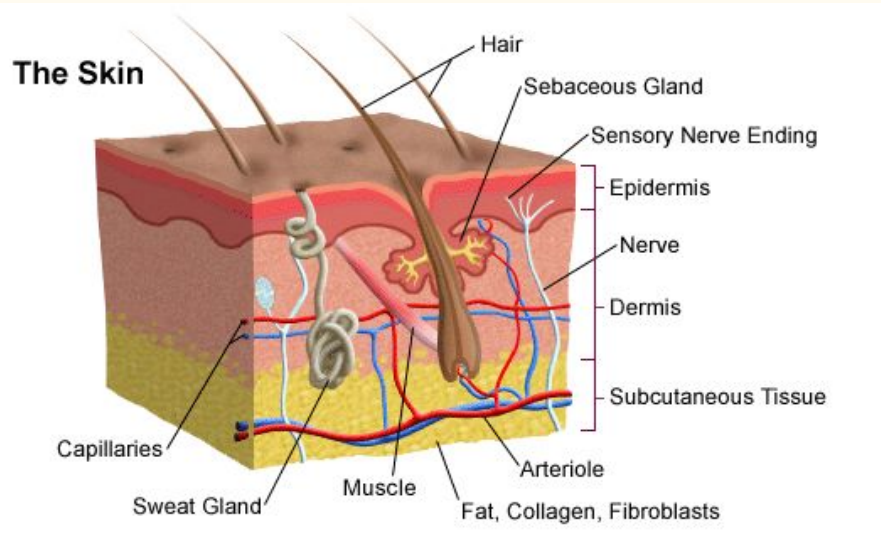


Thermal Injuries

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Life Science 4M03

INTRODUCTION

Anatomy of the skin



http://www.hopkinsmedicine.org/healthlibrary/conditions/dermatology/burns_85,P01146/

- The skin has three anatomical layers
 - Epidermis
 - Dermis
 - Subcutaneous tissue
- When the skin is damaged, the epidermal cells regenerate from cells deep within the dermal appendages

What is a burn and how does it occur?

- The International Society of Burn Injuries:
 - An injury to the skin or other organic tissue that is primarily caused by thermal or other acute trauma

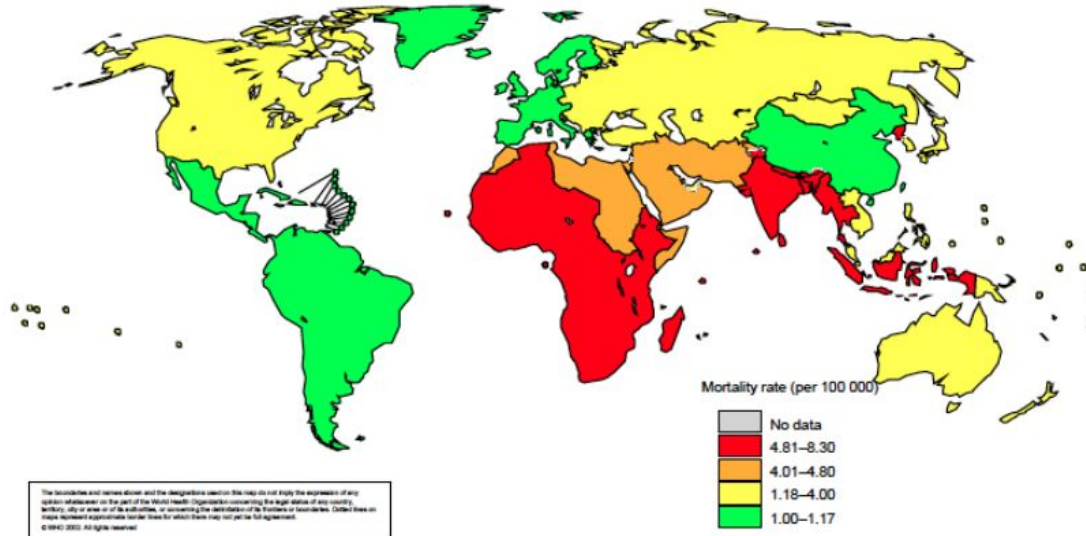
- Some or all cells in skin and other tissues destroyed by:
 - Hot liquids (scalds)
 - Hot solids (contact burns)
 - Flames (flame burns)

