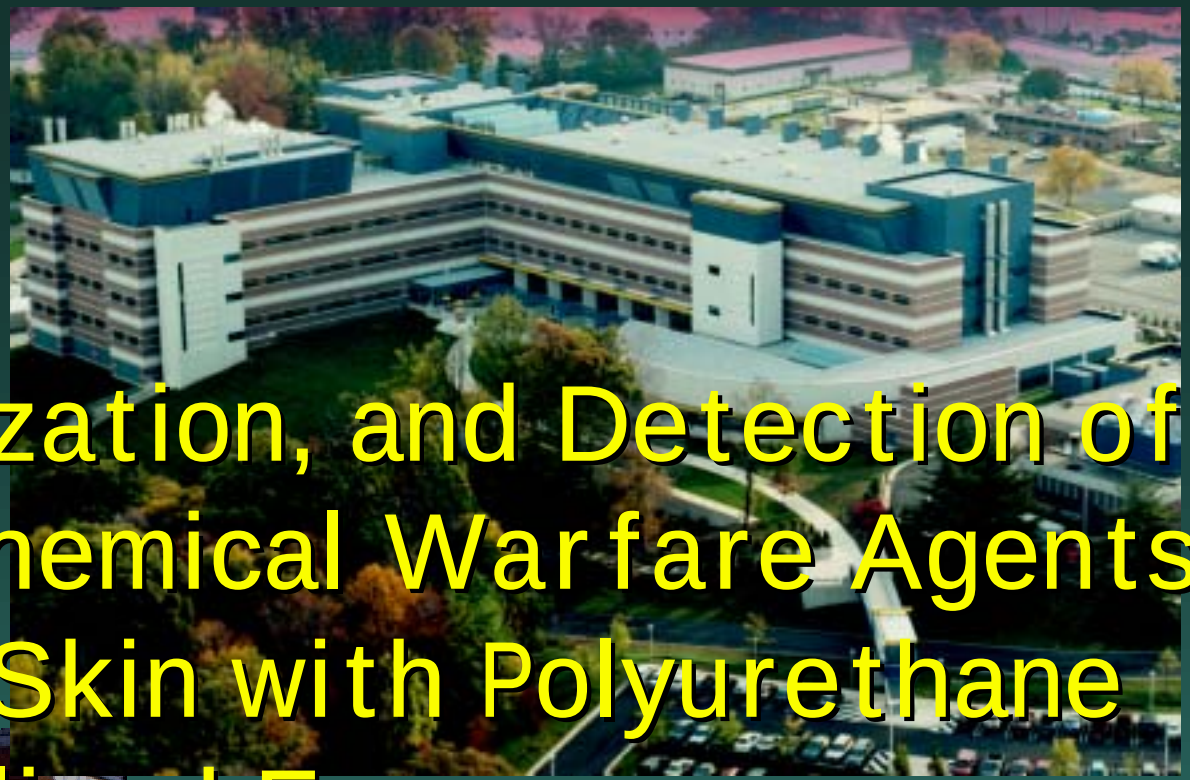
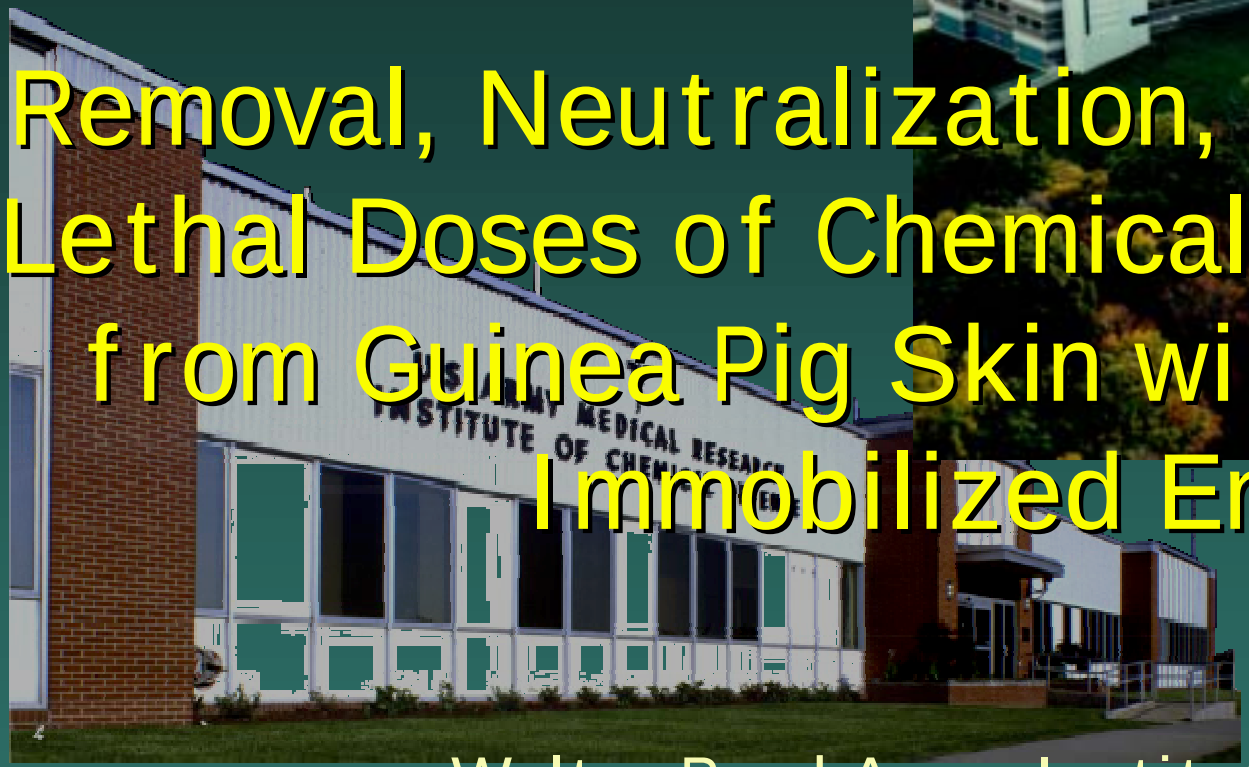




