

# **INVESTIGATING THE RISKS INVOLVED WITH GENERATORS AND SERVICE PROVIDERS NOT BEHAVING IN A RESPONSIBLE AND ETHICAL MANNER REGARDING HCRW**

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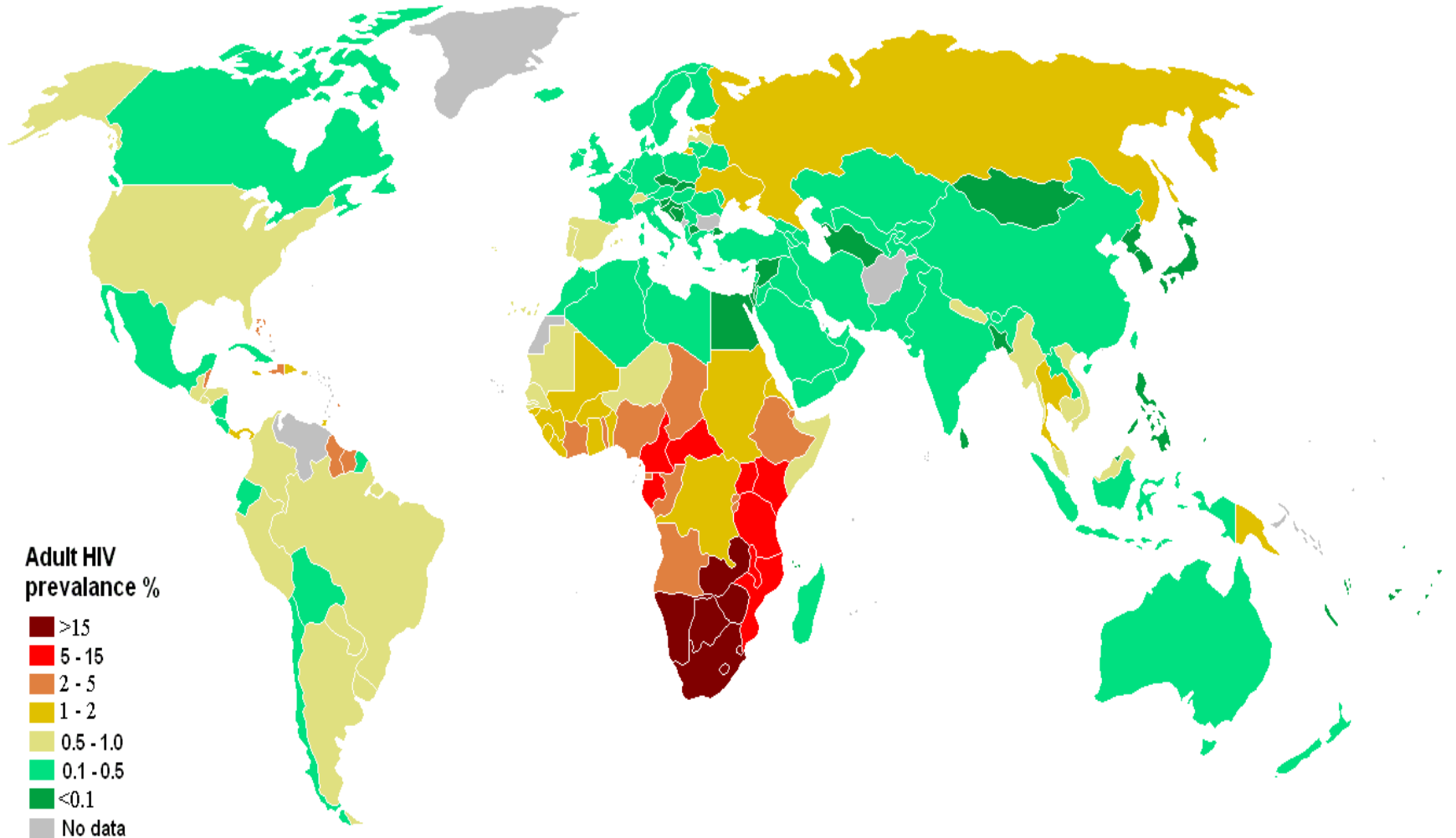
**Nelson R. Mandela School of Medicine**

