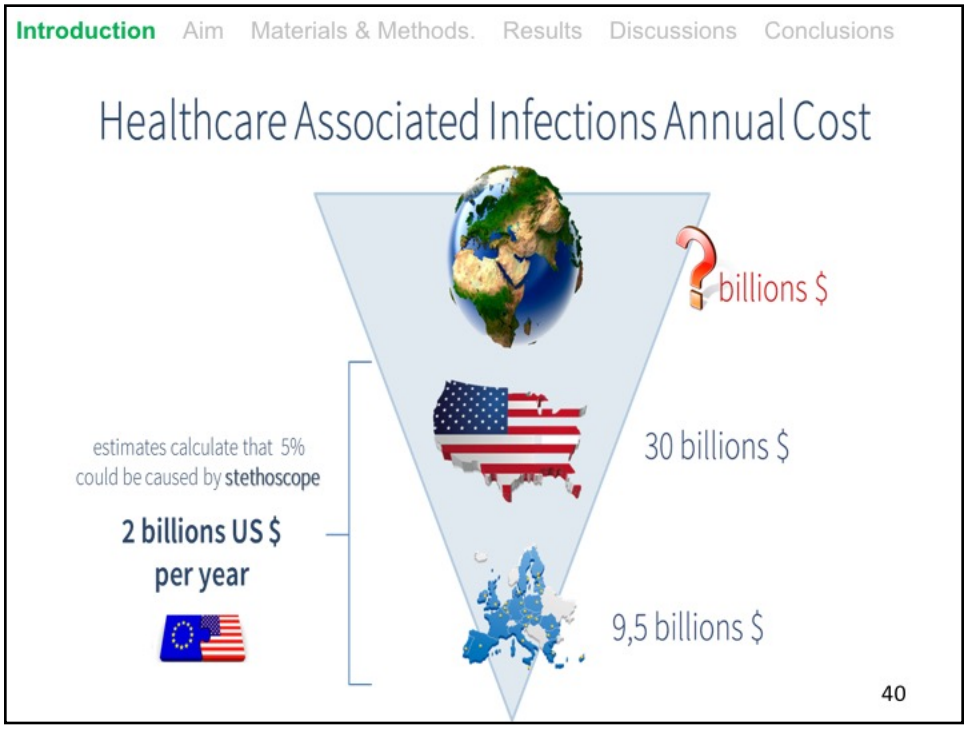
Healthcare Associated Infections Annual Cost
billions $
30 billions $
9,5 billions $
39


Introduction Aim Materials & Methods. Results Discussions Conclusions
Healthcare Associated Infections Annual Cost
billions $
30 billions $
9,5 billions $
estimates calculate that 5%
could be caused by stethoscope
2 billions US $
per year
40

Introduction Aim Materials & Methods. Results Discussions Conclusions

Test a wearable UV-C device for stethoscope disinfection:

THE EASINESS OF USE

THE EFFECTIVENESS IN HOSPITAL SETTING

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The study:

The clinic

NOVEMBER 2016 – MAY 2017
CROSS SECTIONAL STUDY

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The Study:
The stethoscope selection

2 MEDICINE WARDS

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The Study:
The stethoscope selection

2 MEDICINE WARDS

1 PERMANENT VEGETATIVE STATE WARD

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The Study:
The stethoscope selection

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Introduction Aim Materials & Methods Results Discussions Conclusions

The Study:
The stethoscope selection

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The study:
The device: Stet Clean®
5
MINUTES
UV-C LED
275nm
100% AUTOMATIC
AND
WEREABLE
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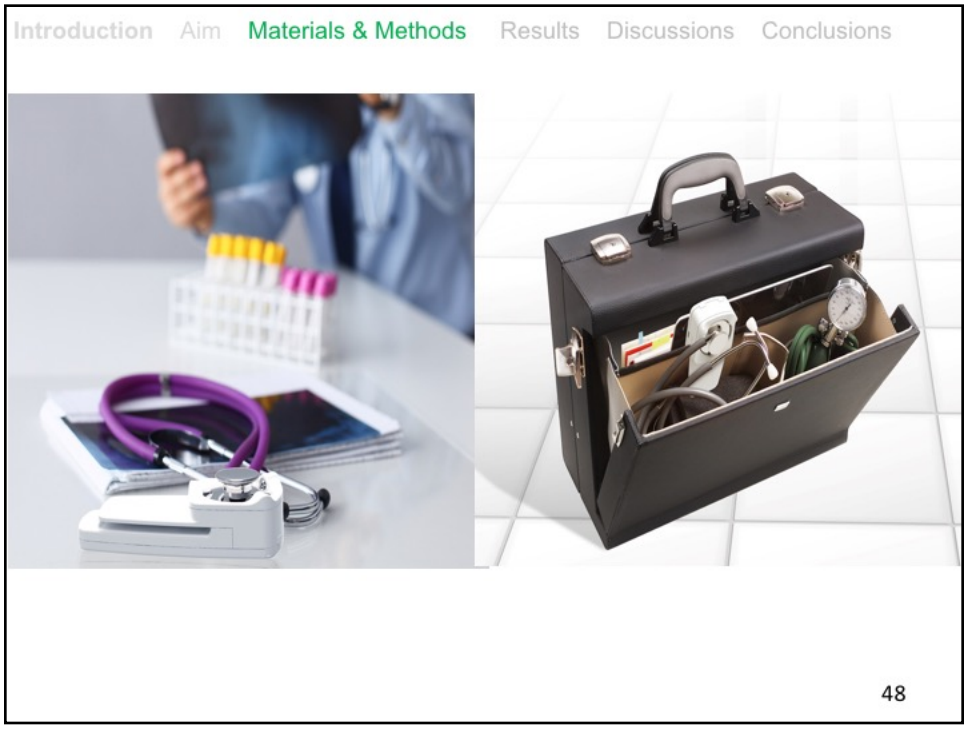
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Introduction Aim Materials & Methods Results Discussions Conclusions

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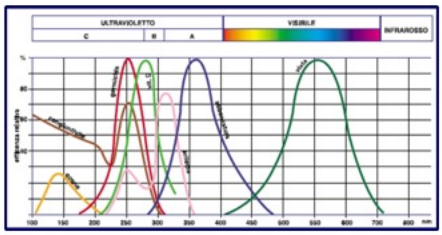
Stet Clean uses Ultraviolet Germicidal Irradiation Technology (UV-C)



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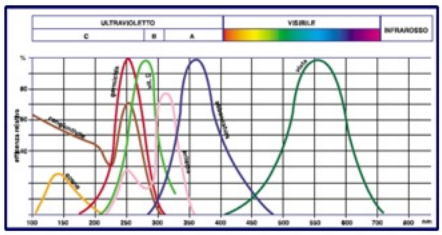
Stet Clean uses Ultraviolet Germicidal Irradiation Technology (UV-C)



Light can be divided in visible, infra-red and ultraviolet rays.

Ultra-violet rays (invisible) can be classified in:
- UV - A (with tanning properties)
- UV - B (with therapeutic properties)
- UV - C (with germicidal properties)

UV-C radiation **destroys DNA** of Bacteria, Viruses, Spores, Fungi, Moulds and Mites avoiding their growth & proliferation.

UVGI technology is a physic disinfection method with a **great costs/benefits ratio**, it's **ecological**, and, unlike chemicals, **it eliminates every microorganisms without creating any resistance**.

