IUVA AMERICAN CONFERENCE

REDONDO BEACH, California, U.S.A.

UNIVERSITY OF SIENA

DEPARTMENT OF MOLECULAR AND DEVELOPMENTAL MEDICINE

UV-C Emergency Kit for Critical Condition

Spataro G., Cevenini G., Burgassi S., Nante N., Tani M., Messina G.

Dr. Giuseppe Spataro

STERILIZATION

Process that destroys or eliminates all form of microbial life and is carried out in health-care facilities by physical or chemical methods

(Guideline for disinfection and sterilization in Healthcare facilities, 2008)

In practical terms:

the probability to find a microrganism is less of 1 on 10^6

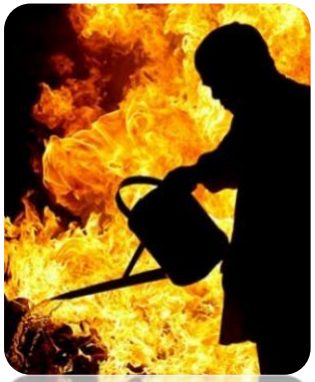
WHY STERILIZE INSTRUMENT?

- Blood, and wounds are excellent breeding ground for almost all pathogenic microorganisms

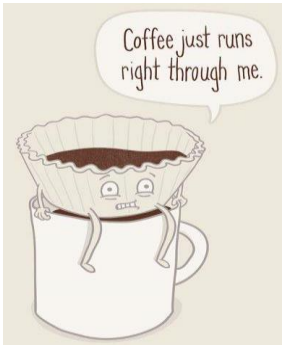
- There are hundreds of diseases that can be transmitted via inoculation or the contact of infected blood on the injured skin

STERILIZATION COMMON METHODS (I)

Phisical Methods



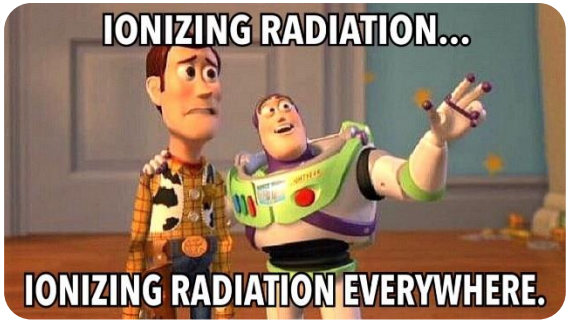
Dry Heat



Filtration

Steam

Microwave

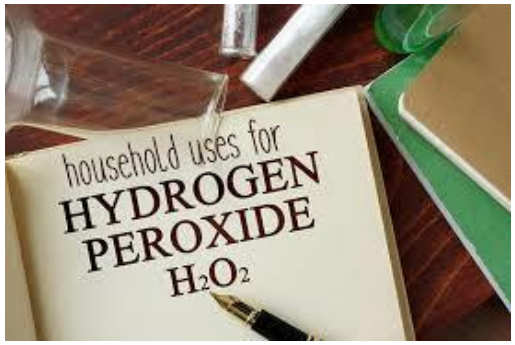


Ionizing Ratiation

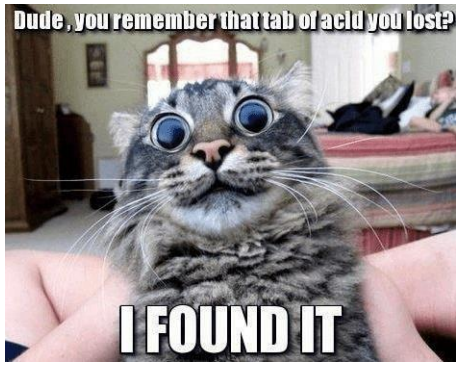
STERILIZATION COMMON METHODS (II)

Chemical Methods

Ethylene Oxide



Vaporized
Hydrogen Peroxide (VHP®)



Paracetic Acid

ROUTINARY SITUATIONS

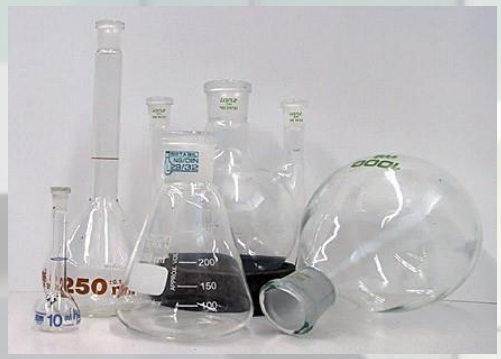
Used
Surgical Instruments

Cleaning and Disinfescting

Packaging

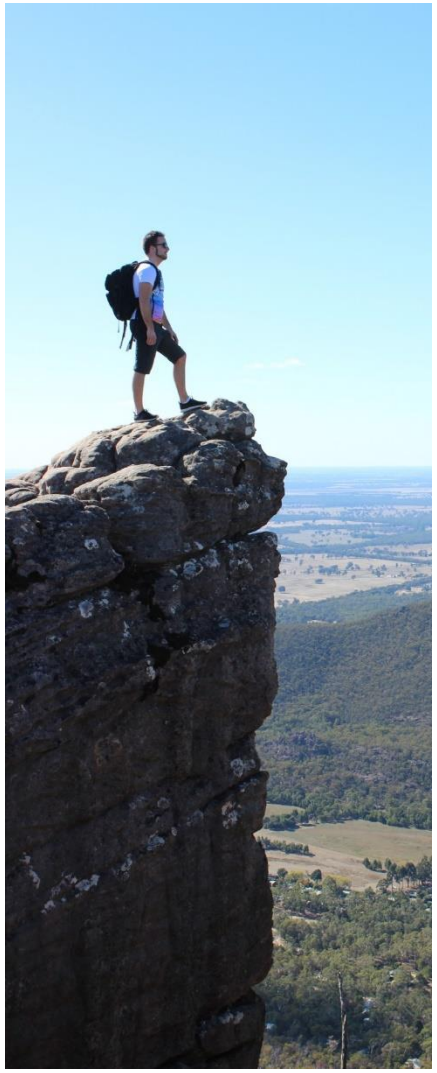
Sterilization

ROUTINARY SITUATIONS



BUT IN CRITICAL SITUATIONS ?.....

BUT IN CRITICAL SITUATIONS ?.....



BUT IN CRITICAL SITUATIONS ?.....