# Removal, Neutralization, and Detection of Lethal Doses of Chemical Warfare Agents from Guinea Pig Skin with Polyurethane Immobilized Enzymes

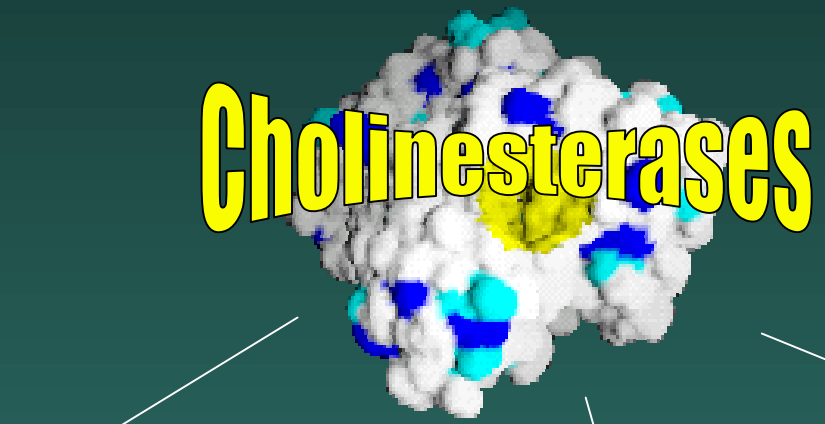
Walter Reed Army Institute of Research,

USA Medical Research Institute of Chemical Defense