**University of KwaZulu Natal**

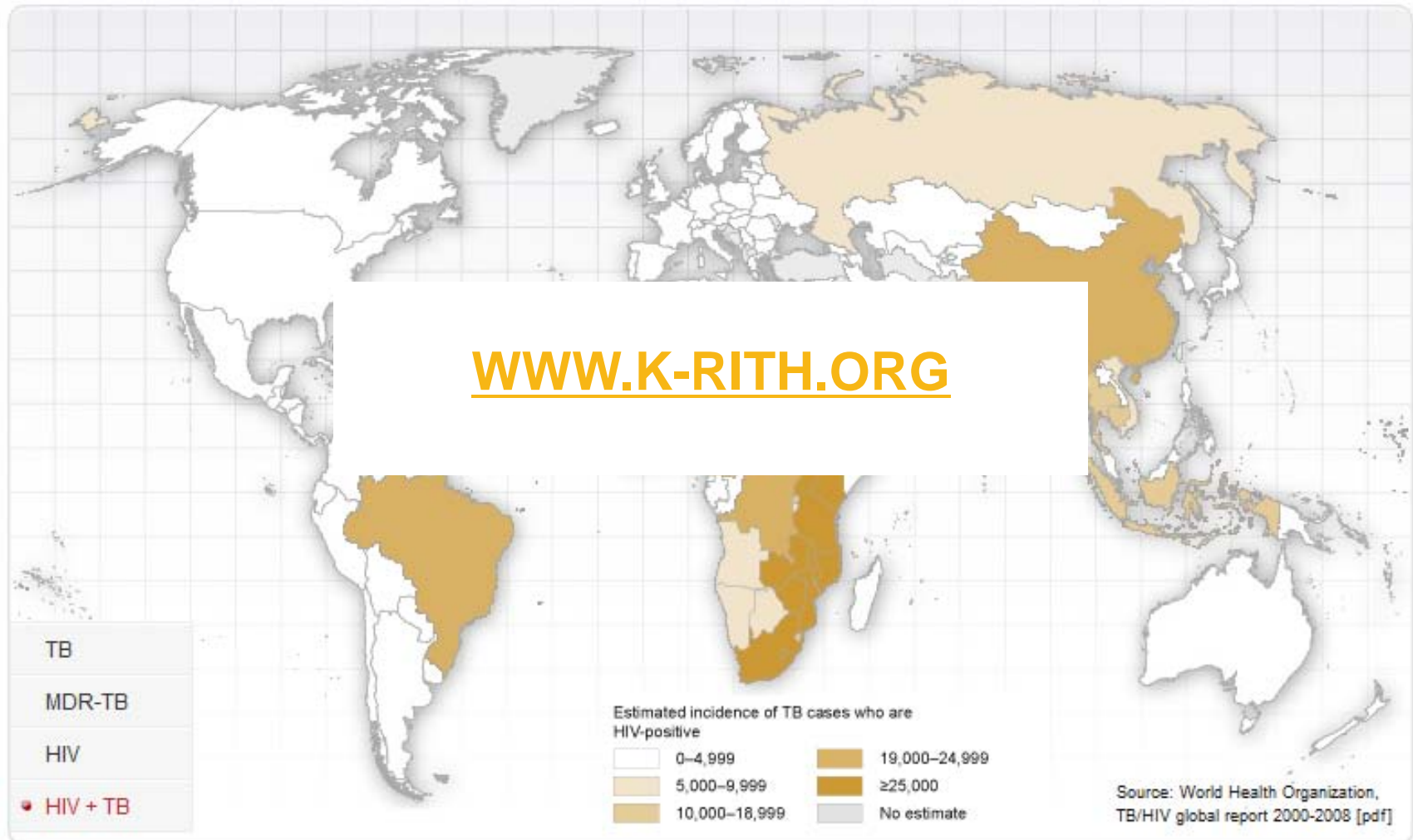
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## SOUTHERN AFRICA AS AN HIV "HOTSPOT"



# EPICENTRE FOR TB, MDR-TB & HIV





A collaboration between **Howard Hughes Medical Institute & University of KwaZulu-Natal** at the Nelson R. Mandela School of Medicine. The building will have 6,000 sq. ft. of biosafety level-3 laboratory space for the safe handling of HIV and TB bacteria including drug-resistant *M. tuberculosis*



## TOPIC COVERAGE

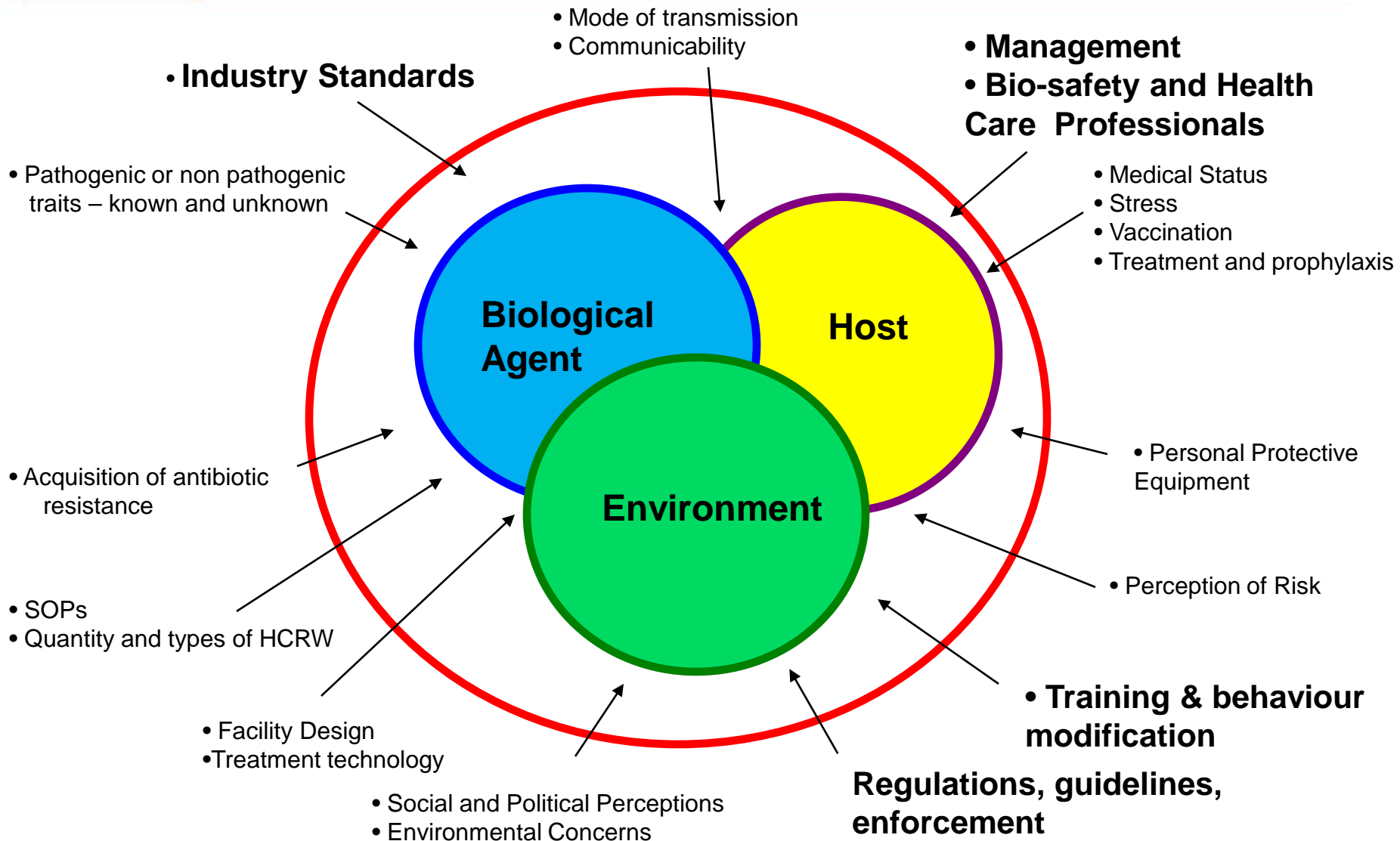
**Waste segregation – whose responsibility?**