Epidemiology

Burns: A Global Burden

- Fourth most common type of trauma worldwide
- 265,000 deaths occur each year
- 96% of fatal deaths in LMIC
- Highest incidence in southeast Asia

Global distribution of fire-related burns



Fire-related burn mortality rates (per 100 000 population) in WHO regions, 2000

Africa		Americas			South-East Asia		Europe		Eastern Mediterranean		Western Pacific		
LMIC	HIC	LMIC	India	Other LMIC	HIC	LMIC	HIC	LMIC	HIC	China	Other LMIC		
5.5	1.3	1.17	8.3	8.2	1.0	4.0	1.5	4.8	1.5	1.1	2.0		

HIC, High-income countries; LMIC, Low- and middle-income countries.

RISK FACTORS

Table 2 – Relative impact of risk factors on burn injury incidence

Risk factor	HICs	LMICs
Poverty	+++	+++ More prevalent
Education	++	± High immolation rate associated with higher education
Ethnicity		– Association of ethnicity to poverty, low education, and certain cultural habits is the major factor of higher risks
Family patterns	+	±
Type of residence	+++	+++ More prevalent

Invariably, components of low socio-economic status are associated with higher burn injury risk. (+++) High impact, (++) moderate impact, (+) low impact, (±) equivocal impact, (–) no impact.

PATHOPHYSIOLOGY

Forms of Response

The body responds to a burn injury in two ways:

1. Local Response (tissue damage)
2. Systemic Response (organ systems affected)



<http://www.healthcaretips101.com/how-to-treat-a-mild-burn/>



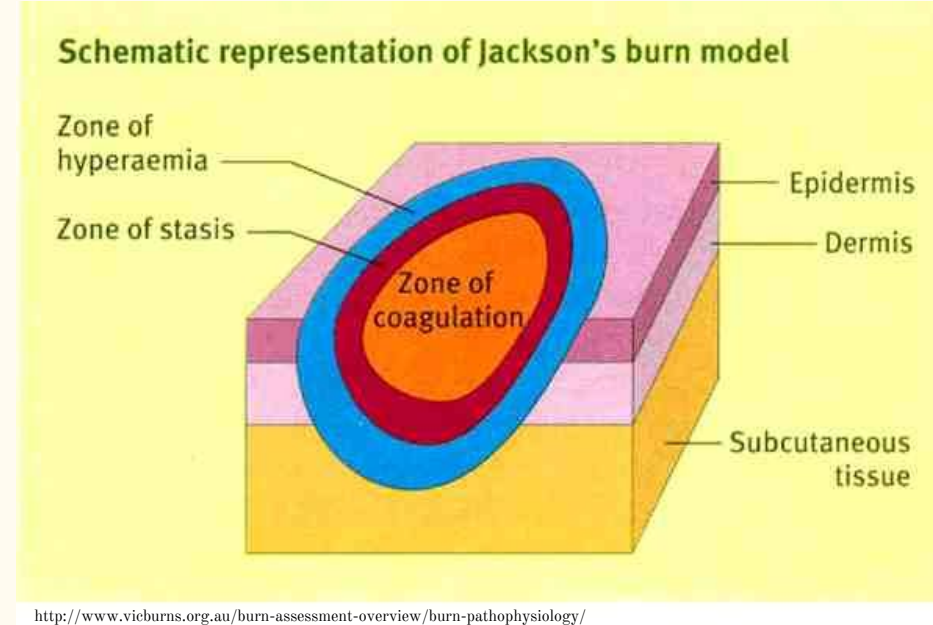
<http://www.healthcaretips101.com/how-to-treat-a-mild-burn/>

(DeSanti, 2005)