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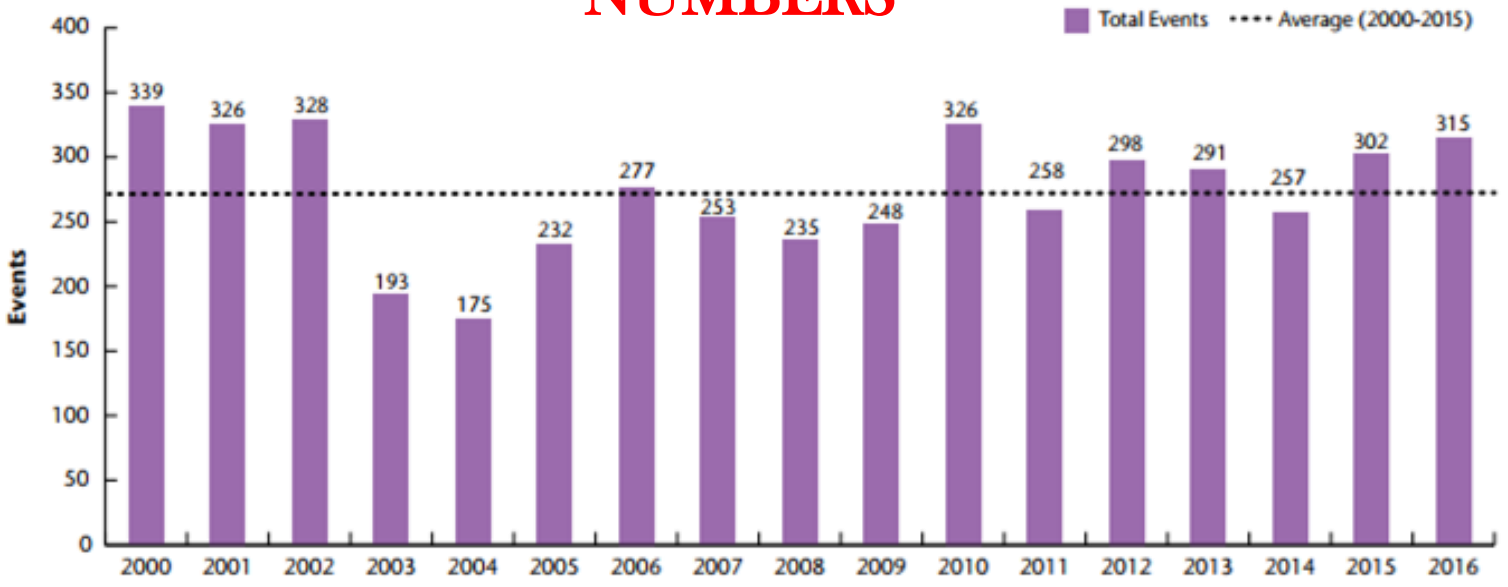
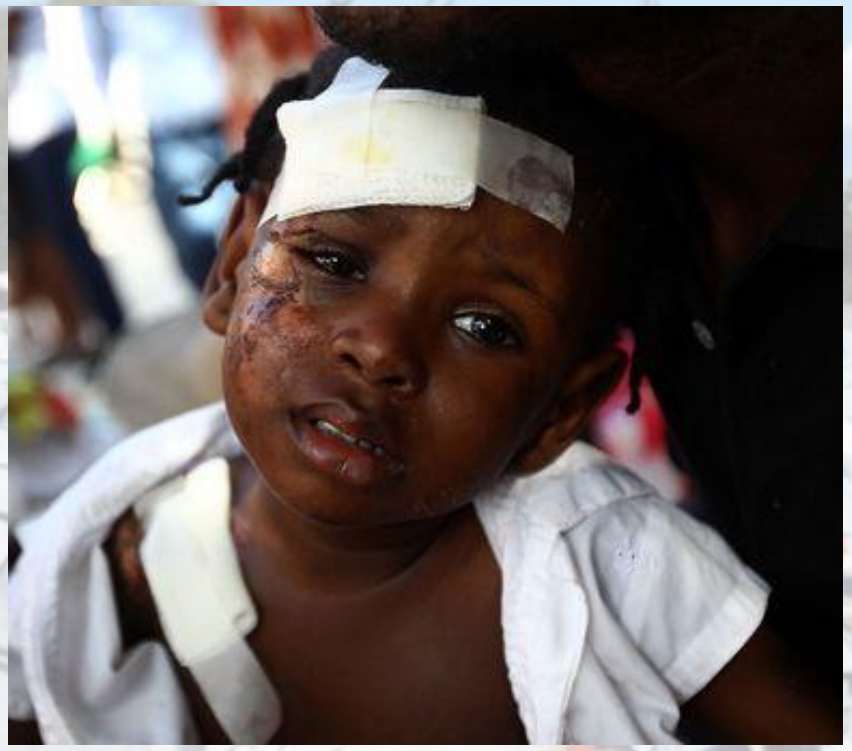
NUMBERS



2016 Annual Global Climate and Catastrophe Report

AON
Empower Results®

NUMBERS : HAITI



DEATHS

+ 220,000

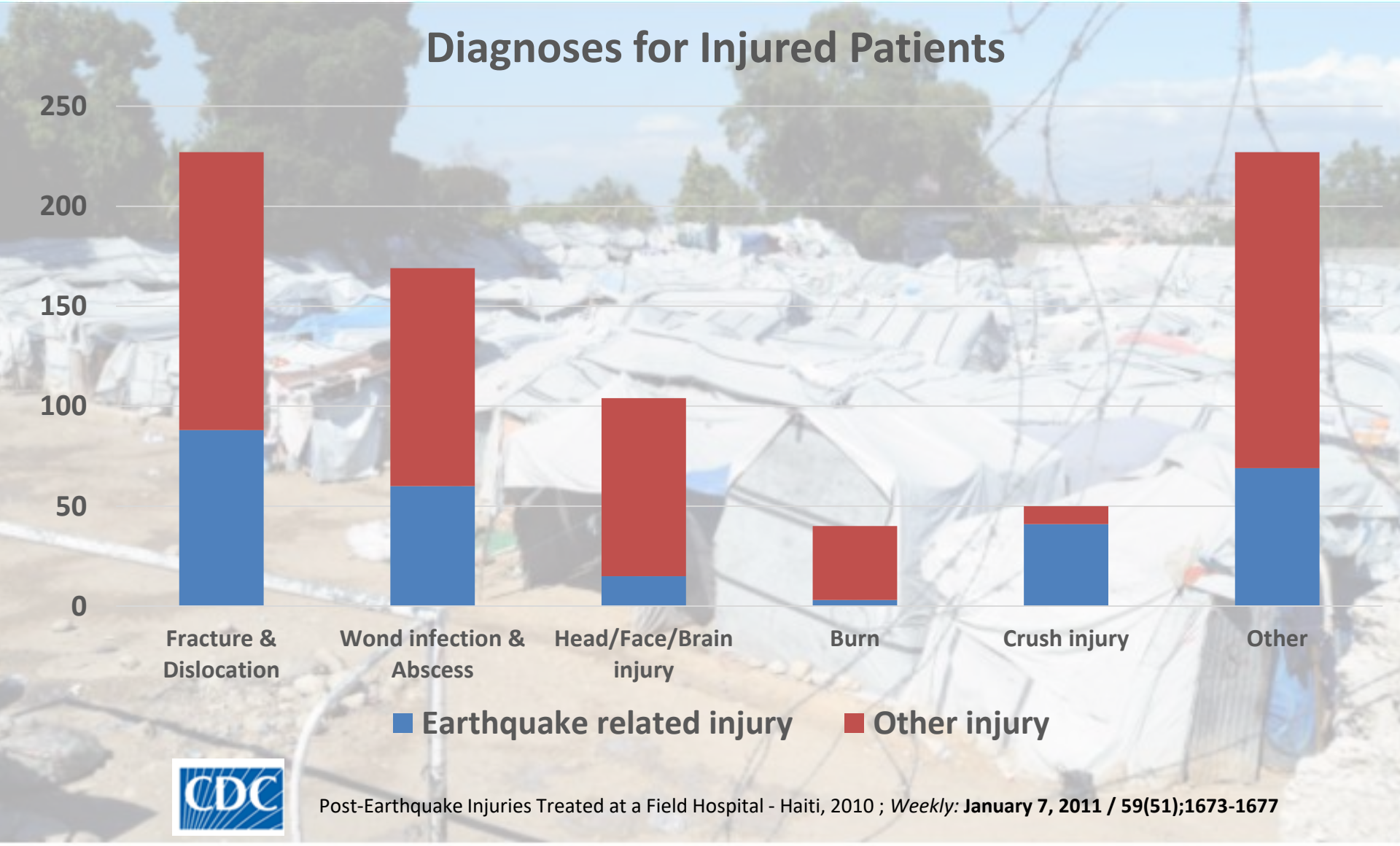
INJURIES

+ 300,000

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

Post-Earthquake Injuries Treated at a Field Hospital - Haiti, 2010
Weekly
January 7, 2011 / 59(51);1673-1677