**Service Provider - **risks** to workers from sub-standard equipment?**

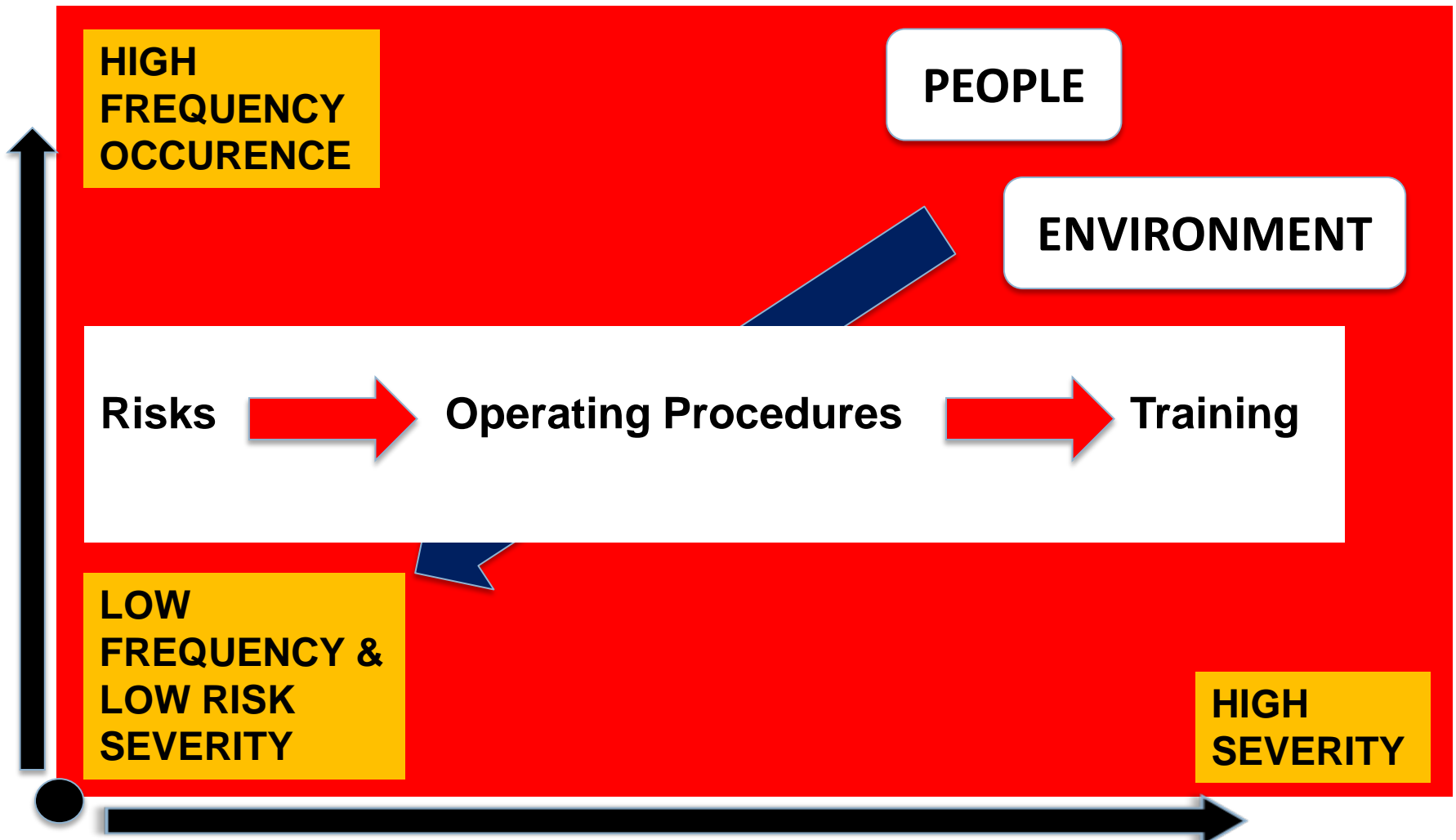
**HCRW generator – managing properly and taking responsibility – sturdy ethics**

**Change and **risk** management and acceptance of HCRW responsibilities**

**What are the environmental **risks**?**



## PROBABILITY-IMPACT DIAGRAM



## MANAGEMENT , STANDARDS AND OPERATIONAL PARAMETERS

1. that can be **measured**, and for which critical **limits can be set** to define effectiveness (e.g. disinfection of re-usables, norm/standard)
2. that can be **monitored** sufficiently frequently to reveal any failures in a timely manner (e.g. segregation of HCRW and HCGW at CSA)  
**N.B.** 'timely' may also mean monitoring regularly rather than frequently
3. with potential **corrective actions** that can be implemented in response to deviations from critical limits

# THE ENVIRONMENT

THERE ARE 5 QUALITATIVE MEASURES OF IMPACTS ON THE ENVIRONMENT

INSIGNIFICANT  
MINOR  
MODERATE  
MAJOR  
CATASTROPHIC

## IMPACTS ON THE ENVIRONMENT five levels with descriptors

**1 Insignificant** - Insignificant impact or not detectable.

**2 Minor** - Minor impact for small population. Potentially harmful to local ecosystem with local impacts contained to site. Short-term reversible environmental impacts. No detectable change to ecology. Can be readily managed but nevertheless requires immediate action to minimise impacts.