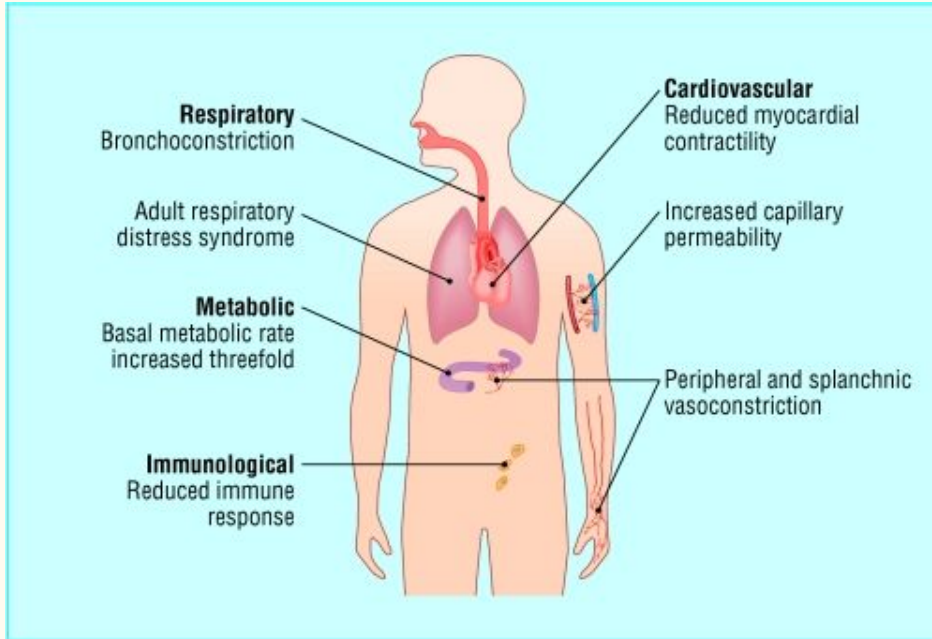
Local Response: Three Zones of a Burn

Jackson's Thermal Wound Theory

- Zone of Coagulation
 - Central
 - Max/irreversible damage
 - Coagulation of constituent proteins
- Zone of Stasis:
 - Decreased tissue perfusion (flow of blood)
 - Tissue here can be salvaged
- Zone of Hyperemia
 - Peripheral area of the burn
 - Increased flow of blood
 - Decreased cell injury
 - Generally recovers



Systemic Response



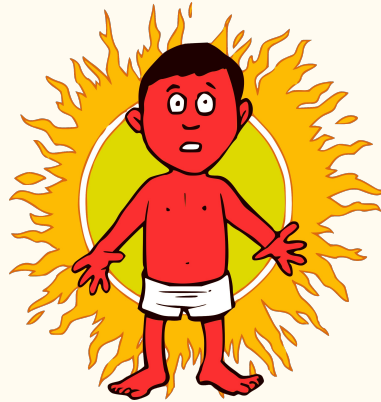
http://intranet.tdmu.edu.ua/data/kafedra/internal/11/classes_stud/en/Med-prof%20faculty/Fts/Combustology/3/01.%20Burn%20trauma.%20Pathogenesis.%20Diagnostic%20criteria.%20Clinic.htm

- Activated once the burn reaches 30% of total body surface area
- Inflammation and cytokine release initiated; peaks 5 to 7 days after
- Acute/Resuscitative Phase (48 hrs)
- Hypermetabolic Phase (>48 hrs)

Type	Response
Cardiovascular	<ul style="list-style-type: none"> ● ↓ blood flow to tissues and organs ● ↑ capillary permeability (fluid and protein loss), internal temperature, water permeability, blood flow to tissues/organs ● Edema formation
Pulmonary	<ul style="list-style-type: none"> ● Lung inflammation ● Respiratory difficulties from inhaling smoke ● Bronchial obstruction and airway resistance ● Altered capillary permeability
Renal	<ul style="list-style-type: none"> ● ↓renal blood flow, GFR ● ↑ levels of stress hormones ● Acute renal failure → mortality
Gastrointestinal	<ul style="list-style-type: none"> ● ↓nutrient absorption, DNA synthesis in small intestine ● ↑ ulcer incidence, gastric secretions
Immune	<ul style="list-style-type: none"> ● Immunosuppressed state and release pro-inflammatory factors ● Microbial invasion in damaged skin ● ↓ lines of defense, phagocytic activity, T-cell functioning ● ↑ neutrophil accumulation increases, macrophage hyperactivity, reactive nitrogen intermediates ● Susceptibility to sepsis ● Multiple organ failure <p style="text-align: right;">(Cakir, 2004) (Hettiaratchy, 2004)</p>