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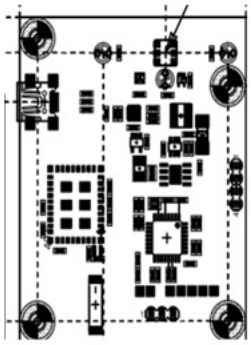

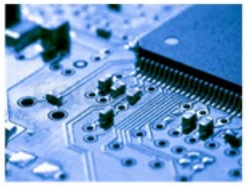

- UV-C light

- Microprocessor

- Memory of use

- Rech. Battery

- Sensors

- Mechanical & Magnetic Coupling

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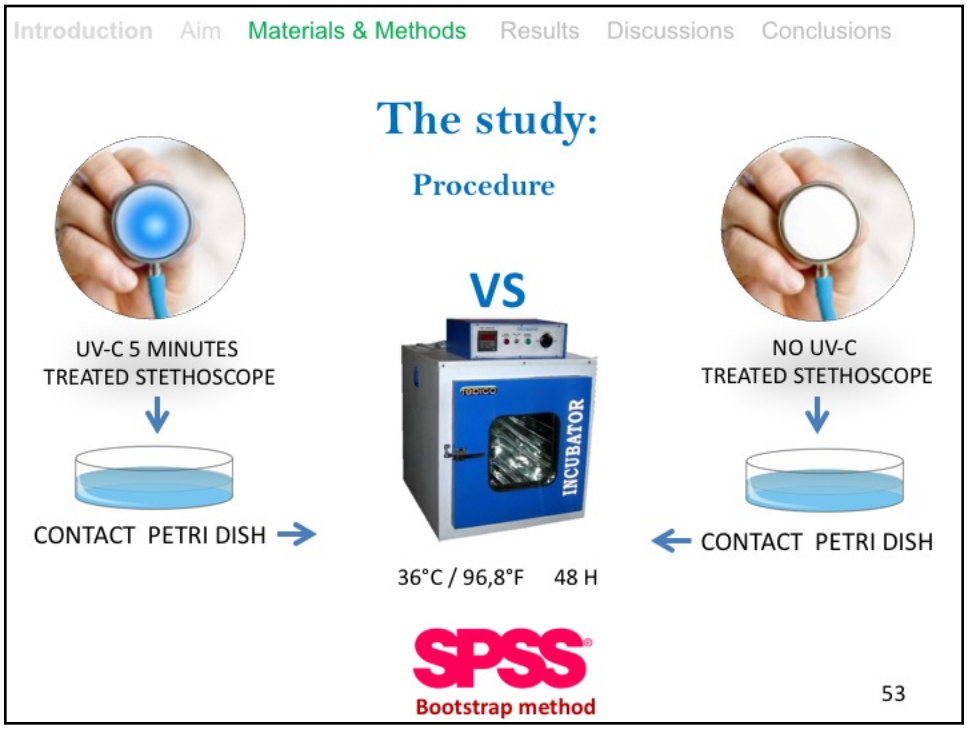
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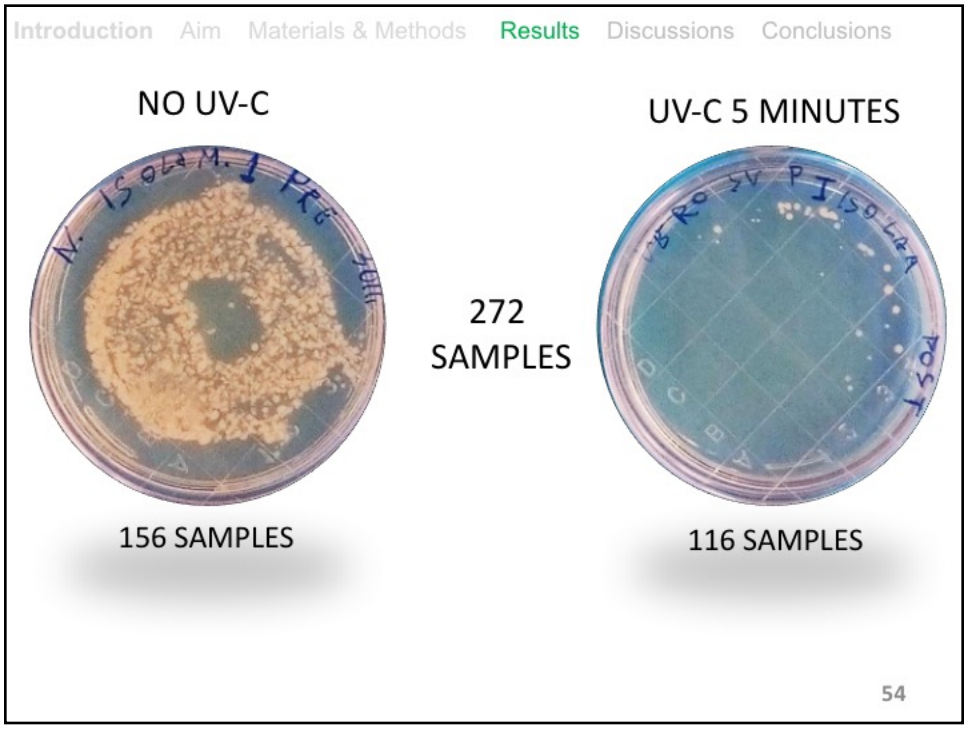
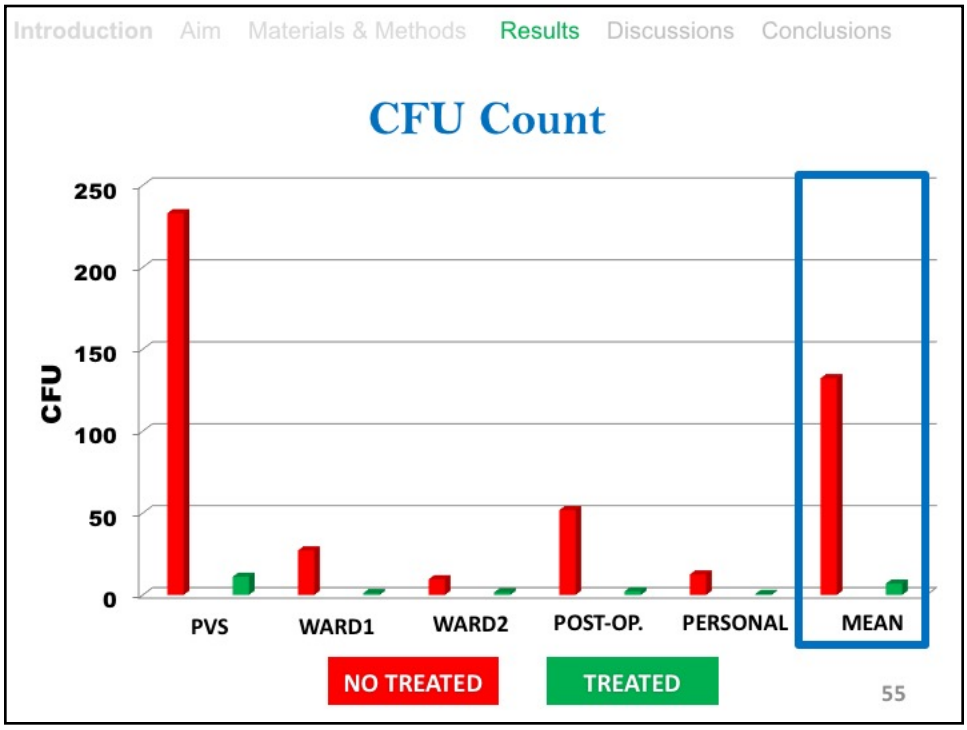
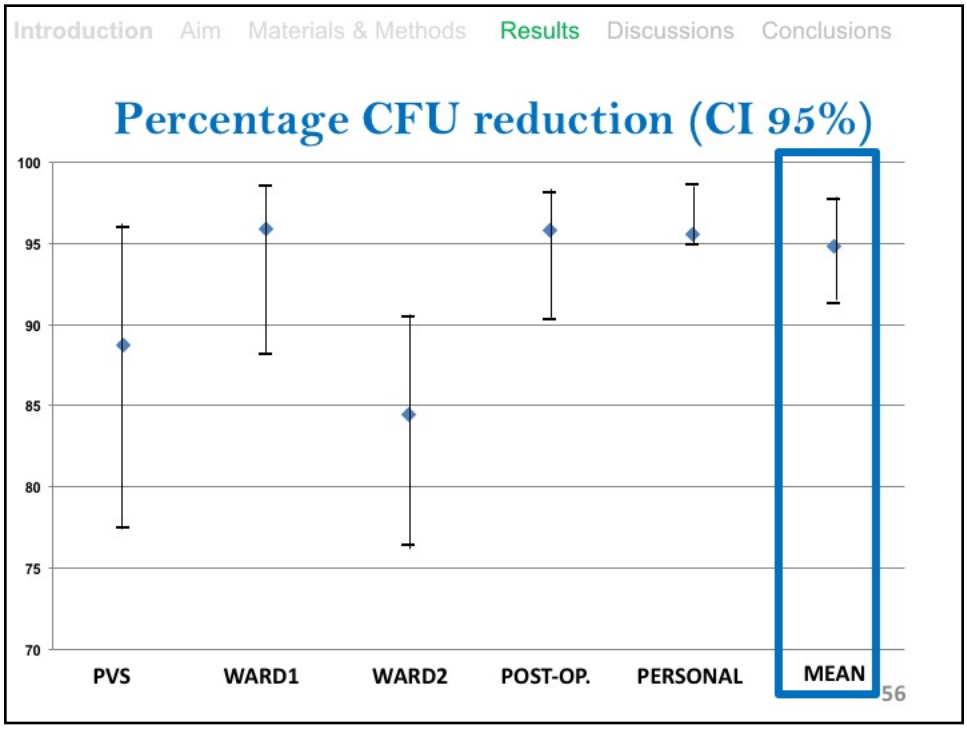
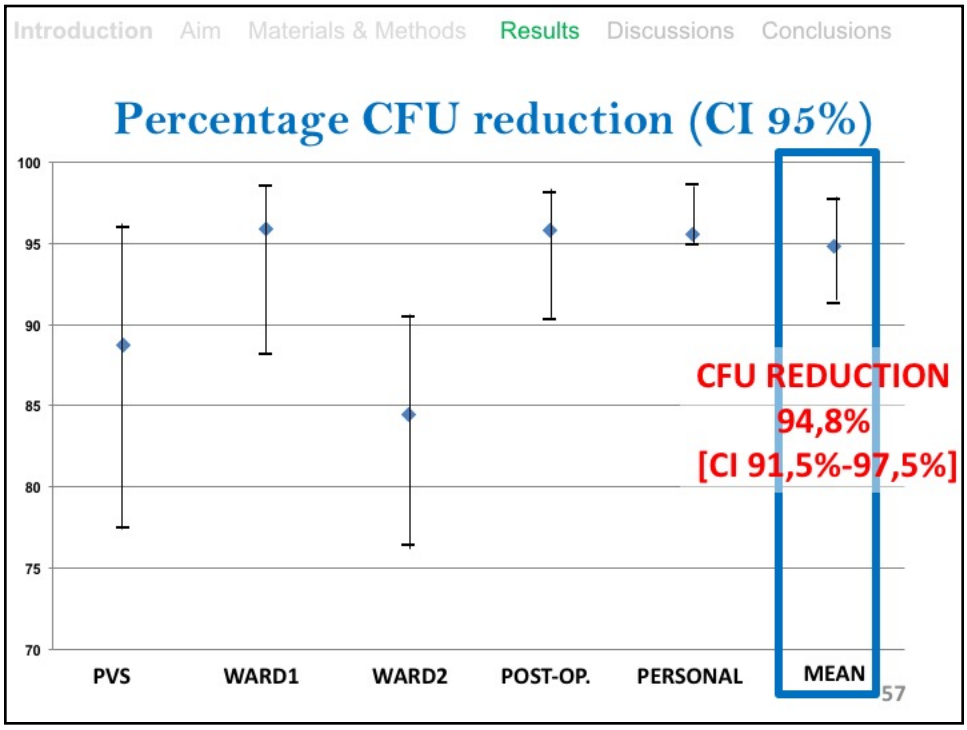
The study:
Procedure
VS
UV-C 5 MINUTES TREATED STETHOSCOPE
NO UV-C TREATED STETHOSCOPE
INCUBATOR
CONTACT PETRI DISH
CONTACT PETRI DISH
36°C / 96,8°F 48 H
SPSS
Bootstrap method
53