Pretreatment Drugs for Nerve Agents

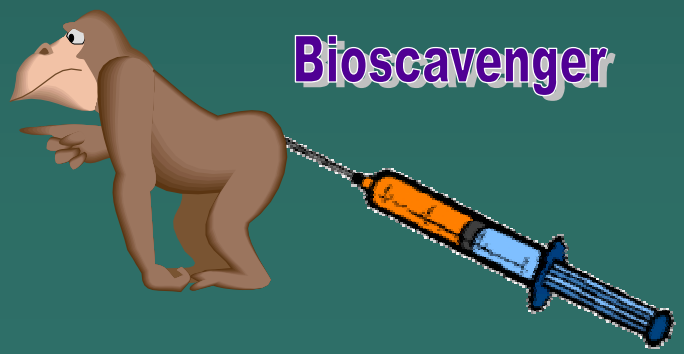
# BIOSCAVENGERS

Detection Detoxification Decontamination



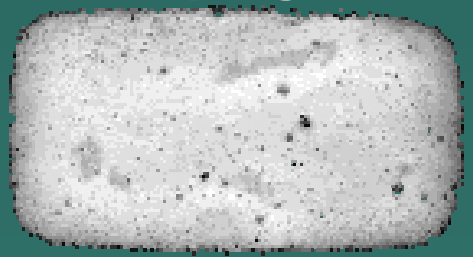

**Pretreatment**

Bioscavenger



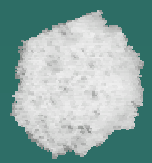
**Decontamination and Detoxification**

Sponge