**3 Moderate** - Minor impact for large population.

Potentially harmful to regional ecosystem with local impacts primarily contained on-site. Possible minor impacts on adjacent areas. Medium-term, generally reversible environmental impacts. Should the event occur, the environmental impacts could be readily contained or mitigated

## IMPACTS ON THE ENVIRONMENT

### five levels with descriptors

**4 Major** - Major impact for small population. Potentially lethal to local ecosystem. Predominantly local, but potential for off-site impacts. Medium- to long-term environmental impacts. Potentially reversible over a duration of several years. Significant impact on ecosystems. Should the event occur, the environmental impacts would be difficult to contain or mitigate (e.g. major fish kills, widespread death of flora and fauna). Possible cessation of use. High level of monitoring required.

**5 Catastrophic** - Major impact for large population. Potentially lethal to regional ecosystem or threatened species. Widespread, on and off-site impacts. Catastrophic harm, should the event occur, the environmental impacts would be extremely difficult, if not impossible, to contain or mitigate (e.g. catastrophic impacts on World Heritage areas, or species, populations or ecological communities identified as threatened). Major failure of system leading to cessation of use.

## PHARMACEUTICALS WITH POSSIBLE IMPACTS?

**Analgesics** – Ibuprofen – Ketoprofen – Morphine – Paracetamol

**Antibiotics** – Amoxicillin – Cefaclor – Cephalexin – Metronidazole

**Cardiovascular drugs** – Atenolol – Beta blockers

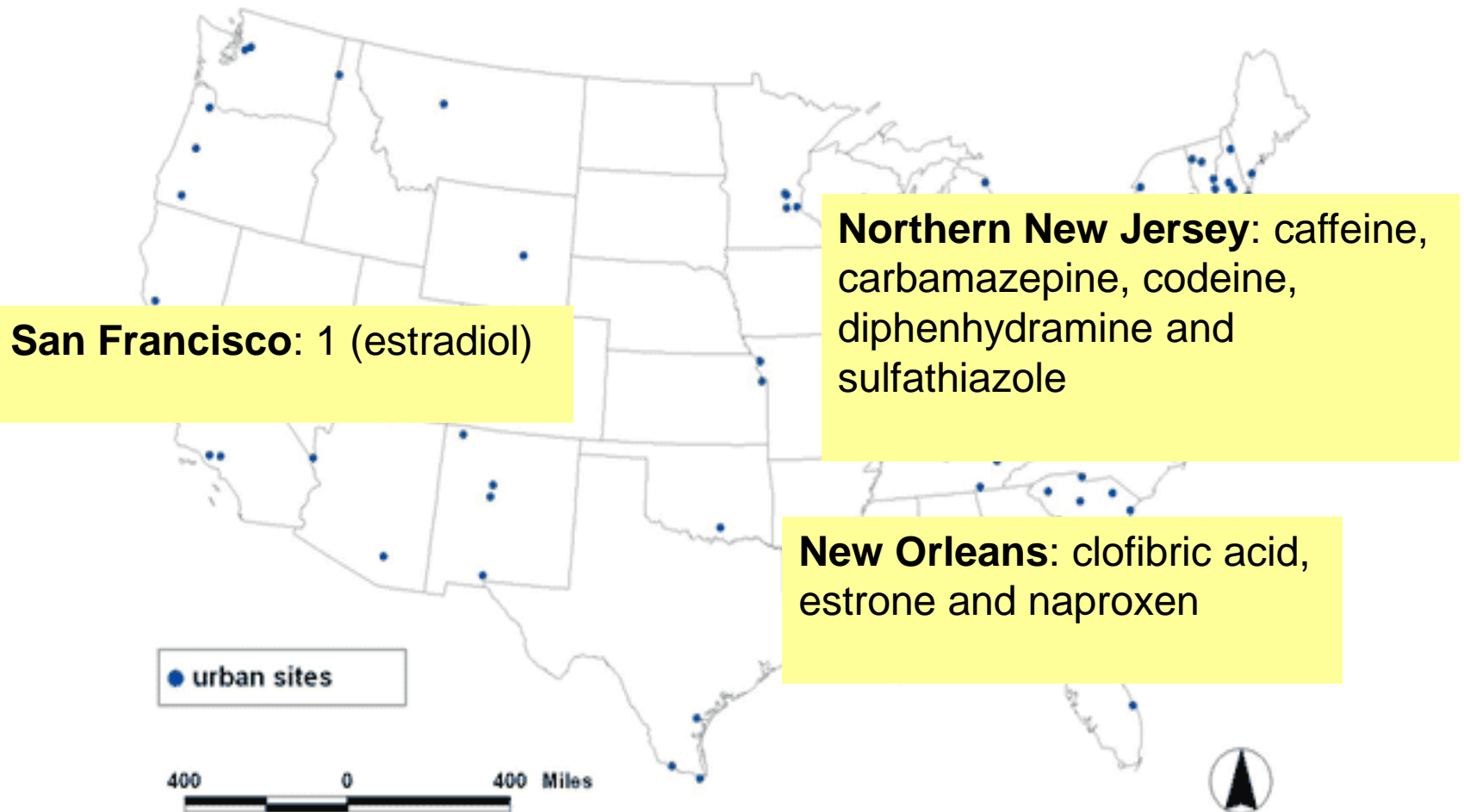
**Cholesterol-lowering drugs** – Gemfibrozil – Simvastatin