Introduction Aim Materials & Methods Results Discussions Conclusions
NO UV-C
UV-C 5 MINUTES
272 SAMPLES
156 SAMPLES
116 SAMPLES
54


Introduction Aim Materials & Methods Results Discussions Conclusions
CFU Count
CFU
250
200
150
100
50
0
PVS
WARD1
WARD2
POST-OP.
PERSONAL
MEAN
NO TREATED
TREATED
55


Introduction Aim Materials & Methods Results Discussions Conclusions
Percentage CFU reduction (CI 95%)
100
95
90
85
80
75
70
PVS
WARD1
WARD2
POST-OP.
PERSONAL
MEAN
56


Introduction Aim Materials & Methods Results Discussions Conclusions
Percentage CFU reduction (CI 95%)
100
95
90
85
80
75
70
PVS
WARD1
WARD2
POST-OP.
PERSONAL
MEAN
CFU REDUCTION
94,8%
[CI 91,5%-97,5%]
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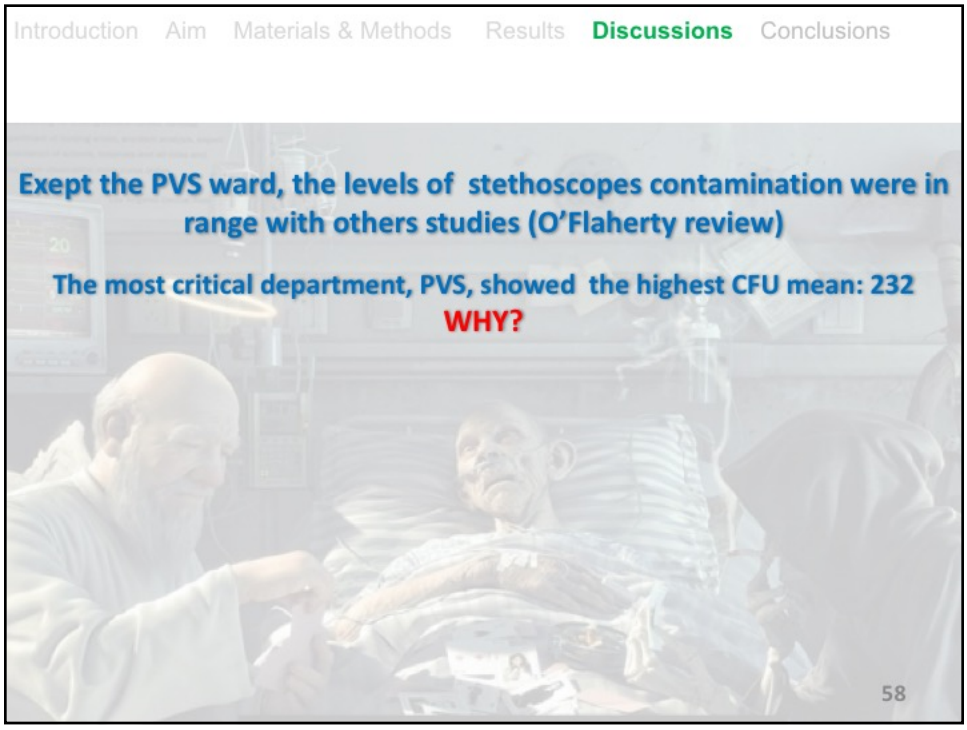
Introduction Aim Materials & Methods Results Discussions Conclusions
Exept the PVS ward, the levels of stethoscopes contamination were in range with others studies (O'Flaherty review)
The most critical department, PVS, showed the highest CFU mean: 232
WHY?
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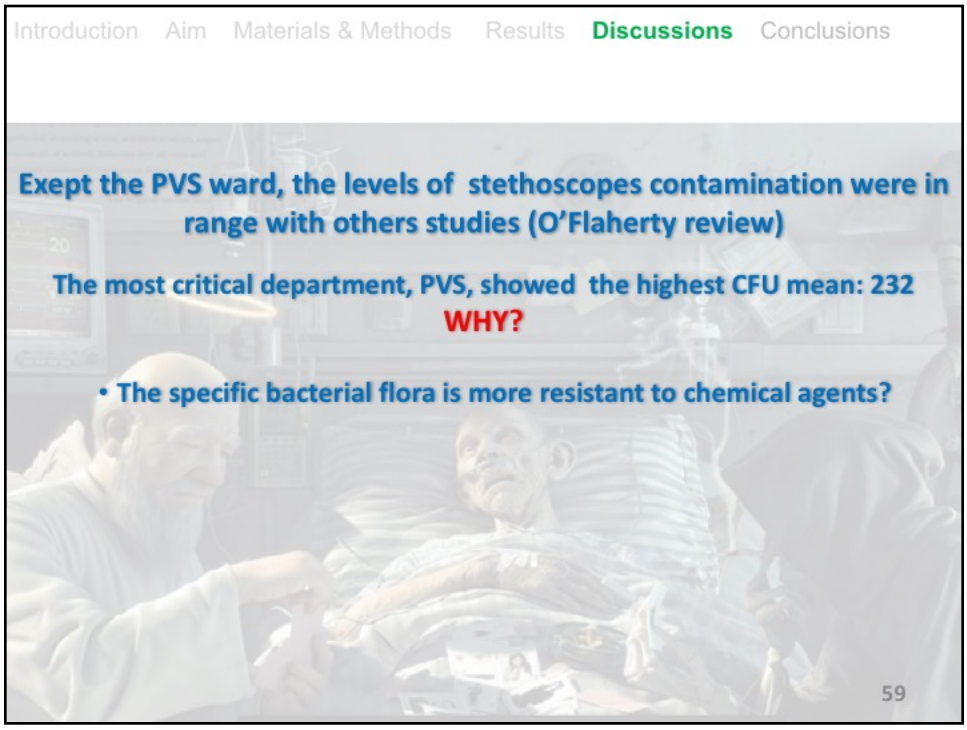
Introduction Aim Materials & Methods Results Discussions Conclusions
Exept the PVS ward, the levels of stethoscopes contamination were in range with others studies (O'Flaherty review)
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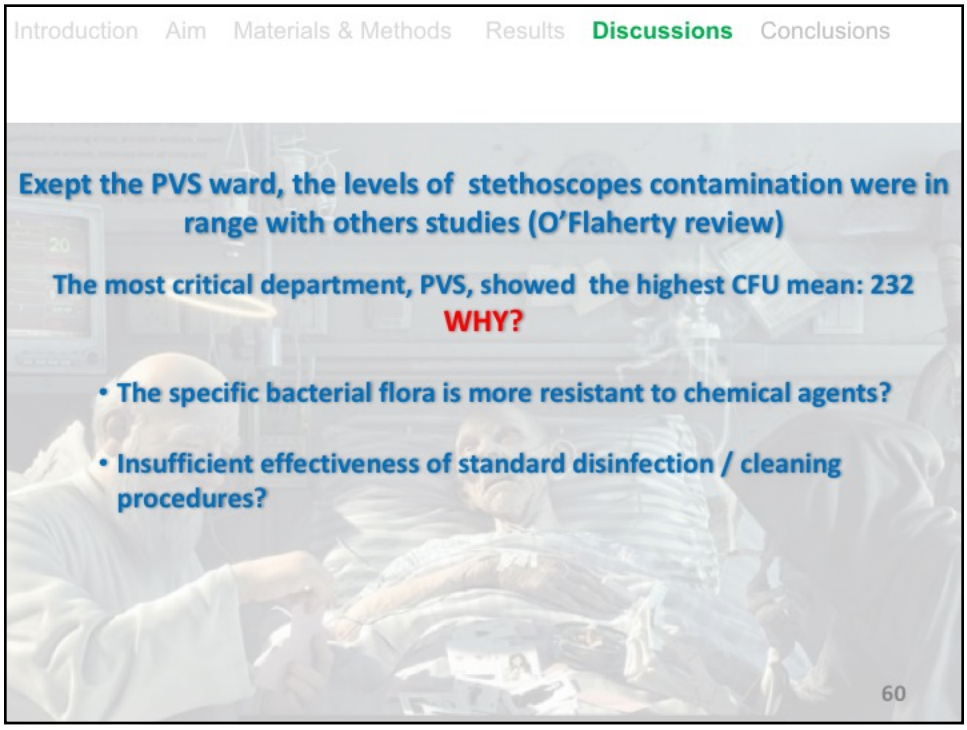
WHY?
• The specific bacterial flora is more resistant to chemical agents?
59