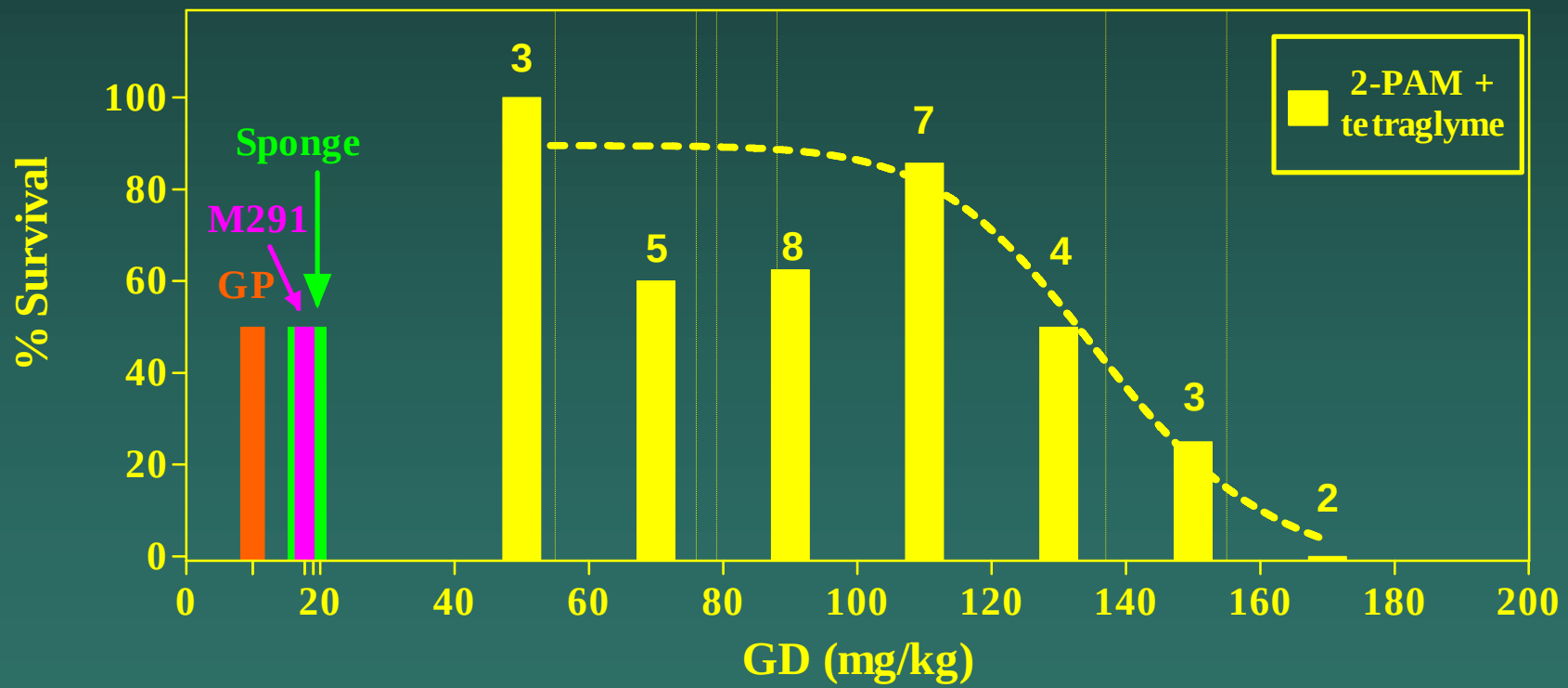


**Detection**

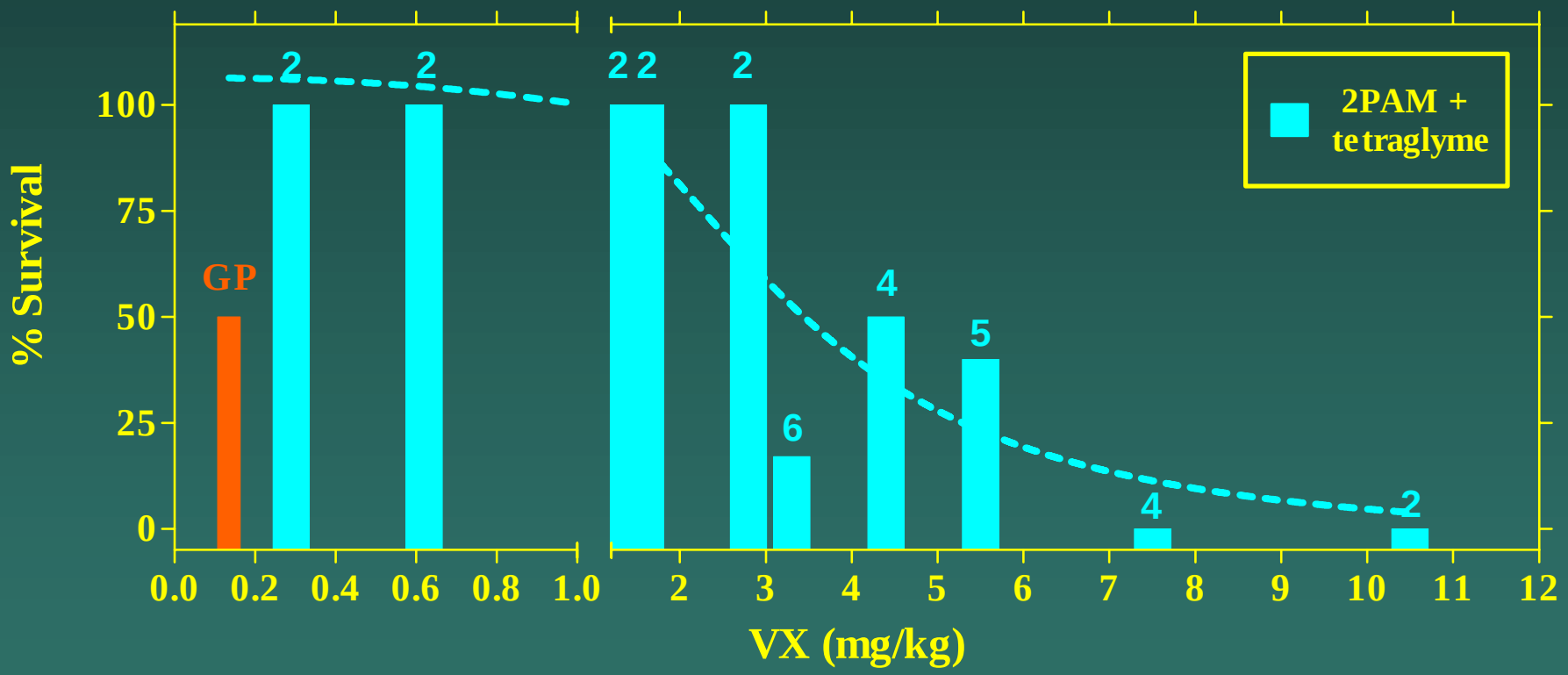
Sensor



# Guinea Pig Survival after GD and Sponge Decontamination



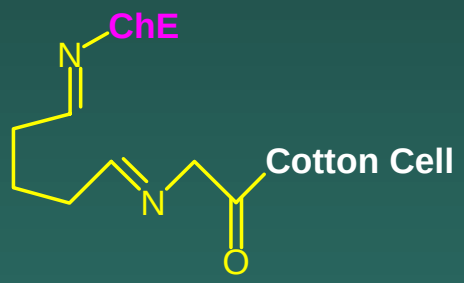
# Guinea Pig Survival after VX and Sponge Decontamination