**Histamine H receptor agonists** – Ranitidine

**Oral contraceptives** – Ethinylestradiol – Levonorgestrel

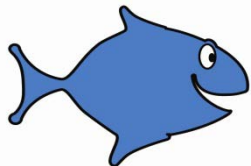
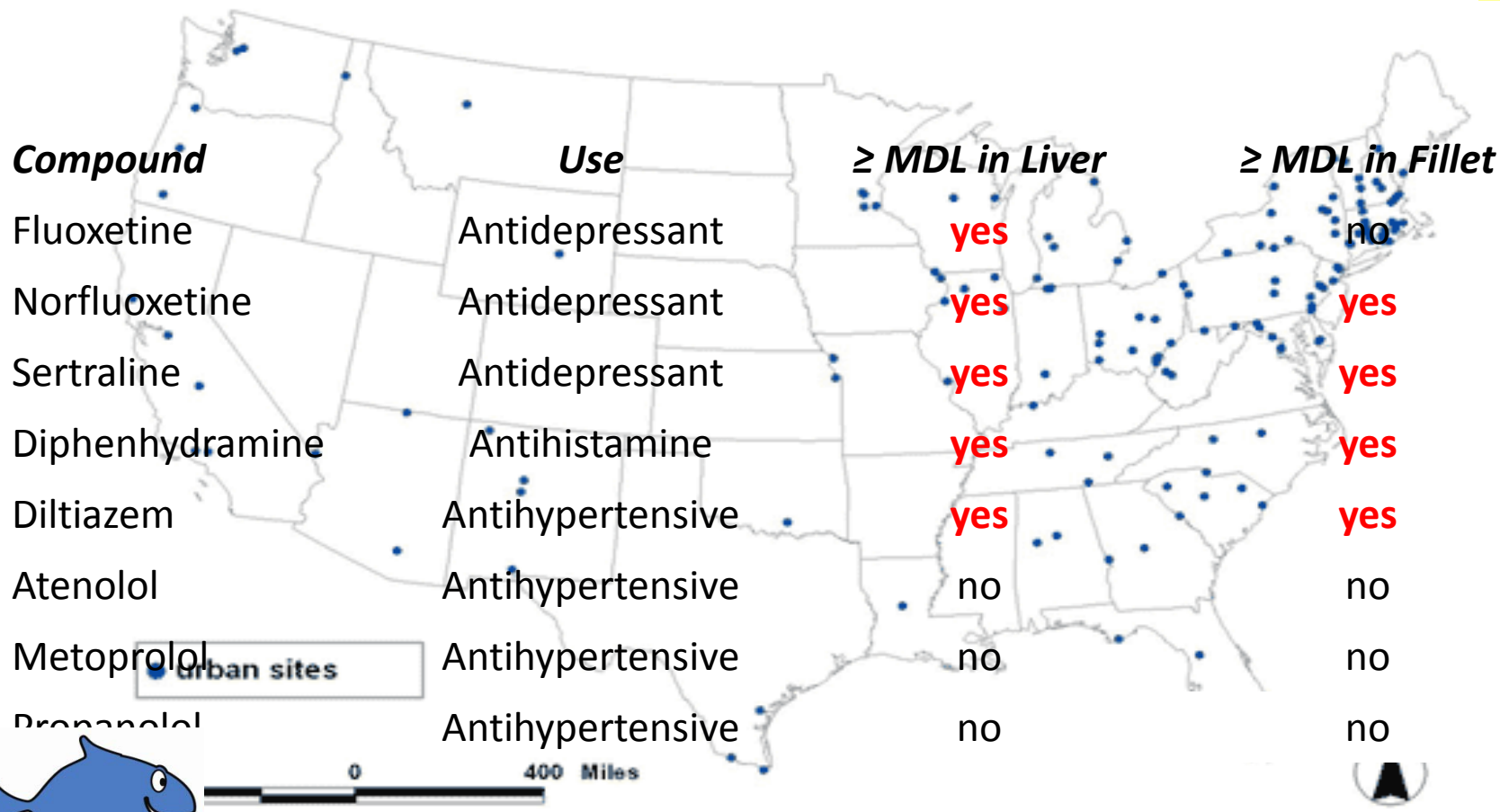
**Sedatives** – Temazepam

IN 2008/2009 US EPA COLLECTED FISH AND SURFACE WATER SAMPLES FROM ABOUT 150 SITES SURFACE **WATER SAMPLES** AND ANALYZED FOR 54 PHARMACEUTICALS.



**FISH FILLETS** ANALYZED FOR MORE THAN 20 PHARMACEUTICALS  
& 15 PERSONAL CARE PRODUCTS

[HTTP://WWW.NCBI.NLM.NIH.GOV/PMC/ARTICLES/PMC2702425/TABLE/T1-EHP-117-703/](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2702425/table/T1-EHP-117-703/)



# THE BIOLOGICAL AGENT

## Pathogen

Growth characteristics  
Stability, spore former,  
Antibiotic resistance,  
Pathogenicity & virulence

## Reservoir

Containers: RUC  
Single use  
Processing @ facility  
**TIME-DEPENDENT DECAY**

## “Escape” from Reservoir

Operational & management issues  
RUC and containers

## Transmission

Contact: direct, indirect, droplets  
Common vehicle: food, water, medication  
Airborne: droplet nuclei  
Vectors?

# THE HOST

## Susceptible host

Incubation period  
Non-specific defence mechanisms – age, sex, skin, secretions, cough, nutrition, genetic factors, personal hygiene, behaviour patterns, chronic disease

## Portal of Entry

BB pathogens & NSI  
Cuts, abrasions  
Mucous membranes  
Aerosolization - TB

## RANKING OF INFECTION BY INFECTIVITY, PATHOGENICITY AND VIRULENCE

severity	infectivity	pathogenicity	virulence
HIGH	Measles > smallpox	Smallpox>rabies	Rabies>smallpox> TB > leprosy
INTERMEDIATE	Rubella>common cold	Rubella> mumps	Poliomyelitis > measles
LOW	TB	Poliomyelitis >mumps	Measles >chicken pox
VERY LOW	Leprosy	Leprosy	Rubella > common cold

*Adapted from Brachman, P.S., Epidemiology of Nosocomial infections, Lippincott-Raven 1998.*

**BUT**

## A VERY REAL RISKS OF DIVERSE HAI AND LAI VIRAL INFECTIONS - A LITERATURE STUDY OF 66 LITERATURE CASES

....."currently accepted and practiced risk analysis of accidental viral **infections based on the conventional dynamics** of infection of the etiological is *insufficient to cope* with accidental viral infections in **laboratories** and to a *lesser extent* in **hospitals**" .....