Introduction Aim Materials & Methods Results Discussions Conclusions
Exept the PVS ward, the levels of stethoscopes contamination were in range with others studies (O'Flaherty review)
The most critical department, PVS, showed the highest CFU mean: 232
WHY?
• The specific bacterial flora is more resistant to chemical agents?
• Insufficient effectiveness of standard disinfection / cleaning procedures?
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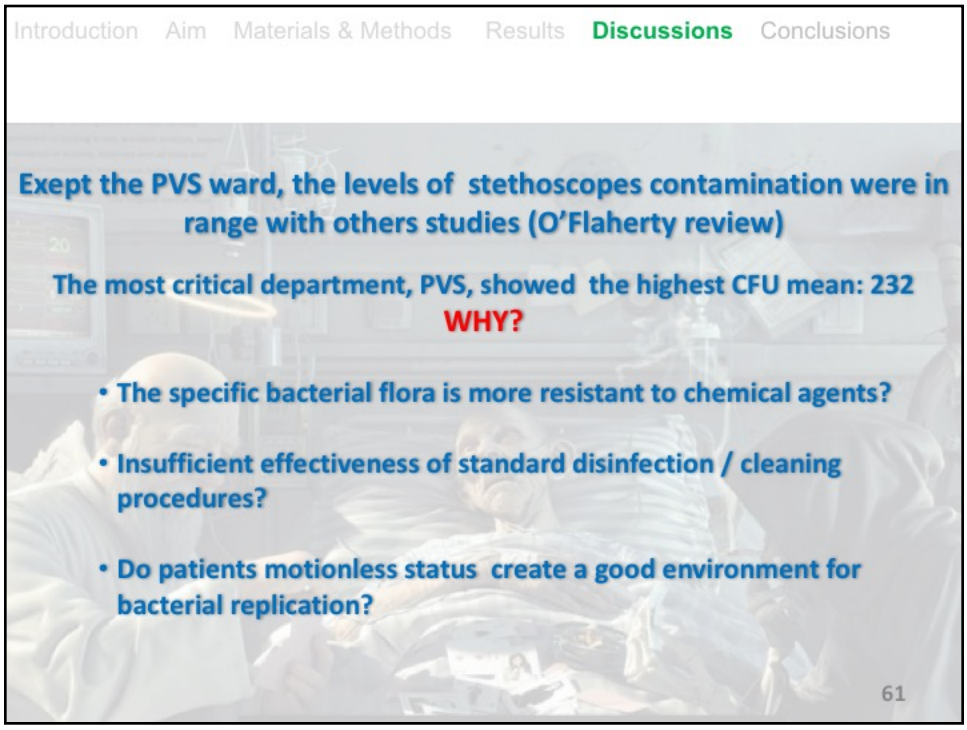
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WHY?
• The specific bacterial flora is more resistant to chemical agents?
• Insufficient effectiveness of standard disinfection / cleaning procedures?
• Do patients motionless status create a good environment for bacterial replication?