NUMBERS : HAITI



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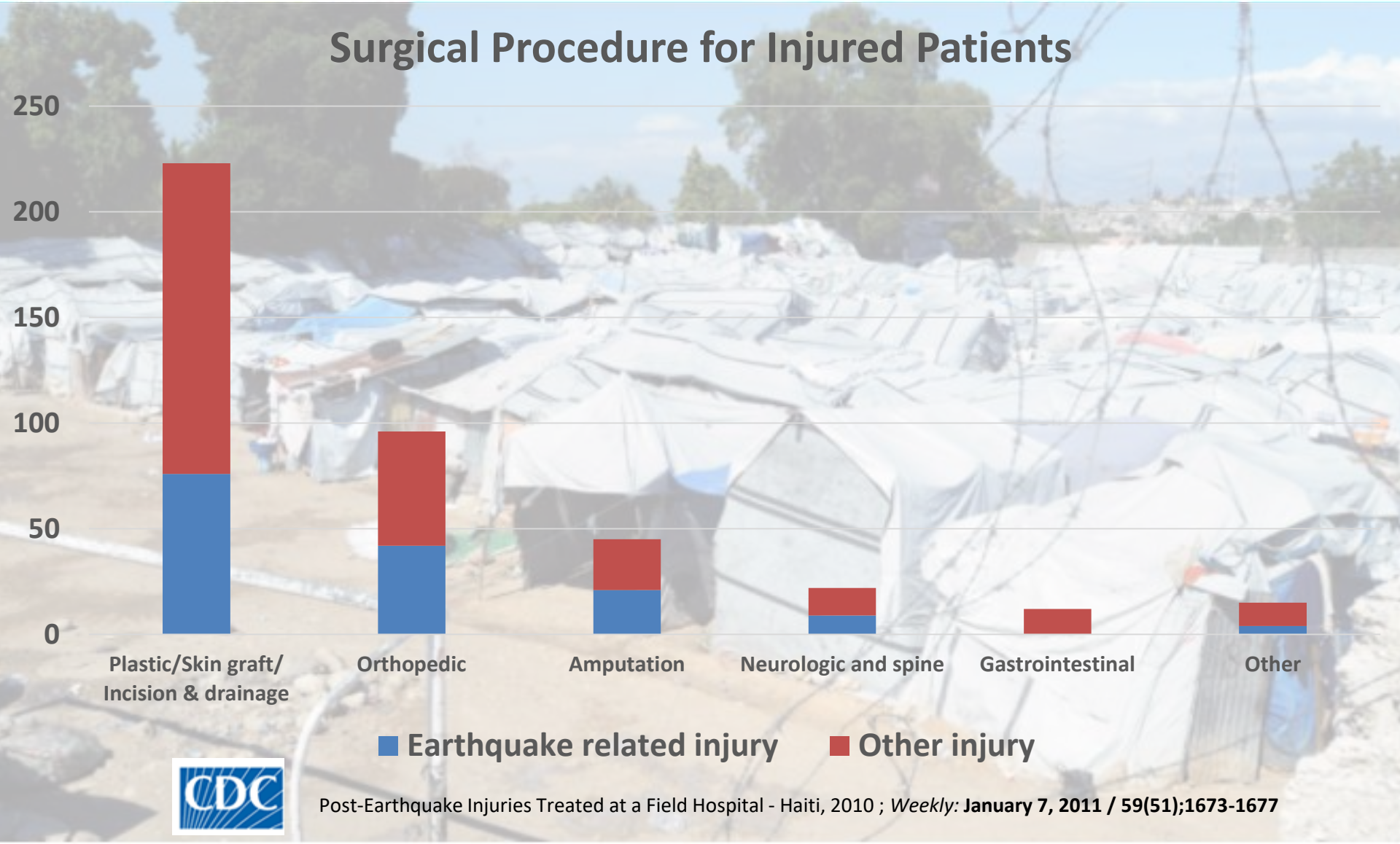

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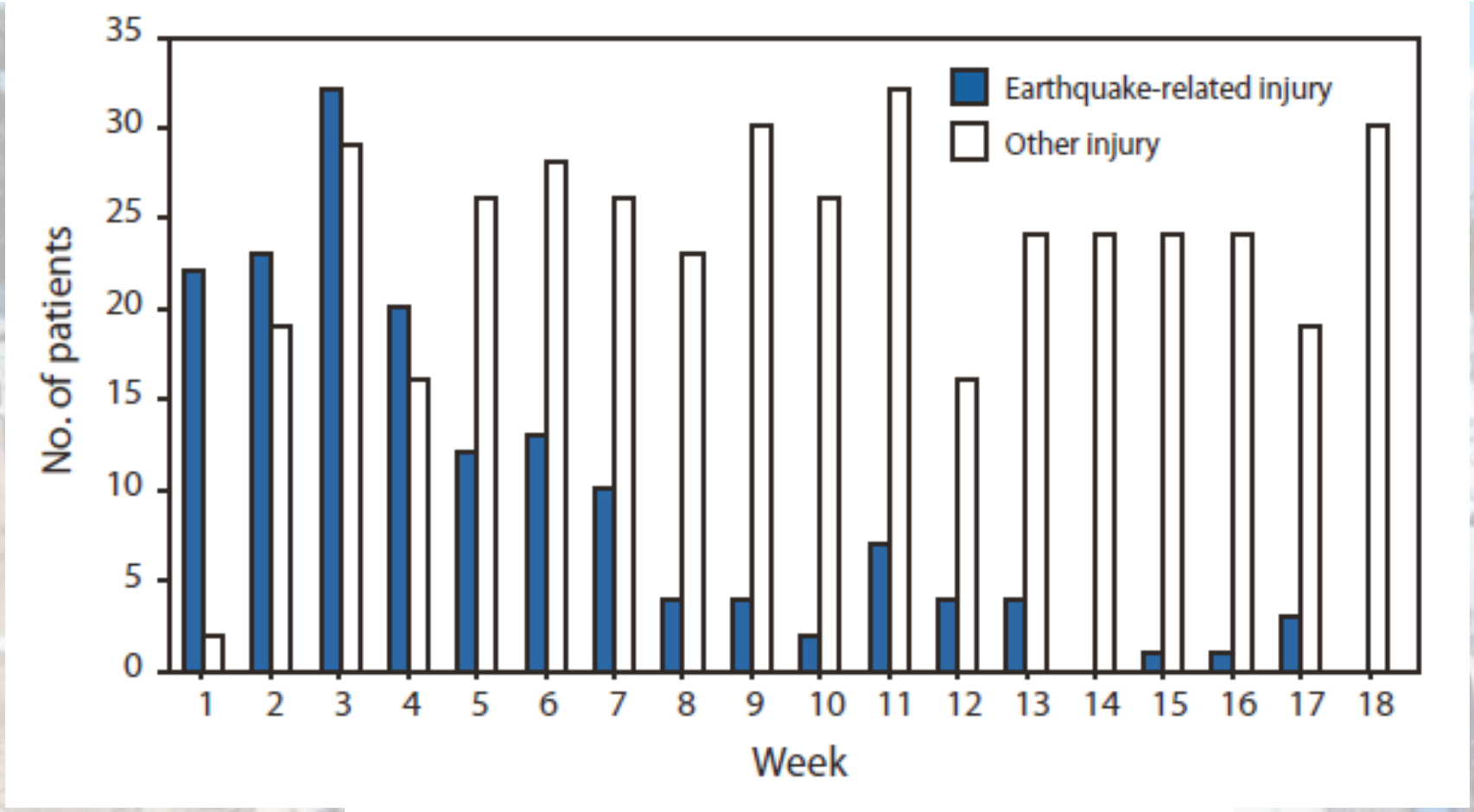

Centers for Disease Control and Prevention
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Post-Earthquake Injuries Treated at a Field Hospital - Haiti, 2010
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WHAT DOES A SURGEON NEED IN A CRITICAL SITUATION?