**Aerosols:** For arboviruses, **84% LAIs** had aerosol as the source; for alphaviruses alone, aerosol exposure accounted for 94% of accidental infections.

**Percutaneous:** Laboratory arboviral infections - **15 % vs. 41%** of hospital infections were percutaneous.

**Airborne :** viruses, 81% of the infections occurred in laboratories, with hantavirus the leading causative agent.

**SARS:** mucocutaneous mode of infection was involved

**Blood-borne viruses:** hospitals 92% vs. 93% LAIs via **percutaneous mode** of infection

3 cases of acute hepatitis following hepatitis C virus 1 laboratory case of HIV through aerosol inhalation

## EXPOSURE REDUCTION BY ON-SITE & OPERATIONAL MATTERS

**Bacteria** *Escherichia coli* (indicators)  $10^5$ – $10^{10}$       *Campylobacter*  $10^2$ – $10^5$

**Viruses** Enteroviruses  $10^2$ – $10^6$       adenoviruses  $10^1$ – $10^4$       Somatic coliphages (indicators)  
 $10^6$ – $10^9$

**Protozoa and helminths** *Cryptosporidium*  $0$ – $10^4$       *Giardia*  $10^2$ – $10^5$       Helminth ova  $0$ – $10^4$

**Cooking or processing of produce (e.g. cereal, wine grapes) 5–6 log**

Removal of skins from produce before consumption 2 log

Drip irrigation of crops with limited to no ground contact (eg tomatoes, capsicums) 3 log

Drip irrigation of raised crops with no ground contact (eg apples, apricots, grapes) 5 log

**Withholding periods — produce (decay rate) 0.5 log/day**

## LOG REDUCTION OF MICRO-ORGANISMS WHAT DOES IT REALLY MEAN?

90 % reduction = 1 log  
99 % reduction = 2 logs  
99.9 % reduction = 3 logs  
99.99 % reduction = 4 logs  
99.999 % reduction = 5 logs  
99.9999 % reduction = 6 logs  
99.99999 % reduction = 7 logs

**So in a log 6 reduction: means that of original**

100 000 000 (10<sup>8</sup> thermotolerant coliforms) will be reduced to 100 (10<sup>2</sup>)

**EPA** water treatment rules require **disinfection and filtration**  
of water at the following levels:

*Cryptosporidium*: 99% removal/inactivation (as of January 1, 2002)

*Giardia lamblia*: 99.9% removal/inactivation

Viruses: 99.99% removal/inactivation

HPC: No more than 500 bacterial colonies per milliliter.

Let's look at the limits for **drinking water**

***“Take the example of commonly used measurements for microbiological water quality – what is its relevance and meaning.....***

***Policy is being made and facilities built with inadequate understanding” ##***

Measuring organisms per 100 mL.....limit set at 0 for drinking water

1 fecal coliform/ 100ml = 1 ppb = 0.001 ppm = 1 buttwipe per swimming pool =  
0.001 buttwipe per bathtub

### **Concentration blindness**

Almost all standards are expressed in terms of concentration, not total quantity of organisms.....but infectivity is measured as MID of micro-organism

**“Engineerspeak”** treatment plants discharge of untreated sewage to the ocean during intense rainfall....logic.....*“the dilution factor is so great.”*

Escherichia coli (E. coli) and Enterococcus **are indicators of faecal contamination** from humans and other warm blooded animals



< 100



101-300



301-2000



>20000



Excellent to  
good – blue  
lagoon



ushaka  
moderate  
*Enterococcus*

# DECONTAMINATION OF SURFACES

**Organism** **Contact Time** **Log Reduction**

**Test method combined BS EN 14348 with BS EN 13704**

*Clostridium difficile* (& spores) 2 minutes >6.29

**ATS LABS Test**

Norovirus (Feline Calicivirus as surrogate) 5 minutes >6.0

Canine Parvovirus 5 minutes >5.0

**Test method combined BS EN 14476**

Adenovirus 10 minutes >4.20

Poliovirus 5 minutes >4.60

**Test method combined BS EN 14348**

*Mycobacterium terra* 5 minutes >7.31

**Test method combined BS EN 13697**

Methicillin resistant *Staphylococcus aureus* & *Pseudomonas aeruginosa* 1 minute >5.91

*Listeria monocytogenes* 1 minute >5.92

1 minute >6.04

**BUT.....**

## WHAT ARE SAMPLING EFFICIENCIES??

Sampling method	Trial	Sampling loss (%)	Processing loss (%)	Overall efficiency (%)
Swab kit	1	1.3	29.8	68.9
	2	2.5	18.3	79.2
	3	2.6	25.0	72.4
	Mean $\pm$ SE	2.1 $\pm$ 0.4	24.4 $\pm$ 3.3	73.5 $\pm$ 3.0
Cotton swab	1	5.9	26.9	67.2
	2	3.3	23.8	72.9
	3	12.5	21.7	65.8
	Mean $\pm$ SE	7.2 $\pm$ 2.7	24.1 $\pm$ 1.5	68.6 $\pm$ 2.2
Sponge swipe	1	0.30	30.8	68.9
	2	0.04	25.0	75.0
	3	0.01	21.1	78.9
	Mean $\pm$ SE	0.12 $\pm$ 0.09	25.6 $\pm$ 2.8	74.3 $\pm$ 2.9

*B. subtilis* from surfaces - Buttner, M.P. et al., Appl. Environ. Microbiol., 67, p2564-2570, 2001

## WHAT ARE SAMPLING EFFICIENCIES??

Method	Number of samples tested	% <i>B. anthracis</i> detected	Range cfu/cm <sup>2</sup>	Median value cfu/cm <sup>2</sup>
Dry swab	28	4(14)	0.45-232.5	60.9
Wet swab (Soaked)	67	36(54)	0,78-232.5	15.5
HEPA vacuum	64	51(80)	0.3-81 000	23.1
Wipe swab (Moistened)	67	58(87)	0.02-232.5 <sup>++</sup>	5.4