Types of Burns

RADIATION BURNS



<http://www.clipartpanda.com/categories/sun-burn-clipart>

ELECTRICAL BURNS



<http://www.clipartpanda.com/categories/electrical-shock-clipart>

THERMAL BURNS



http://www.123rf.com/photo_10560214_illustration-of-a-kid-boiling-water.html

CHEMICAL BURNS

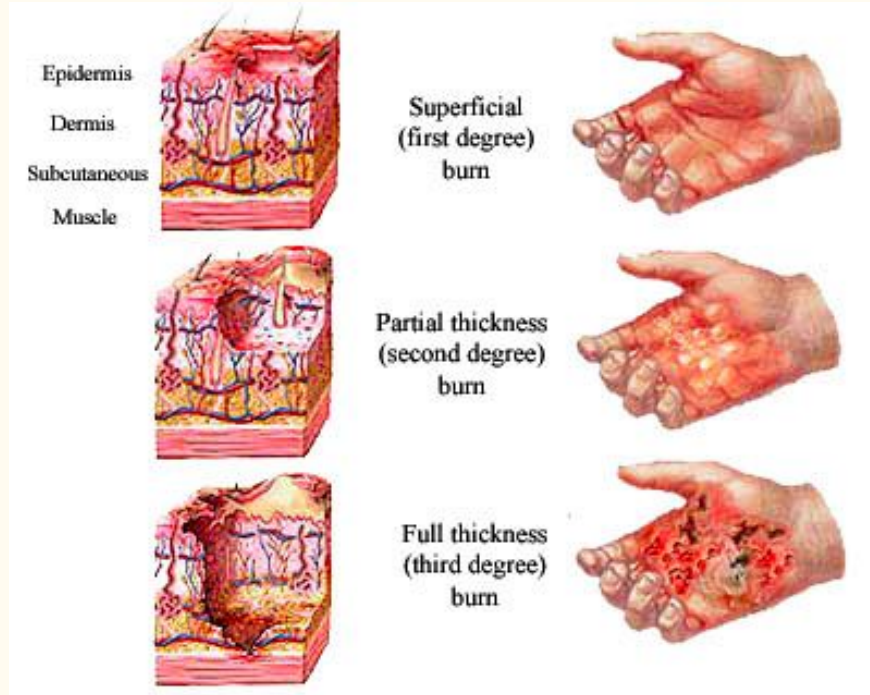


Sorry Professor, you're right:
I DID skip a line of the instructions...

<https://www.gageartoons.com/cartoons/2710/>

(John Hopkins Medicine, 2007)

Classification of Burns



<http://www.burninjuryfirm.com/burn-injury-classification/>

First Degree

- Epidermis (outer layer)
- Dry and red
- Eg. sunburn

Second Degree

- Epidermis and dermis layers
- Red, blistered and swollen
- Eg. Burn from scalding hot water

Third Degree

- Fully penetrate the epidermis and dermis layers and subcutaneous
- White or charred
- No sensations of pain - nerves destroyed
- Eg. flame burn from a fire

ASSESSMENT AND DIAGNOSIS

Assessment

- **Conduct a thorough patient evaluation**

Primary Survey

- A = airway
- B = breathing
- C = circulation
- D = disability
- E = exposure
- F = fluid resuscitation