P.P.E.
Personal protective equipment

Patient in Serius Condition
(high risk of complications or death)

Surgery KIT
(Inseparable)

Good Disinfectant Solution

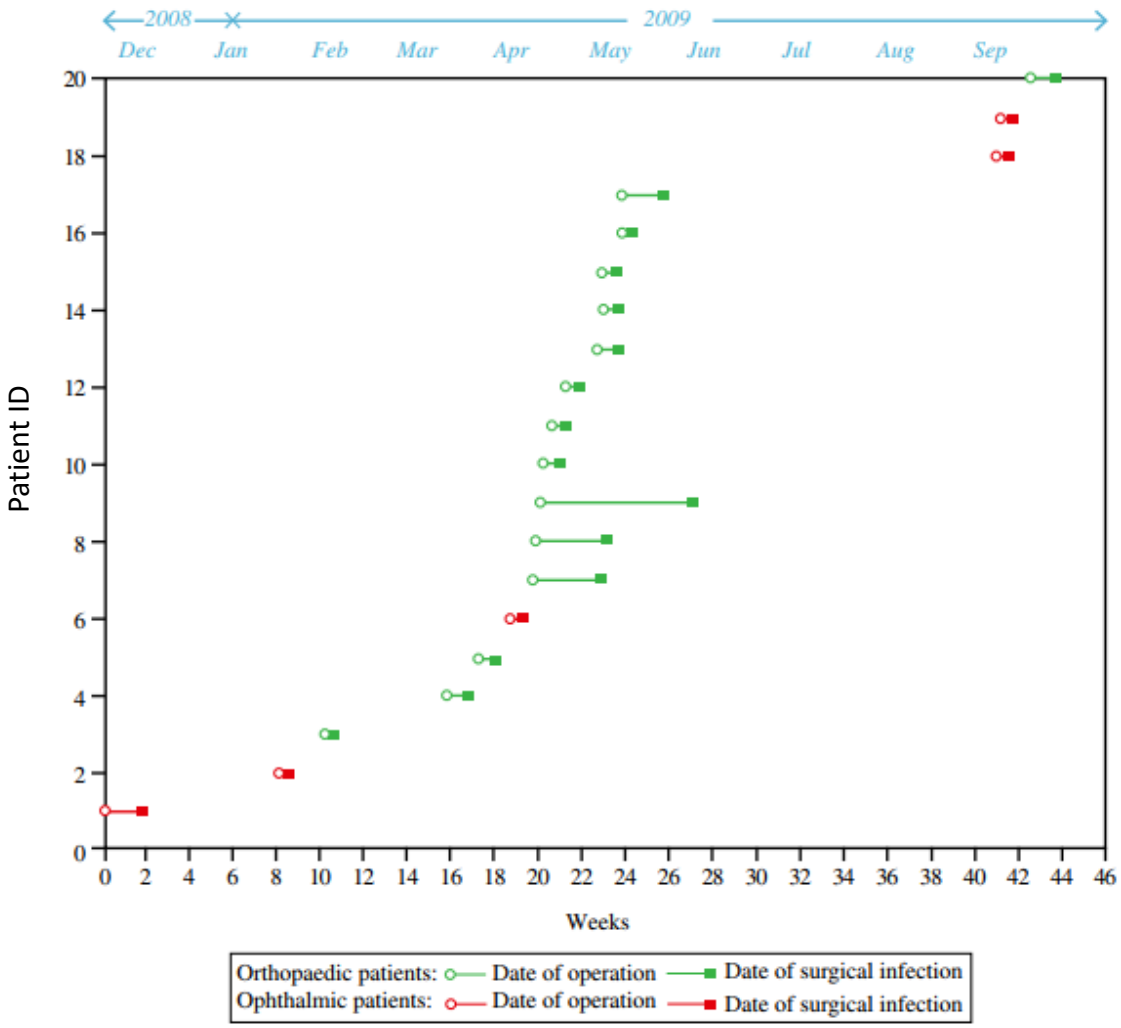
Anestetic
(if you are lucky)

For Pre/Post Therapy
(not always available)

TIME FOR INFECTION

Surgical site infections linked to contaminated surgical instruments

S.J. Dancer [a,*], M. Stewart [a], C. Coulombe [a], A. Gregori [b], M. Virdi [c]



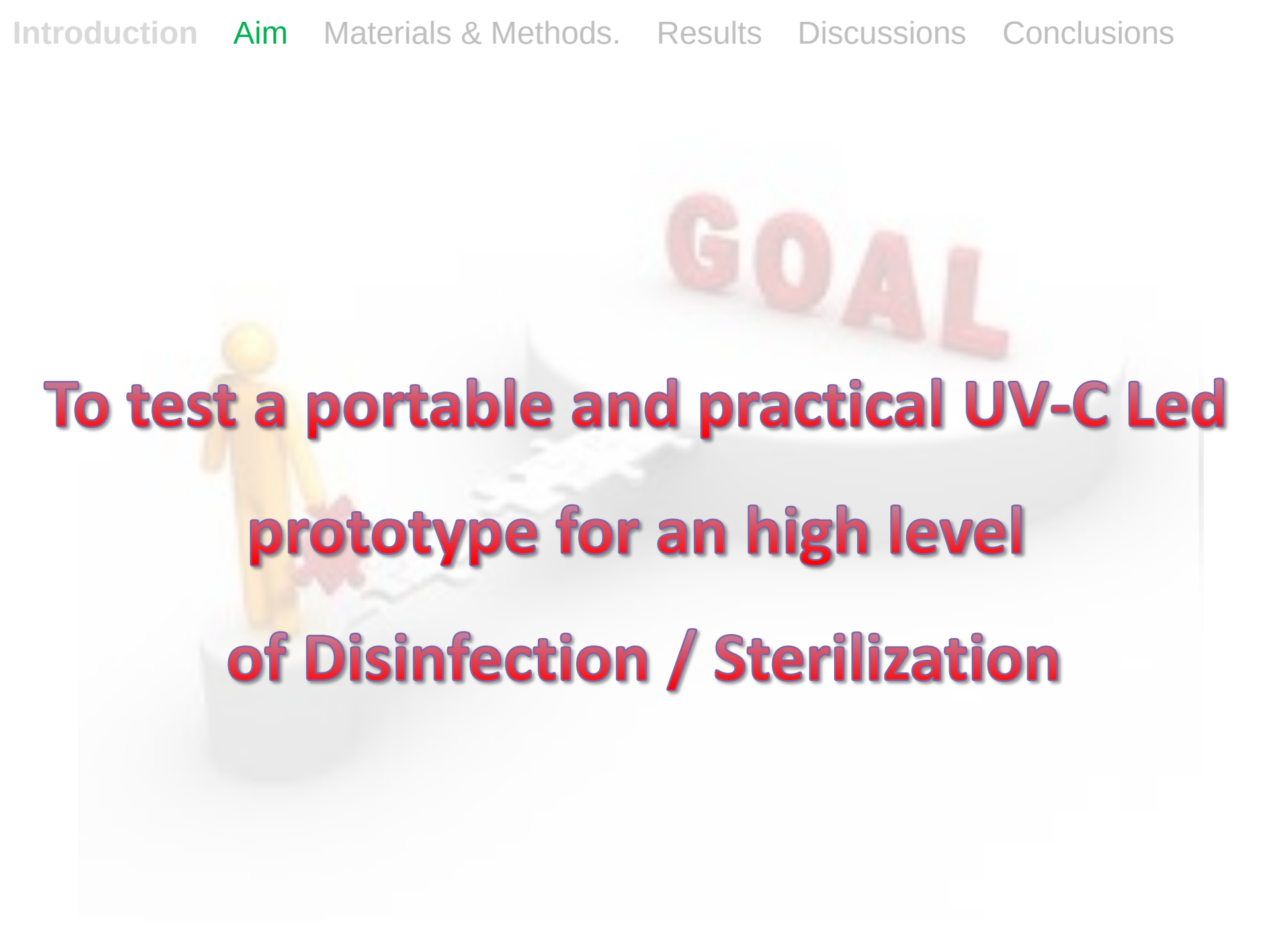
Dates of operation and onset of surgical site infection for 20 orthopaedic and ophthalmic patients.