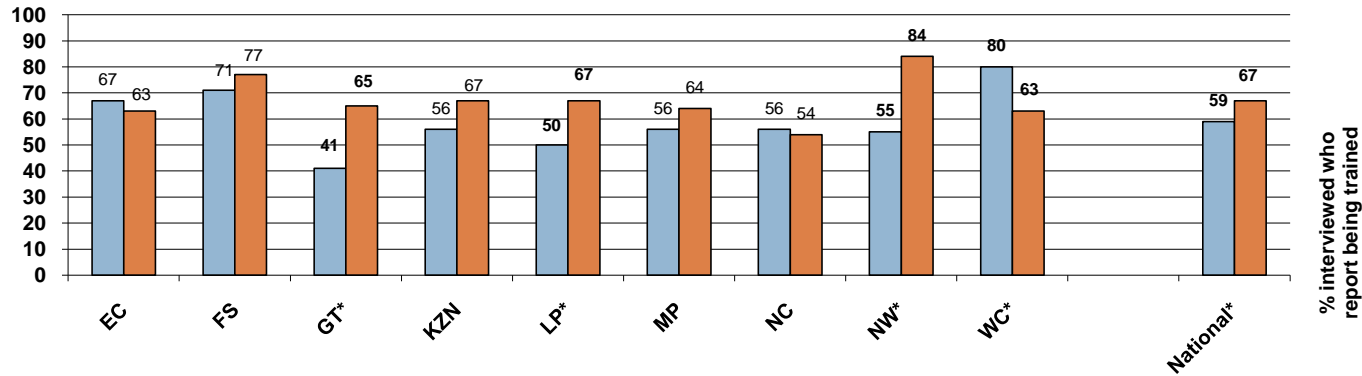
collecting spores of *B. anthracis* Sanderson, W.T. et al., *Emerging Infectious Diseases*, 8, No. 10, October 2002

*PRELIMINARY RESULTS*  
FROM THE FINAL MMIS HEALTH FACILITY EVALUATION

Dr Rose Mulumba  
OR Tambo International Hotel  
*27 October 2009*

PEPFAR  
DOH  
MRC  
MMIS

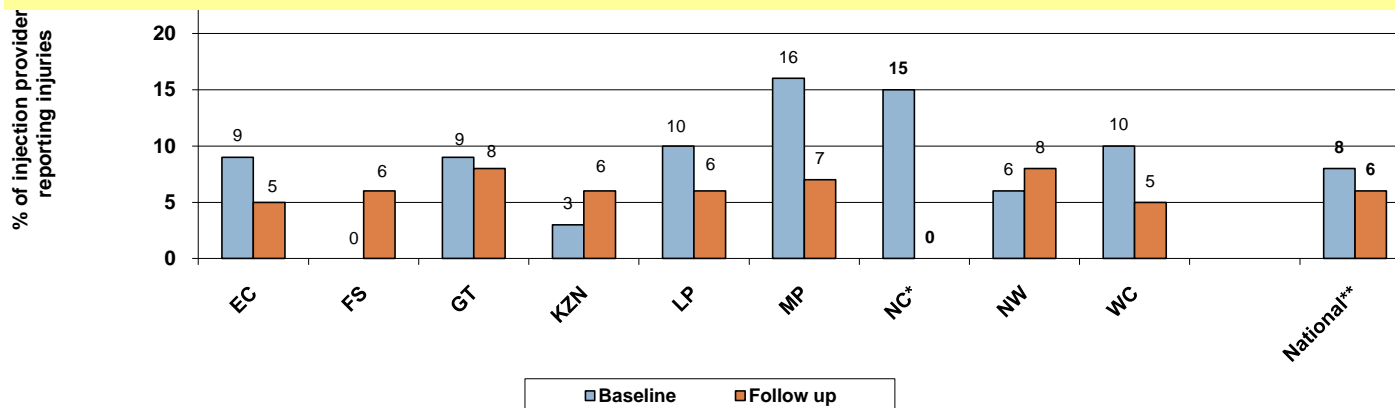
## INJECTION TRAINING FOR HCW



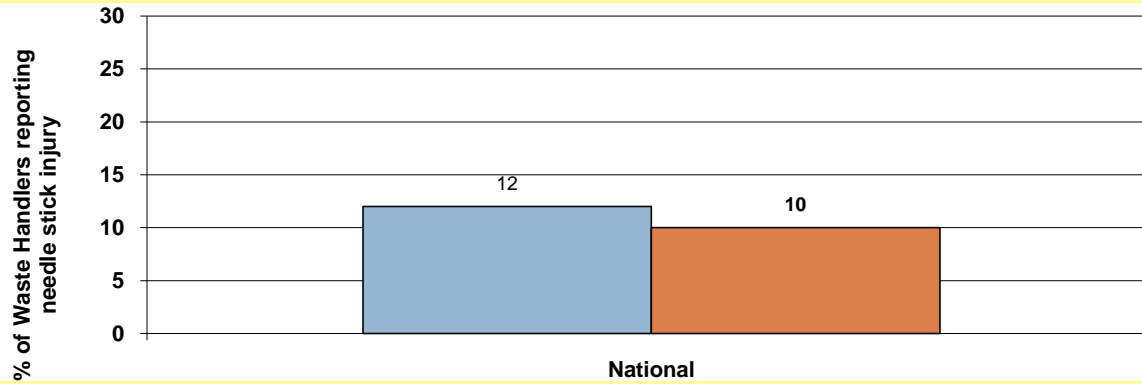
Commonest NSI among Providers (n=35):