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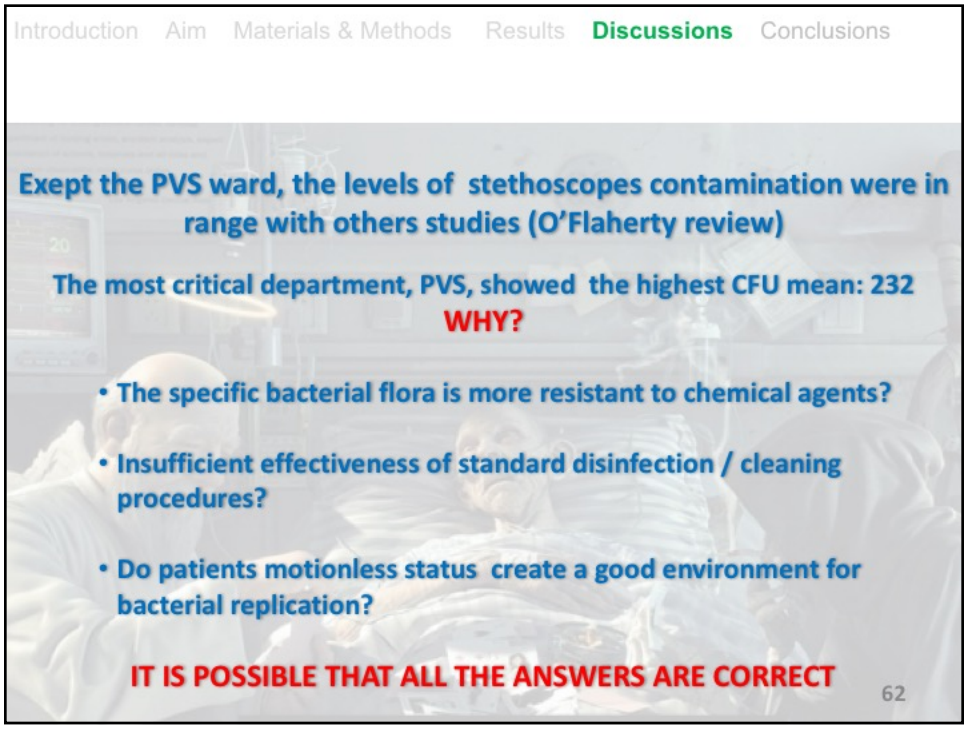
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The most critical department, PVS, showed the highest CFU mean: 232
WHY?
• The specific bacterial flora is more resistant to chemical agents?
• Insufficient effectiveness of standard disinfection / cleaning procedures?
• Do patients motionless status create a good environment for bacterial replication?
IT IS POSSIBLE THAT ALL THE ANSWERS ARE CORRECT
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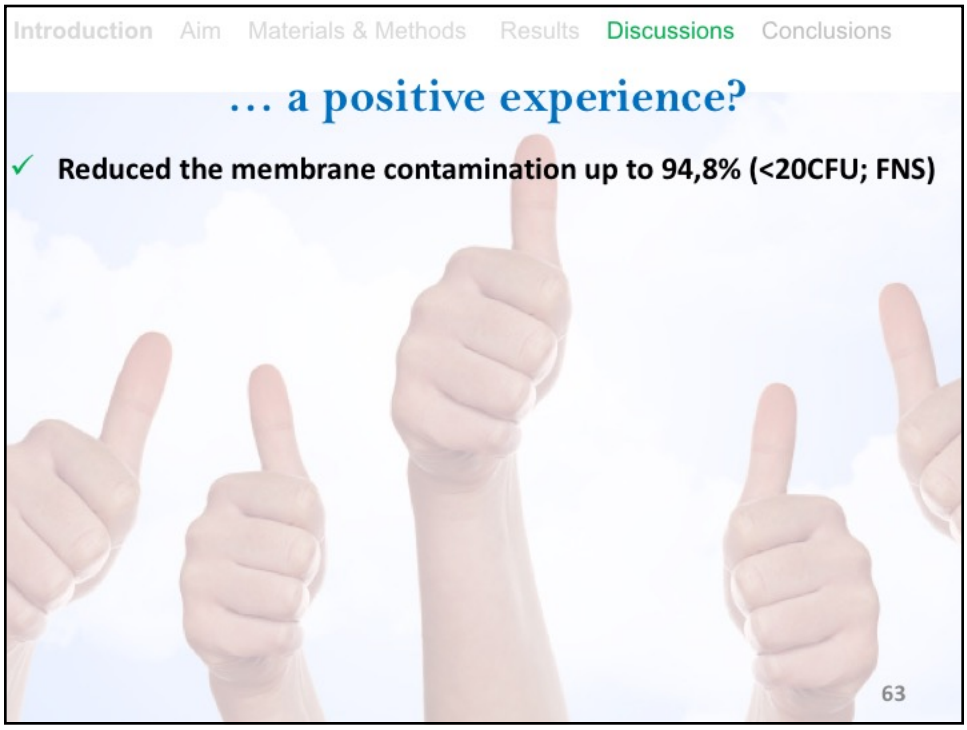
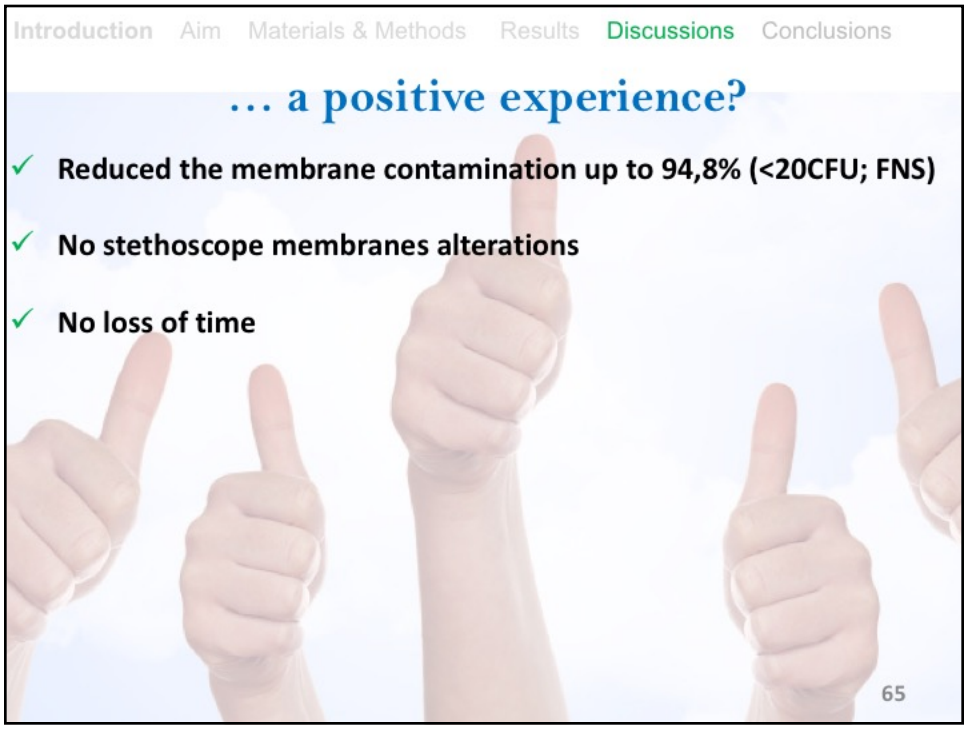
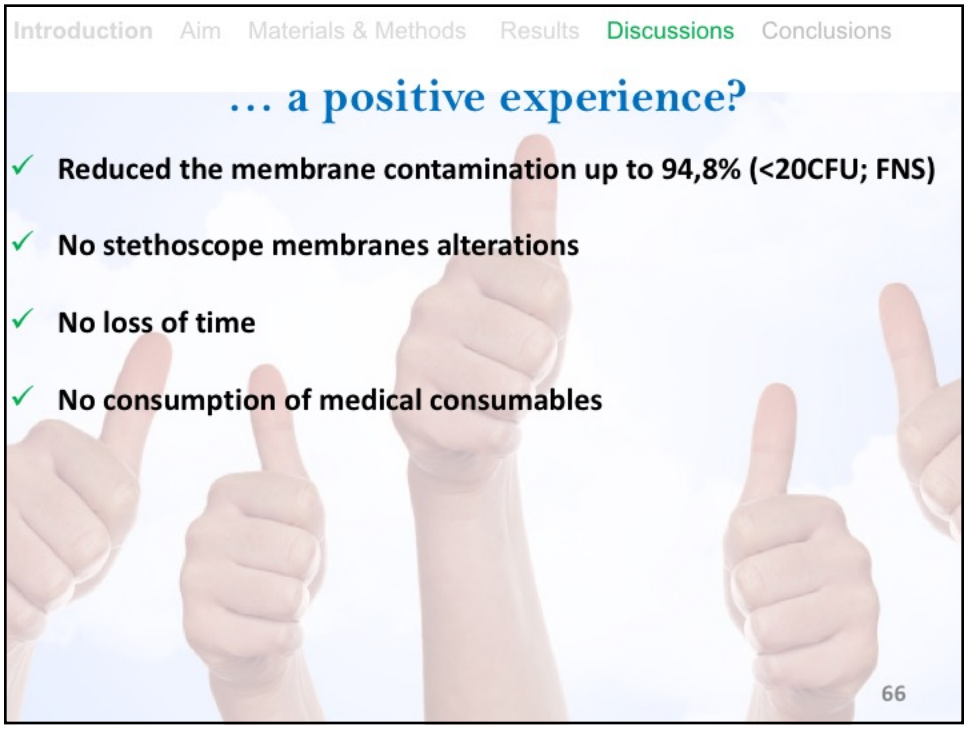
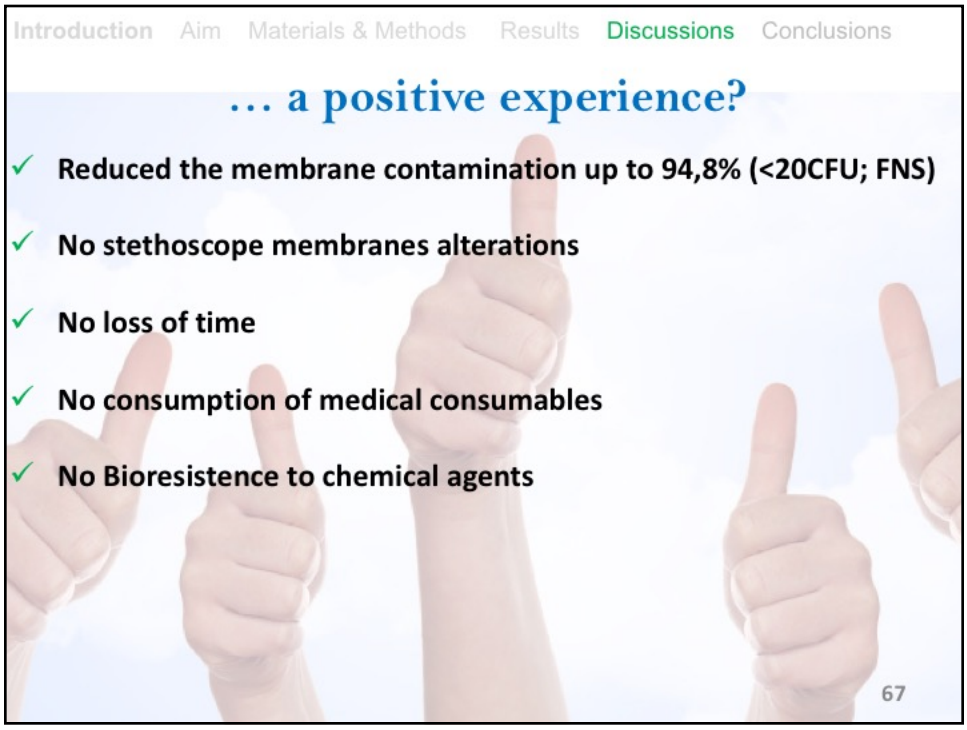