ACTUAL POSSIBLE SOLUTIONS

Solar Autoclave

Powerful Disinfectant Solution

Disposable surgical kit

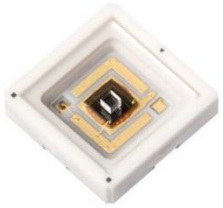


To test a portable and practical UV-C Led prototype for an high level of Disinfection / Sterilization

TECHNICAL EQUIPMENT

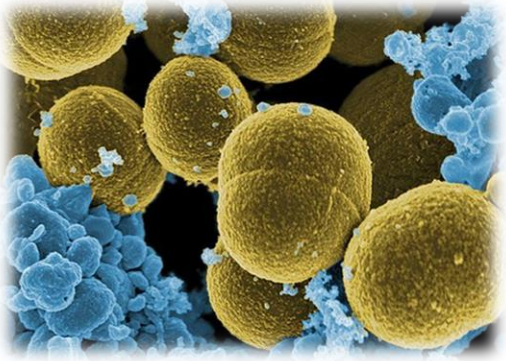
- 3 D design

- 3 D Creation of the experimental setting
- 20 Led UV-C 2,8 mW, 275 nm peak wavelength

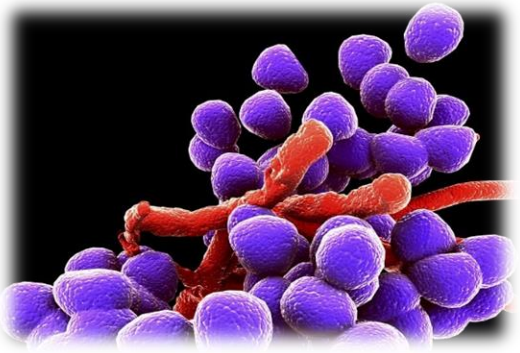


- 7 Different surgical instruments

BIOLOGIACAL EQUIPMENT

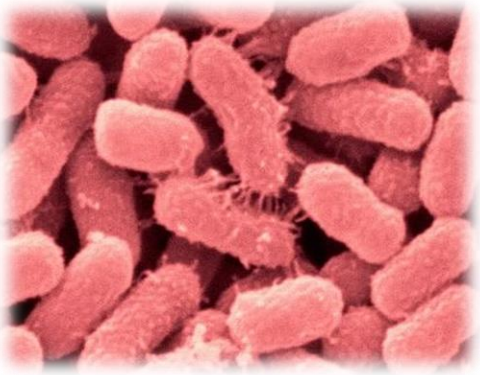


Staphylococcus aureus



Enterococcus faecalis

Pseudomonas aeruginosa



Serratia marcescens

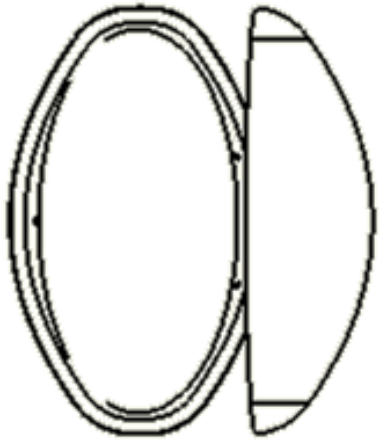
THE STUDY

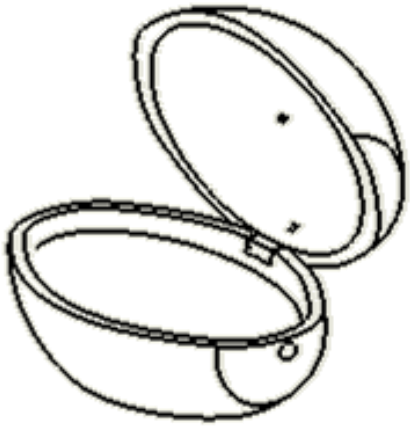
Laboratories of the Department of Molecular and Development Medicine
University of Siena

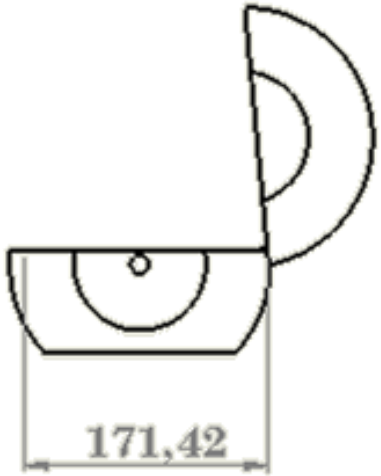
November 2017

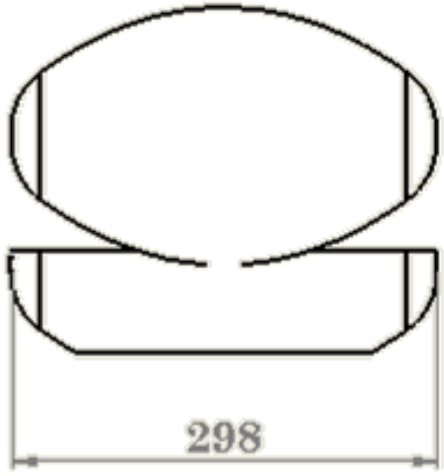
Pilot Crossover Study with Pre/Post comparison