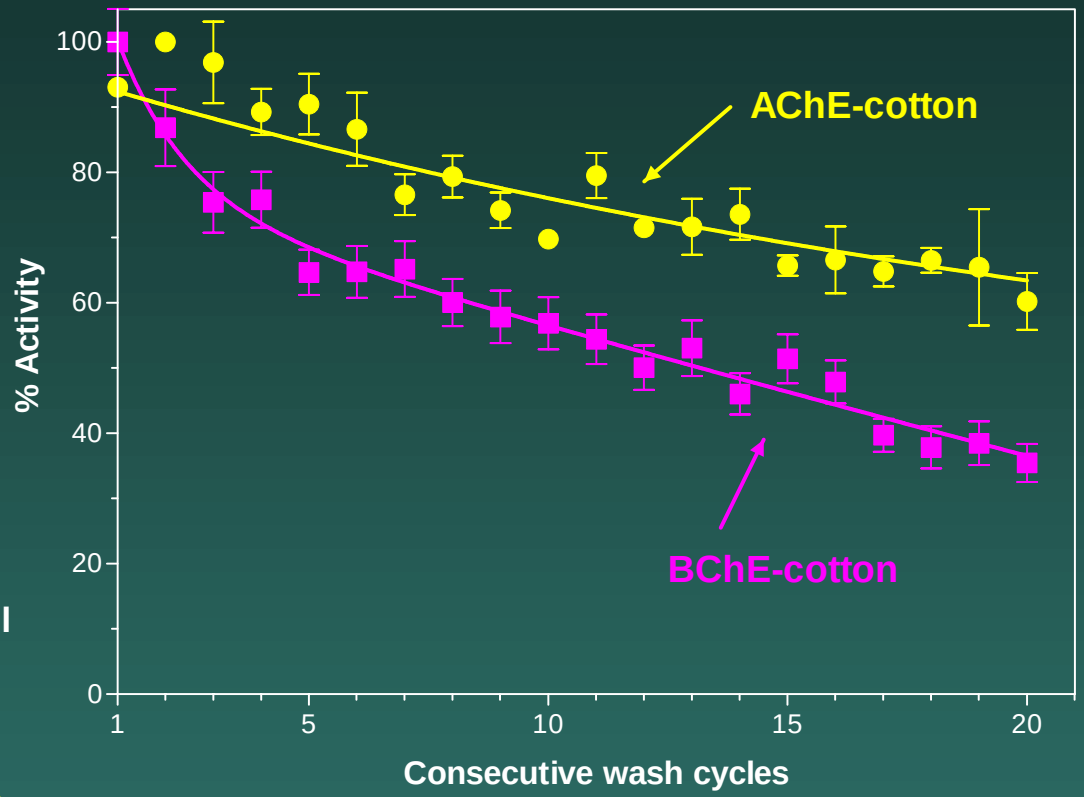
# Sponge Additives Protect Soman Contaminated Guinea pigs

| Additives to Sponge | GD | | VX | |
|---|---|---|---|---|
| | $LD_{50}$ (mg/kg) | PR | $LD_{50}$ (mg/kg) | PR |
| HFE | 55 | 5.6 | | |
| 2-PAM (oxime) | 76 | 7.7 | | |
| HI-6 (oxime) | 79 | 8 | | |
| Tetraglyme | 88 | 8.9 | | |
| 2-PAM + Tetraglyme | 137 | 13.8 | 3.37 | 24.9 |
| HI-6 + Tetraglyme | 156 | 15.7 | 15.7 | 112 |
| **Reference Values** | | | | |
| M291 Decon Kit | 17.7 | 1.8 | 0.14 | |
| OP alone | 9.9 | - | 0.14 | - |