From patients moving = ca. **50% total**; disposal = **9% of NSI**

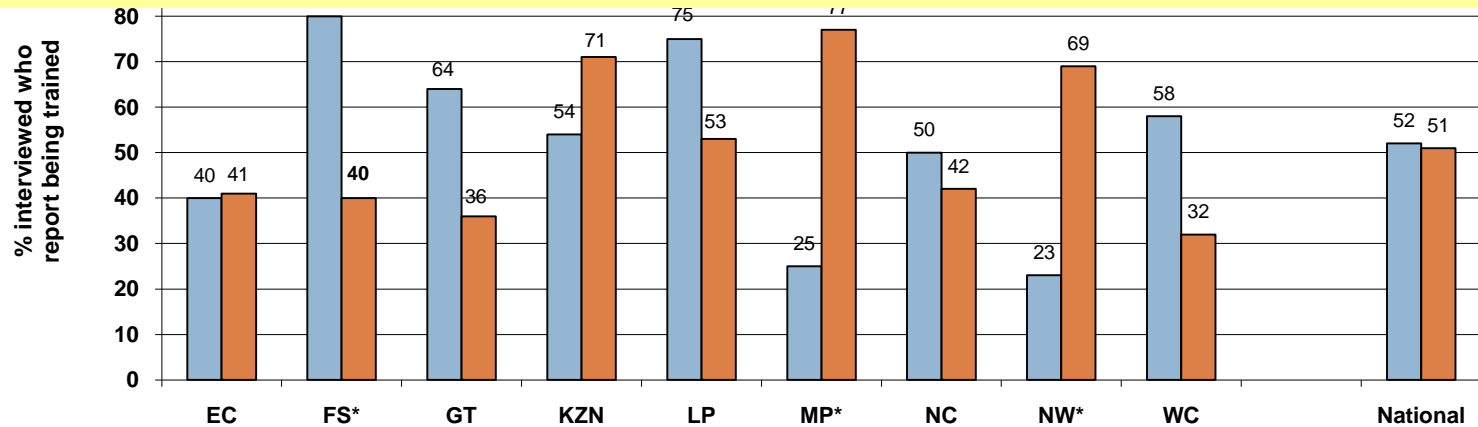
Devices causing NSI at **follow up** = ca 50% needle from std disposable



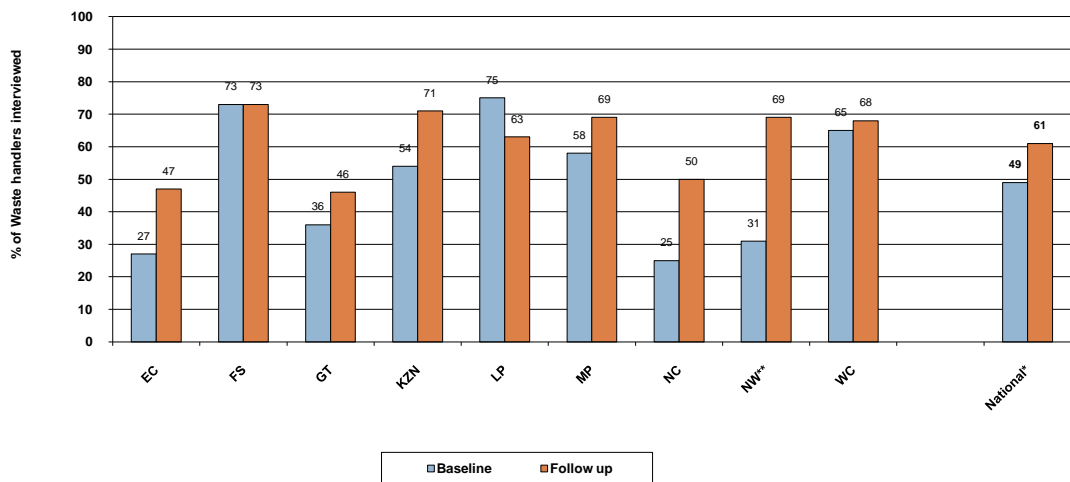
## NATIONAL VALUES FOR NSI IN HANDLERS



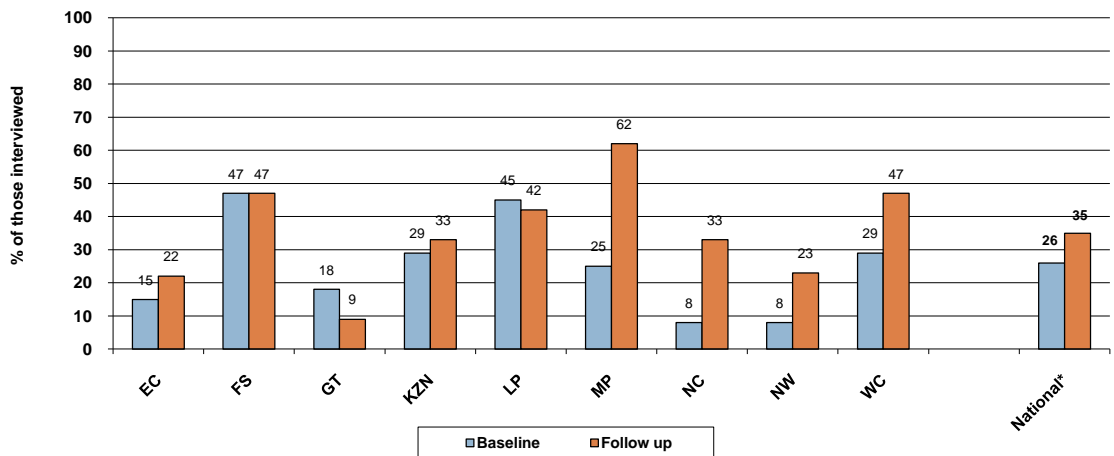
## VALUES FOR TRAINING – WASTE HANDLERS



## ANY VACCINATION AGAINST HEP. B FOR WASTE HANDLERS??



## ALL 3 DOSES AGAINST HEP. B FOR WASTE HANDLERS



- Mode of transmission
- Communicability

- **Management**

## *Take home messages*

HCRW generators and service providers have to remain vigilant

Train-train-train  
Risk drive SOPs which drive training

Show me the science...  
actual vs perceived risks

- Pathogen traits

- Acquisition/resistance

- SOPs
- Quantification