PROTOTYPE



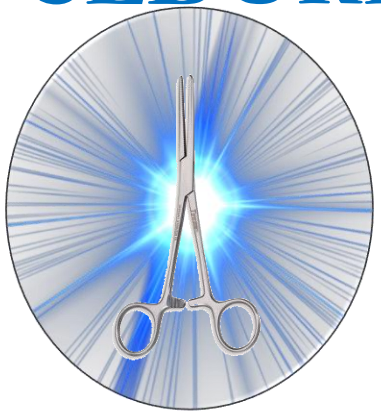




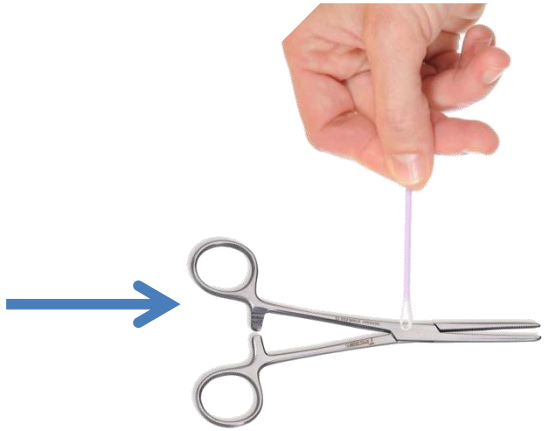


PROCEDURE

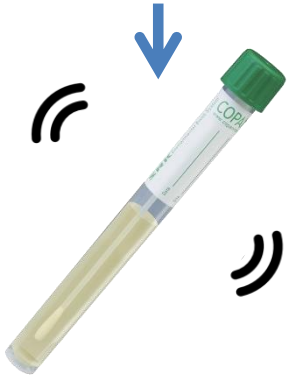
20 µl contaminated solution
(1,5 X 10^3 CFU/ µl)



10 minutes
UV-C TREATMENT



Swab Treated Sample

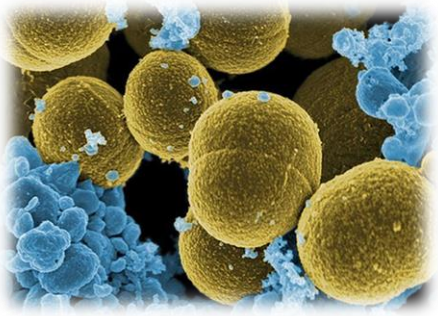


Shaken in 3ml
of PBS solution

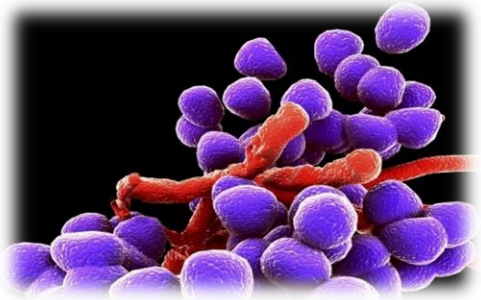
100µl PBS
Were seed in selective soil

36°C / 96,8°F 48 H

AVERAGE BACTERIAL CONTROL



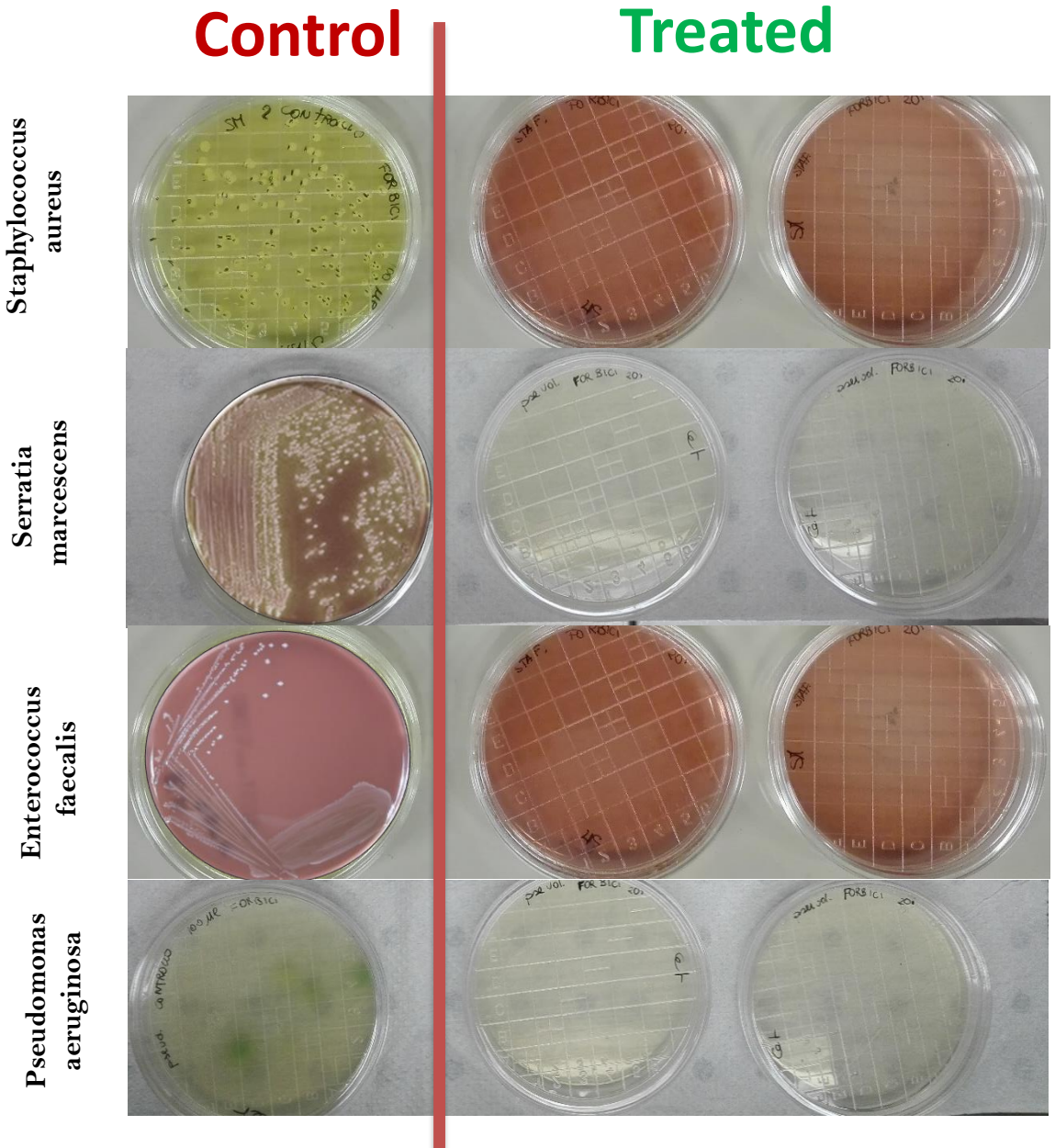
Staphylococcus aureus
81 (SD 79) CFU/100µl