Secondary Survey

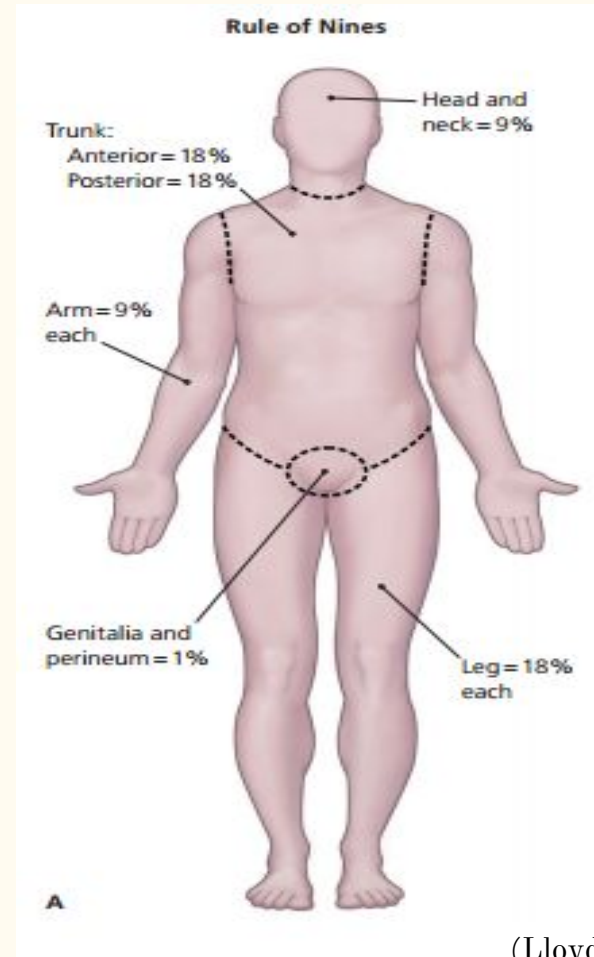
- Head-to-Toe examination
- Size, depth and circumference
- Tetanus shot for more than first degree burn

(Alharbi et al, 2012)

Assessment

Rule of Nines

- Adult: 15% surface area burn
- Children: 10% surface area burn
- Any burn in very young, elderly are at higher risk



(Lloyd et al., 2012)
(WHO, 2007)

Referral to Burn Centers

A patient needs to be admitted to a specialized burn centre if:

- Partial thickness burns greater than 10% TBSA
- Electrical burns, including lightning injury.
- Inhalation injury.
- Burn injury in a patient with preexisting medical disorders.

MANAGEMENT

Objective: Rapid Healing, Pain Control, Return to Full Function, Aesthetics

Initial Management of Burns



<http://technotes.alconox.com/detergents/liquinox/cleaners-water-labs-w-heavy-metals/>



https://encrypted-tbn3.gstatic.com/images?q=tbn:ANd9GcTi_9MjhdleU6PEV5jYgT_4crkBF3kuMFPbgMxNwA93BteF30F <http://boneandspine.com/wound-dressings-and-coverings/>

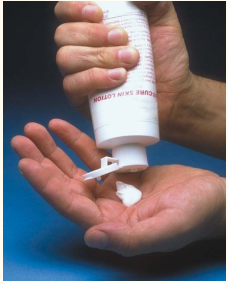


(Lloyd et al., 2012)

(WHO, 2007)

Initial Management of Burns

Superficial Burn



<http://www.uvprocess.com/product.asp?code=SKINCARE+K>



<http://www.honeybar.com/>



<http://www.aloelf.com/>

- Topical non steroidal anti-inflammatory drugs and aloe vera reduce pain
- Lotion, honey, aloe vera or antibiotic ointment