Introduction Aim Materials & Methods Results Discussions Conclusions
… a positive experience?
✓ Reduced the membrane contamination up to 94,8% (<20CFU; FNS)
63


Introduction Aim Materials & Methods Results Discussions Conclusions
… a positive experience?
✓ Reduced the membrane contamination up to 94,8% (<20CFU; FNS)
✓ No stethoscope membranes alterations
64


Introduction Aim Materials & Methods Results Discussions Conclusions
… a positive experience?
✓ Reduced the membrane contamination up to 94,8% (<20CFU; FNS)
✓ No stethoscope membranes alterations
✓ No loss of time
65


Introduction Aim Materials & Methods Results Discussions Conclusions
… a positive experience?
✓ Reduced the membrane contamination up to 94,8% (<20CFU; FNS)
✓ No stethoscope membranes alterations
✓ No loss of time
✓ No consumption of medical consumables
66


Introduction Aim Materials & Methods Results Discussions Conclusions
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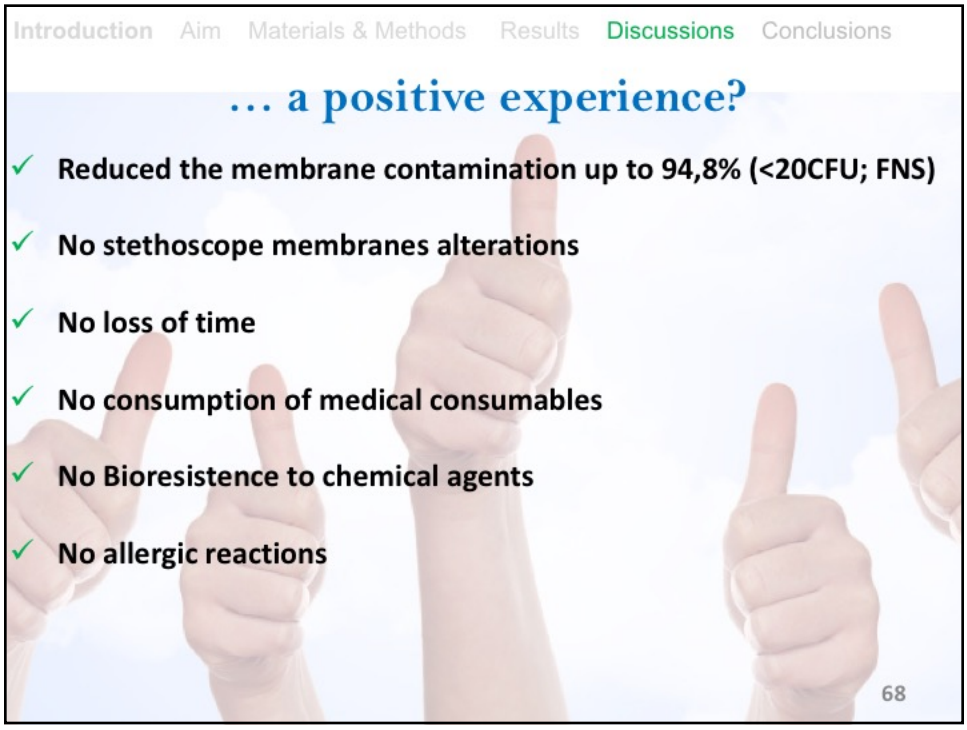
✓ No stethoscope membranes alterations
✓ No loss of time
✓ No consumption of medical consumables
✓ No Bioresistence to chemical agents
67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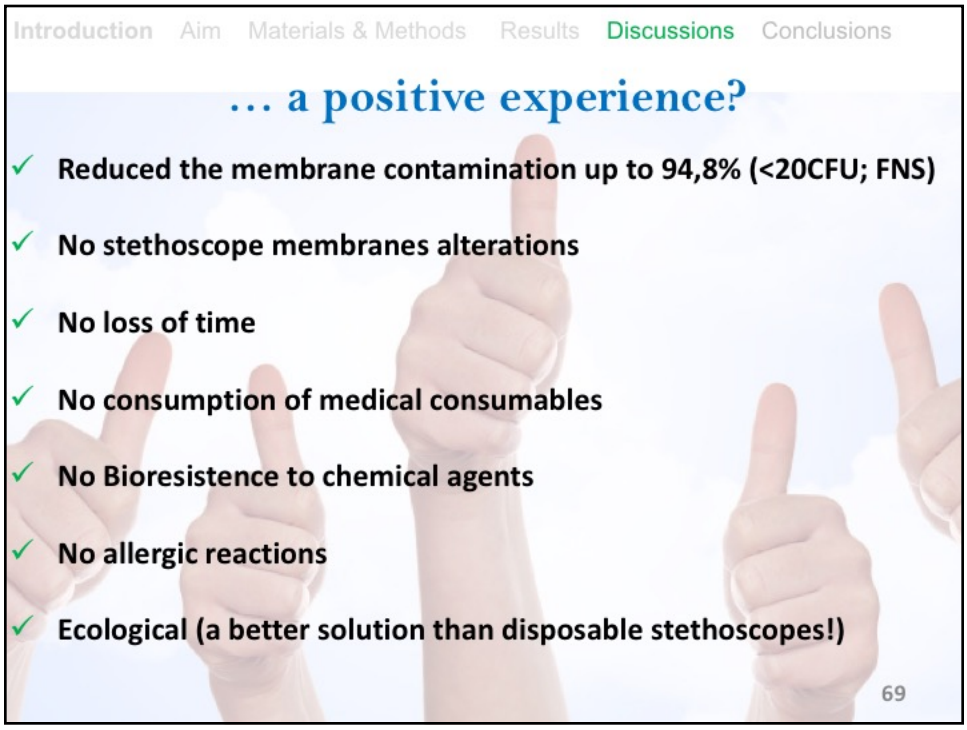