Enterococcus faecalis
41,8 (SD 28,7) CFU/100µl

Pseudomonas aeruginosa
3,5 (SD 1,7) CFU/100µl

Serratia marcescens
61,8 (SD 14,8)75 CFU/100µl

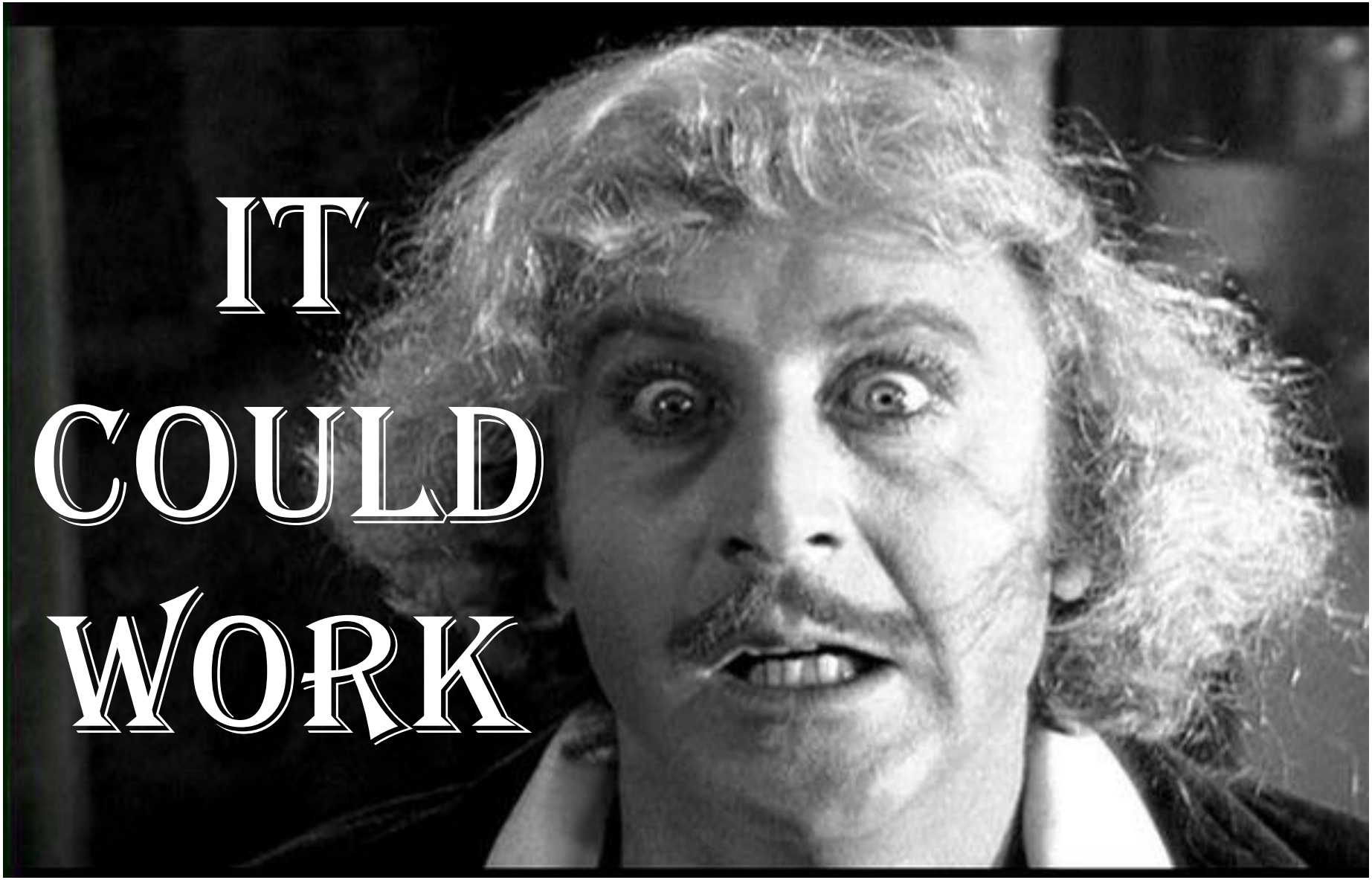


KEEP CALM

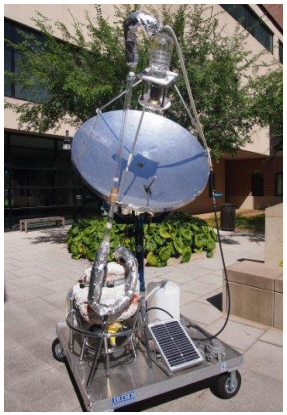
NO

BACTERIAL GROWTH IN TREATED SAMPLES

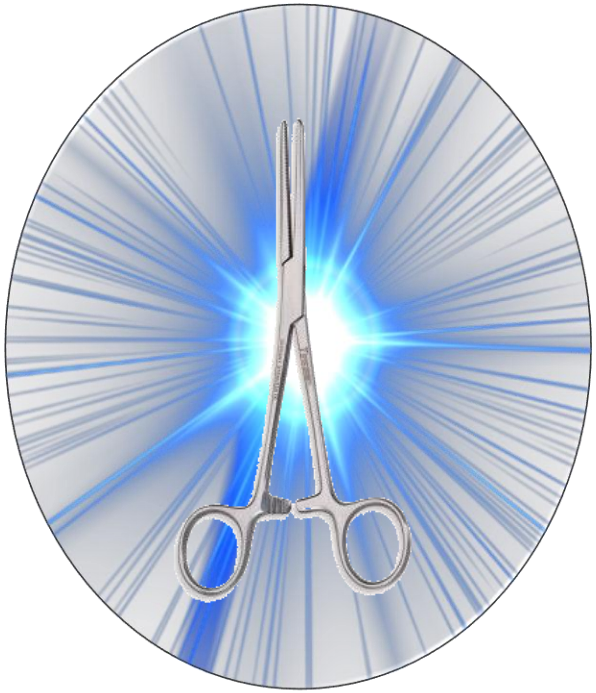
UVC LED PROTOTYPE FOR STERILIZATION IN CRITICAL CONDITIONS



ACTUAL METHODS VS UV-C LED PROTOTYPE



VS



SOLAR AUTOCLAVE

GOOD

- ✓ SOLAR POWERED
- ✓ HIGH EFFICACY
- ✓ EFFECTIVE ON GLASS, CAVITIES AND FOLDS
- ✓ CONTAINS MANY TOOLS

BAD

- X LONG TIME CYCLE
- X LONG INSTALLATION TIME
- X WEATHER DEPENDENT
- X NOT PORTABLE

POWERFUL DISINFECTANT SOLUTION

GOOD

- ✓ NO ELECTRICITY
- ✓ GOOD EFFICACY
- ✓ EFFECTIVE ON GLASS, CAVITIES AND FOLDS
- ✓ MULTIPURPOSE

BAD

- X LONG TIME CYCLE
- X LARGE AMOUNT REQUIRED
- X NOT REUSABLE
- X POSSIBLE RESISTANT BACTERIA

DISPOSABLE SURGICAL KIT

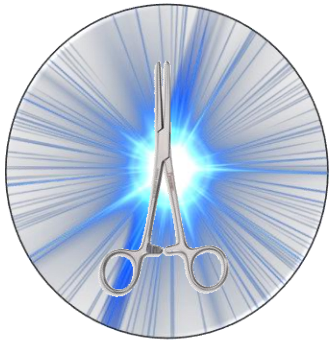
GOOD

- ✓ READY TO USE
- ✓ MANY ITEMS IN THE KIT
- ✓ LIGHT AND COMPACT SIZE
- ✓ STORABLE

BAD