# AChE/OPH Immobilized Cotton (LYNNTECH; SBIR)




**ChE-Glycyl-Cotton**

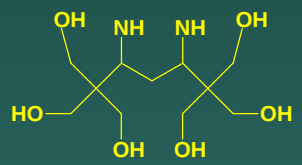


# Agentase LLP – Polymer/Enzyme Optimization

## Polymer Penetration

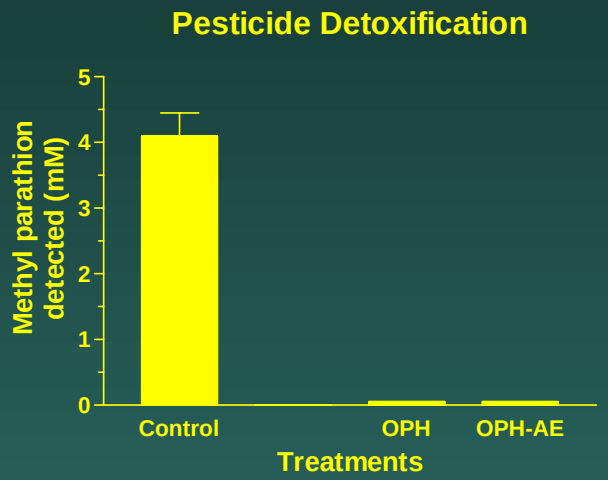


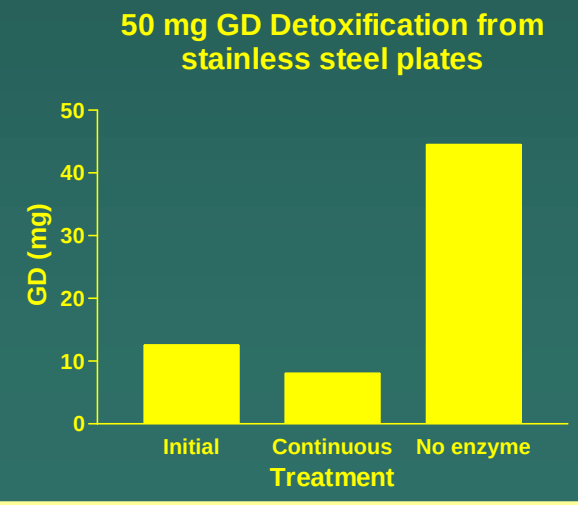
## Buffer Immobilization




**BTP (bis-tris propane)**

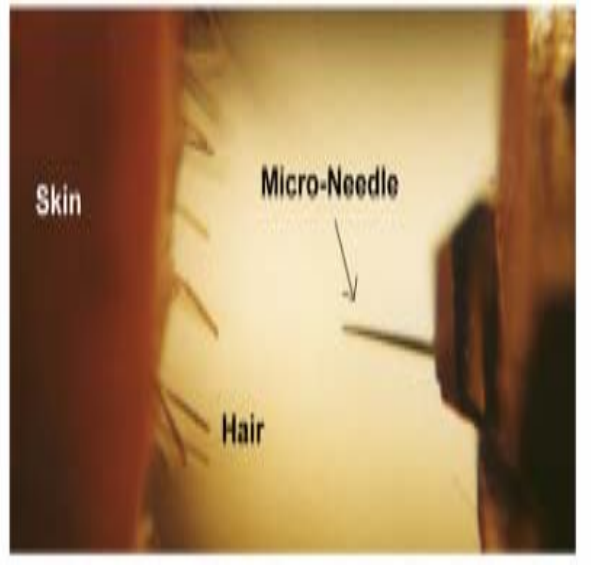
## Detoxification



# Cholinesterase Test with Micro-invasive Technology

- Uses a micro-needle the size of a hair; painless, low-cost and unobtrusive
- Silicon chip micro-fluidics experimental device fabricated
- Proof of ChE measurement demonstrated using electrochemical sensor
- Kumetrix, Inc – Phase II SBIR proposal awarded "Automatic Assay of Blood Cholinesterase in the Field"