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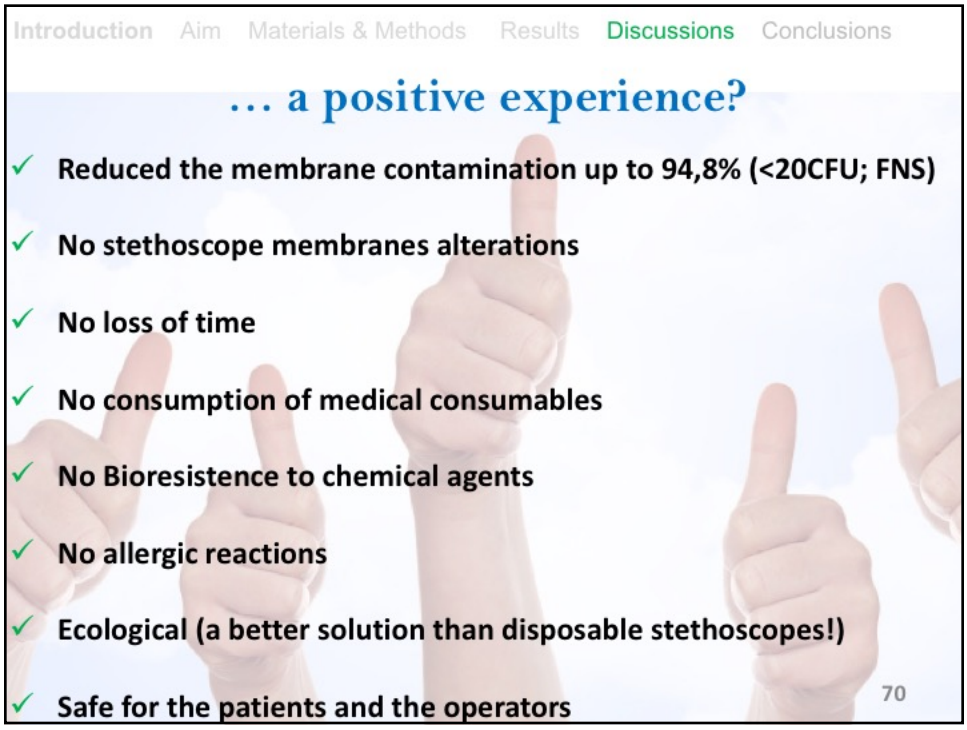
69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✓ Safe for the patients and the operators
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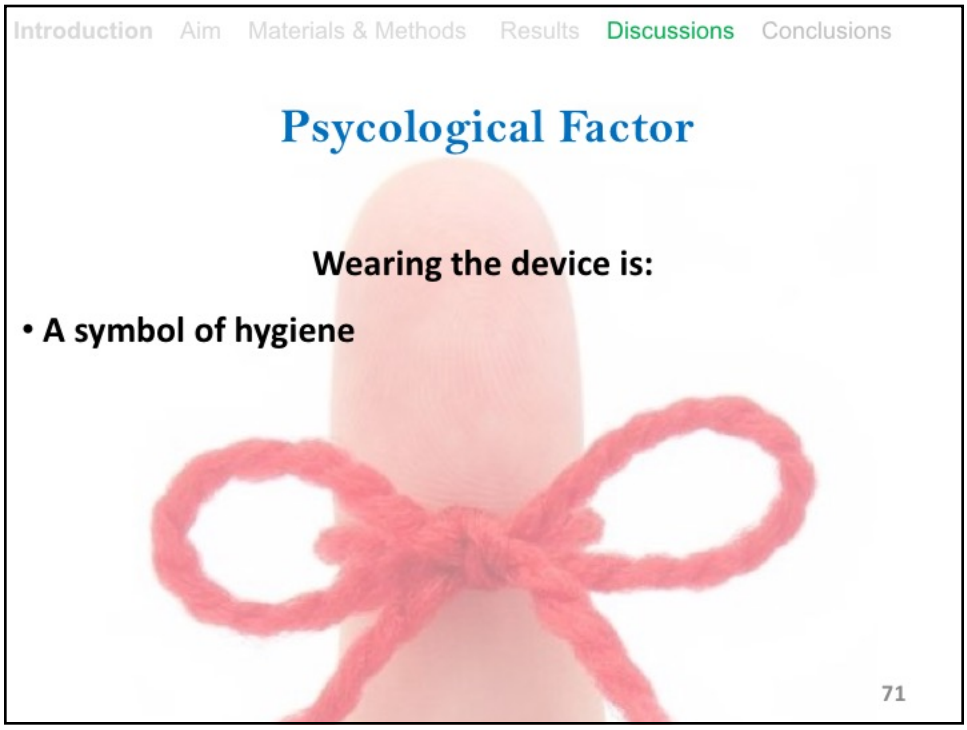
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Psycological Factor
Wearing the device is:
• A symbol of hygiene
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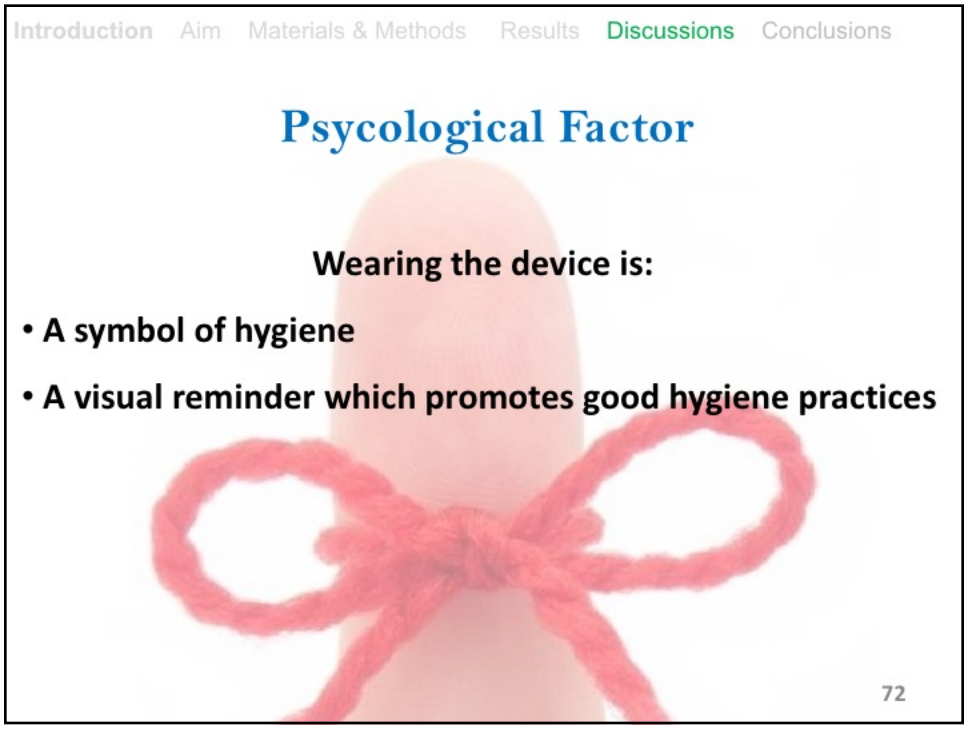
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• A symbol of hygiene
• A visual reminder which promotes good hygiene practices
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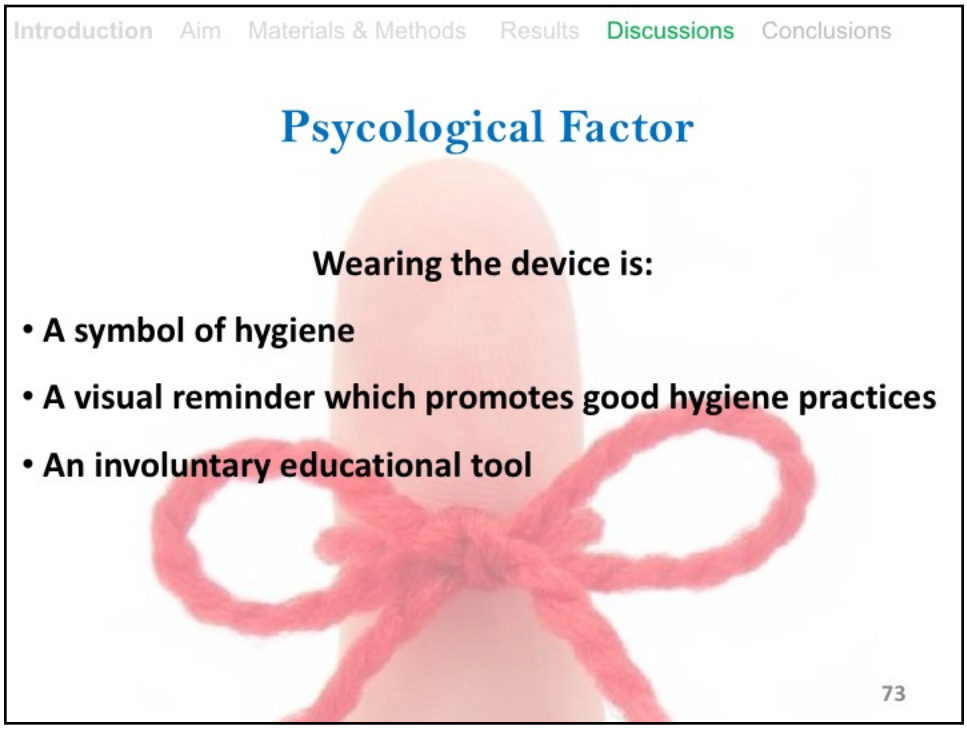
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Psycological Factor
Wearing the device is:
• A symbol of hygiene
• A visual reminder which promotes good hygiene practices
• An involuntary educational tool
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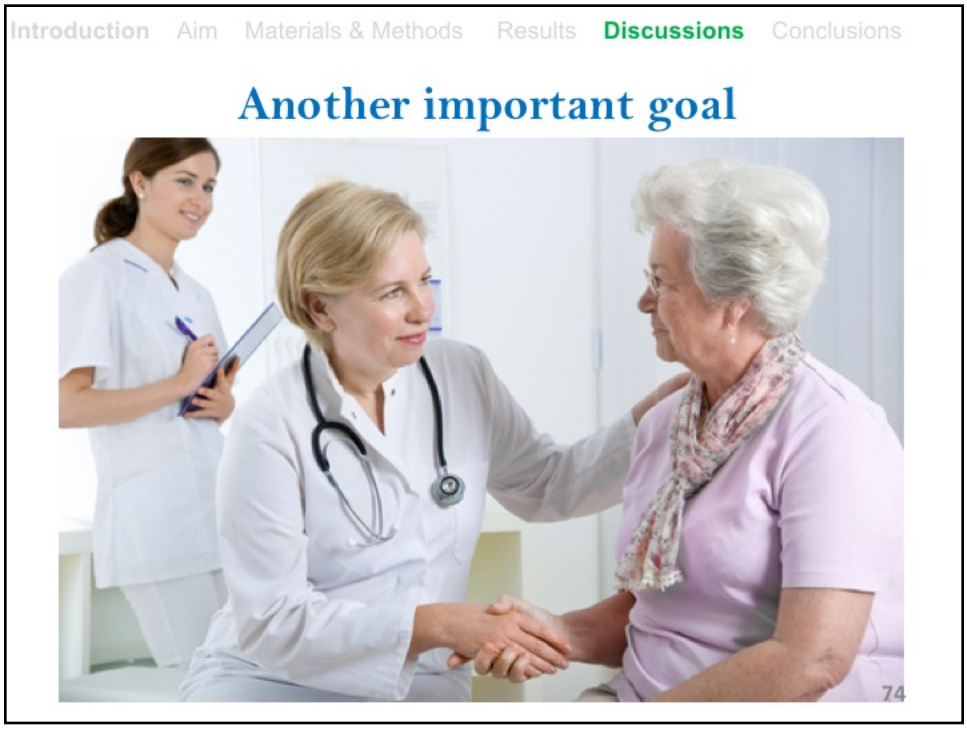
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Another important goal
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Introduction Aim Materials & Methods Results **Discussions** Conclusions