- X OFTEN BAD QUALITY
- X YOU CAN NOT CHOOSE THE TOOLS
- X NEED HIGH KIT NUMBER
- X DIFFICULT TO PRESERVE

UV-C LED PROTOTYPE



GOOD

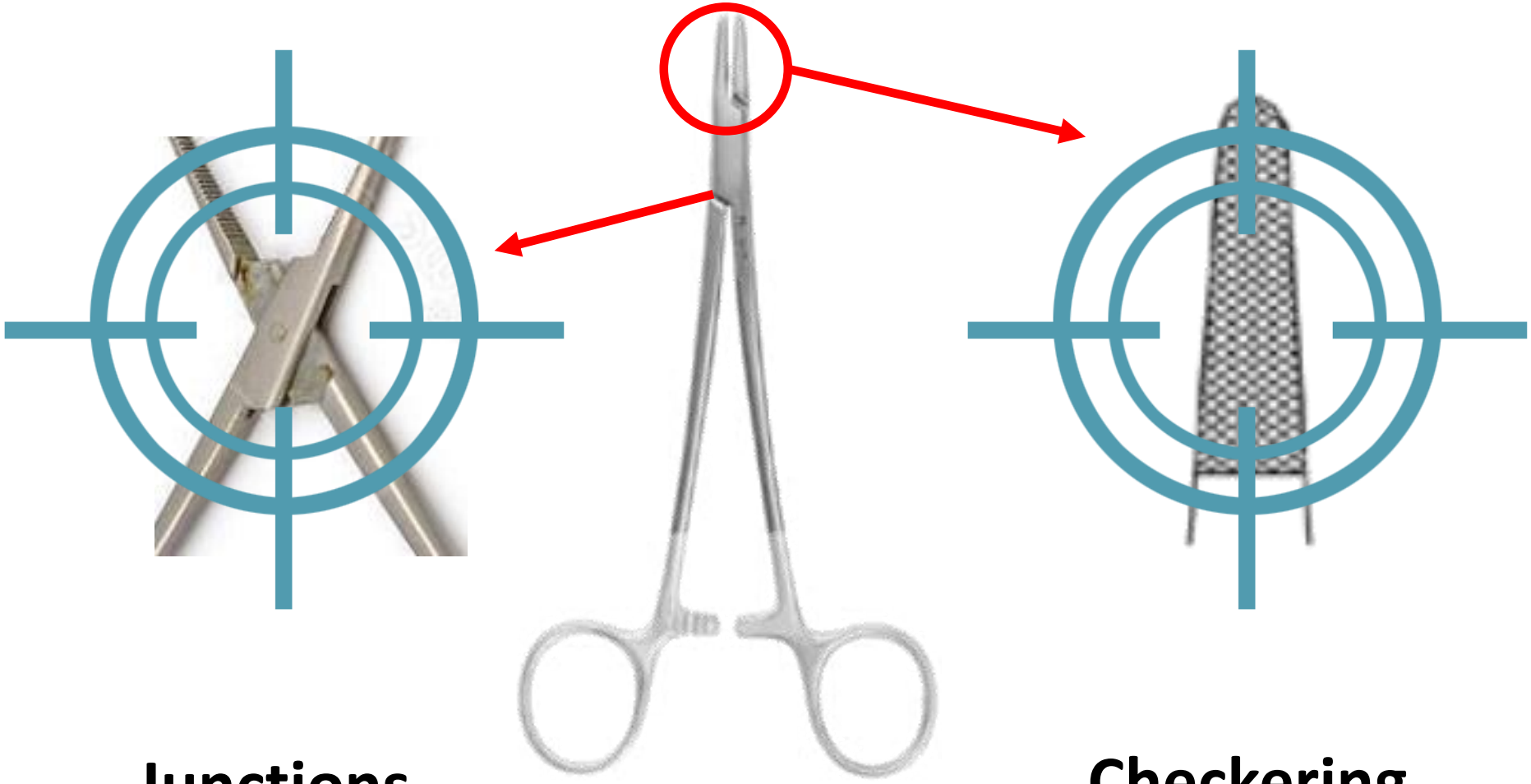
- ✓ REUSABLE
- ✓ YOU CAN CHOOSE THE TOOLS
- ✓ LIGHT AND COMPACT SIZE
- ✓ RAPID CYCLE
- ✓ NO RESISTANT BACTERIA

BAD

- X ATTENTION TO OBJECTS POSITION
- X NO GLASS, CAVITIES AND FOLDS

CRITICAL STERILIZATION POINTS

SPECIFIC UV-C LED TARGET



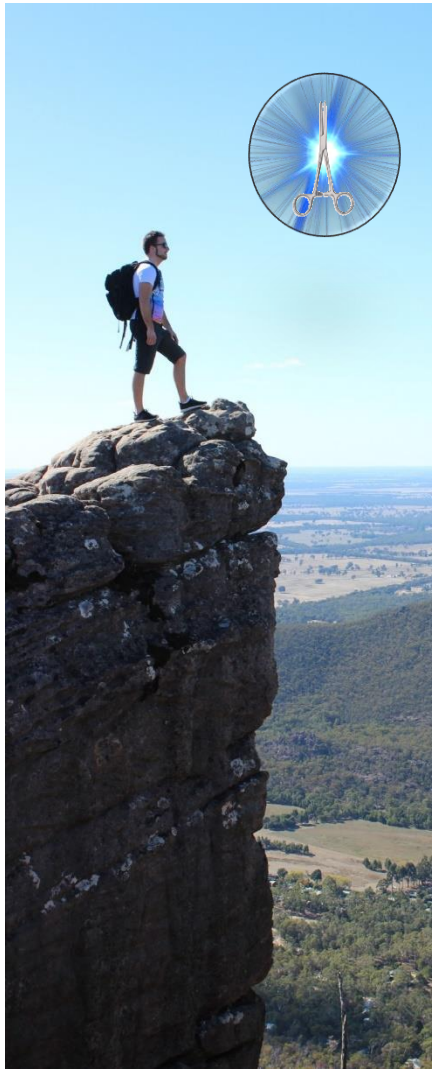
Junctions

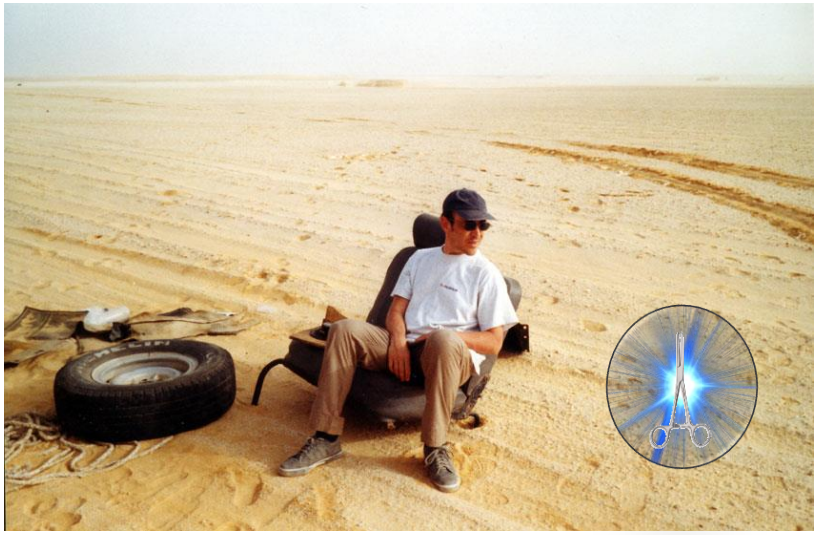
Checkering

CRITICAL STERILIZATION POINTS

- **THE DEVICE PROVIDES A HIGH DISINFECTION LEVEL IN 10 MINUTES.**
- **THE POCKET SIZE OF THE DEVICE MAKES POSSIBLE TO EASILY CARRY IT**
- **POSSIBILITY TO RECHARGE THE BATTERY USING SOLAR LIGHT MAKES POSSIBLE TO USE IT IN REMOTE PLACES WHERE THE ELECTRIC LINES ARE NOT AVAILABLE.**

IN CRITICAL SITUATION





IN CRITICAL SITUATION

University of Siena

Dr. Giuseppe Spataro

Department of Molecular and Developemental Medicine

Post Graduate School of Public Health

spataro2@student.unisi.it