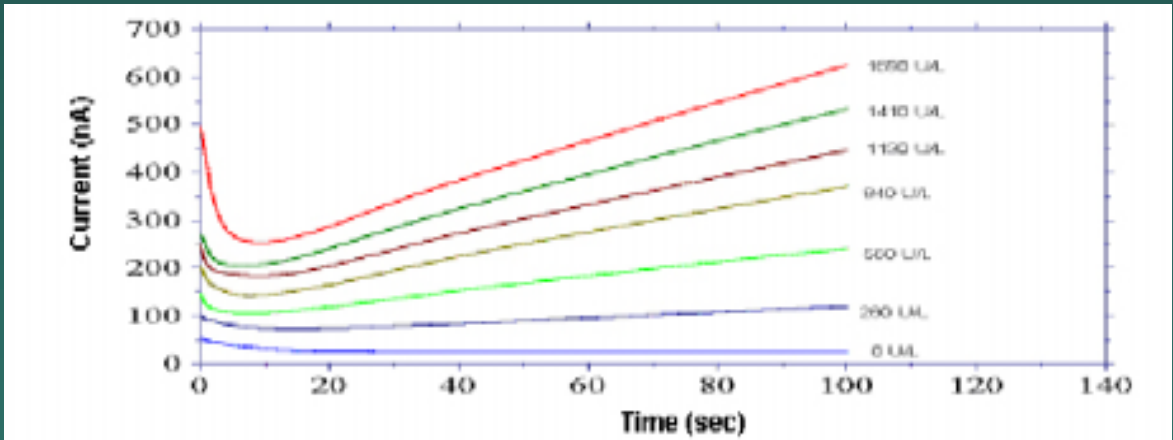




Fig. 29: Measurement of Serum Cholinesterase Activity Over 0-1690 U/L Range

# Comparison of Biosensor and Standard Ticket

Sensor

## New Immobilized Biosensor

+ enzyme, *not exposed to buffer*

+ enzyme, exposed to buffer for 10 min

+ enzyme + OP

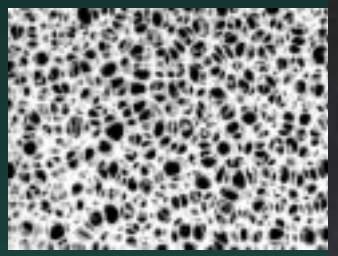
## Current OP-water ticket

+ enzyme, *not* exposed to buffer

+ enzyme, exposed to buffer for 10 min

+ enzyme + OP

# Cooperative Agreements, SBIRs



CRDAs

- Hydrophilix/Biomerix (Saco, ME) [Co-Foam, 2-layers]
- Entropic Systems (Waltham, MA) [additives, testing apparatus]

Phase II SBIRs (decontaminating sponge)

- LYNNTECH, Inc (College Station, TX) [cotton wipes]
- Agentase, LLP (Pittsburgh, PA) [OPH polyurethanes]

Phase I SBIRs (detectors) (**Phase II approved)

- **Semorex, NJ [Molecularly Imprinted Polymers]
- **LUNA innovations, VA [Yeast-based Biosensor]
- Advanced Sensor Technologies, MI [Lightweight Biosensor Badge
- Sensera, MA [Improved Field Biosensor for Organophosphates]

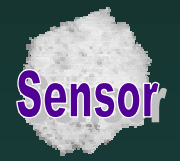
# Patents in review (initiated by WRAIR, filed by the Dept of Army)

- A Rapid Method to Make OP Detoxifying Sponges Composed of Multiple Immobilized Enzymes of Cholinesterases and OP Hydrolases and Oximes as Reactivators (Serial No. 09/559,396)
- Differentially Acting OP Detoxifying Sponges (Serial No. 09/588,512; allowed)
- Immobilized enzymes as biosensors for chemical toxins (Patent No. 6,406,876)
- Assay for detecting, measuring and monitoring the activities and concentrations of proteins and methods of Use thereof (Application No. 60/202,201)

Decontamination and Detoxification


# Collaborations – past, present, future

Detection




**WRAIR**

LT Askins
K Blocher
BP Doctor
SR Feaster
RK Gordon
AT Gunduz
P Herron II
E Lowe
S Strating

**USAMRICD**

K. Brecht
E Clarkson
D Lenz
B Lukey
R Macalalag
D Maxwell
L Mitcheltree
M Ross
JP Skvorak

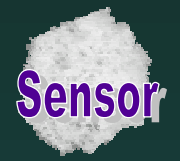
**SBCCOM/ Geo-Centers**

T-C Cheng
V Rastogi

Decontamination and Detoxification


# Summary

Detection




Please see the following posters for additional details!

Removal, Neutralization, and Detection of Lethal Doses of Chemical Warfare Agents from Guinea Pig Skin with Polyurethane Immobilized Enzymes

Detection and Identification of Chemical Warfare Agents Polyurethane Immobilized Enzymes

WRAIR Protocols for Soldier Status and Readiness to Organophosphate Exposure: Unprocessed Whole Blood Cholinesterase and Pyridostigmine Bromide Quantification