Another important goal

Bring closer the UV-C technology to health operators and patients

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Limits

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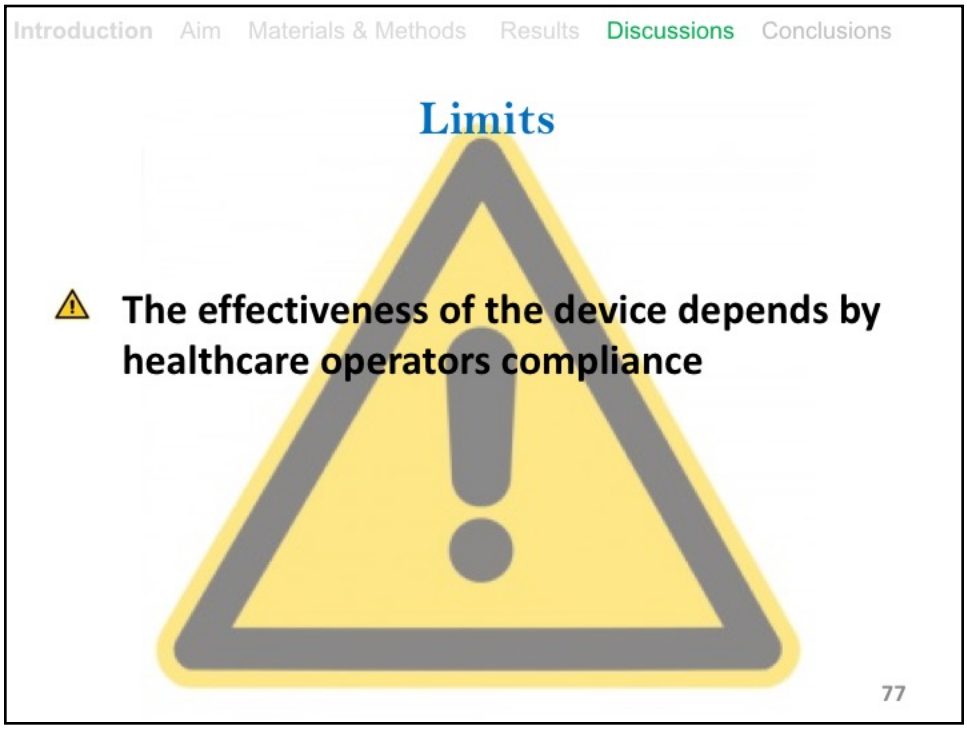
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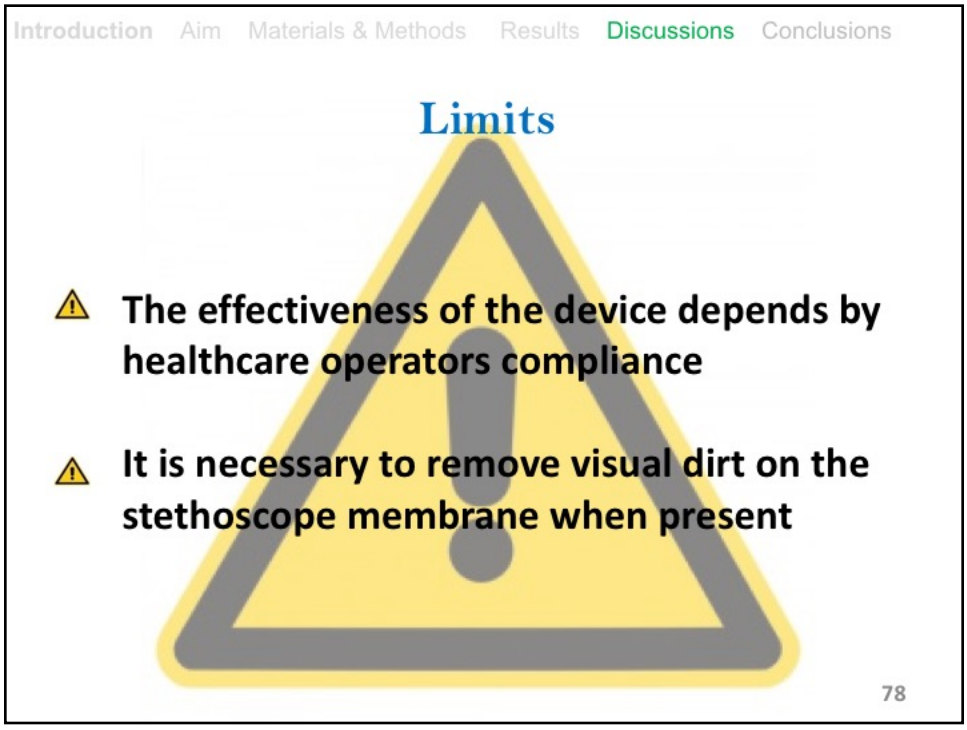
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Limits
The effectiveness of the device depends by healthcare operators compliance
It is necessary to remove visual dirt on the stethoscope membrane when present
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Introduction Aim Materials & Methods Results Discussions Conclusions
• The use of the automatic and wearable UV-C device resulted practical and easy for the health professionals.
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- **The use of the automatic and wearable UV-C device resulted practical and easy for the health professionals.**

- **UV-C irradiation on stethoscope membranes showed a marked reduction of bacterial contamination.**

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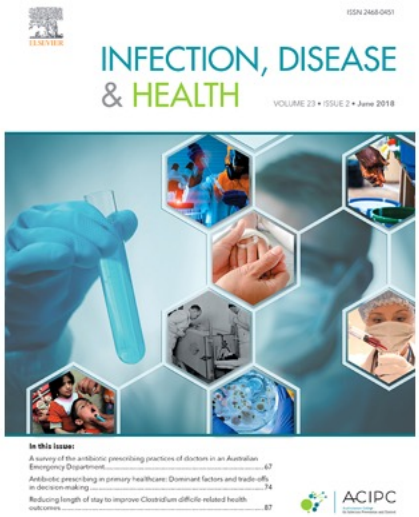

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Infection, Disease & Health, 2018, 23:211-216
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