Initial Management of Burns



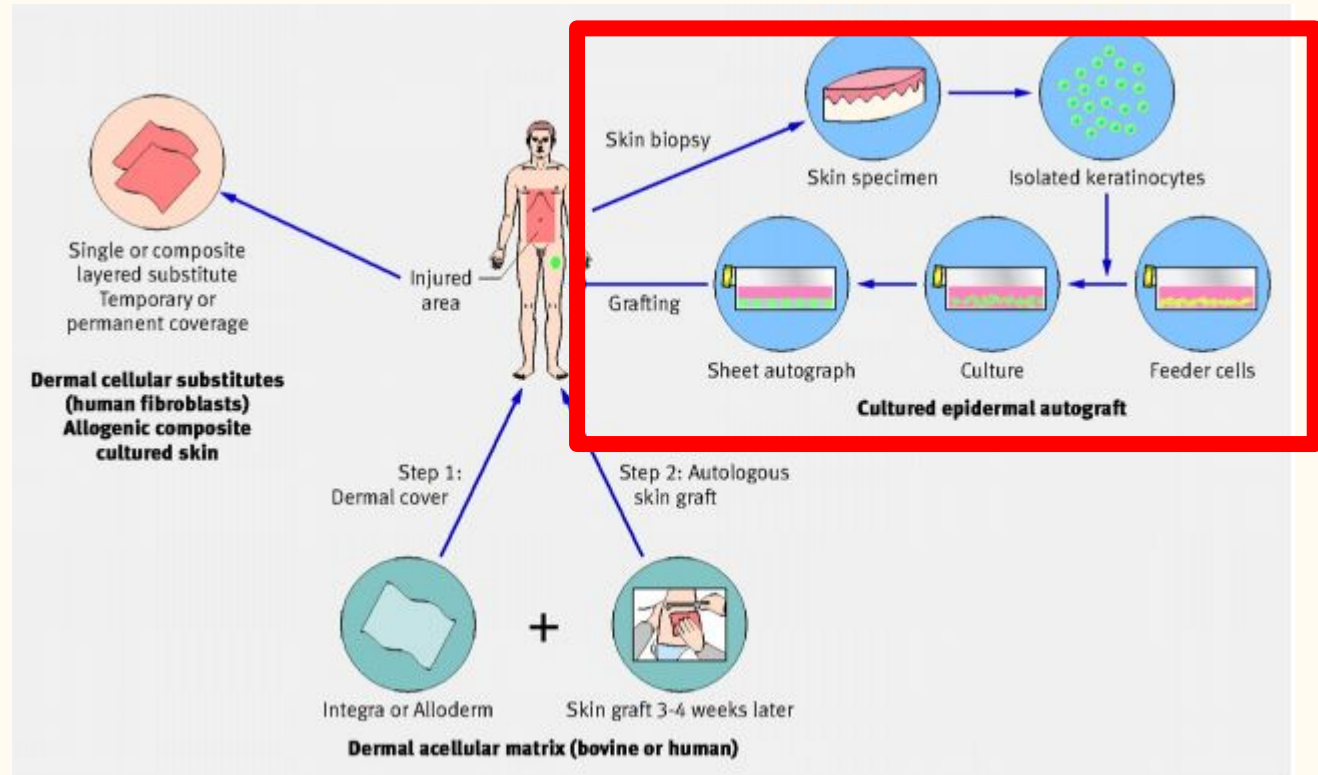
<http://www.webmd.com/drugs/2/drug-13530/silver-sulfadiazine-topical/details>

Partial Thickness Burn

- Topical antimicrobial agent
 - Alternate occlusive dressing
 - Silver sulfadiazine (Ag-SD)

Long Term Management of Burns

- Scars undergo maturation
- Facial burns
- Infections
- Skin graft
 - Depth and thickness of burn



(Enoch, Roshan & Shah, 2009)

(Lloyd et al., 2012)
(WHO, 2007)

Pediatric Burn Management

- Burns scars do not expand and keep pace with child growth
 - Lead to contractures
 - Early surgical release of contracture recommended
- Burn prevention focused on children
 - Scalding
 - Flame related injuries

Table 1. Burn Prevention in Children

Always test bathwater³

Check household smoke alarms regularly⁸

Cook on the back burners of the stove when children are present³

Do not leave a child unattended in the bathtub or near water faucets³

Do not leave a child unattended near a fireplace⁹

Keep matches, firecrackers, gasoline, and other explosives out of reach of children³

Never hold a child when working with or around hot objects³

Set household water heaters to less than 120°F (48.9°C)³

Supervise children carefully while an exercise treadmill is in use³

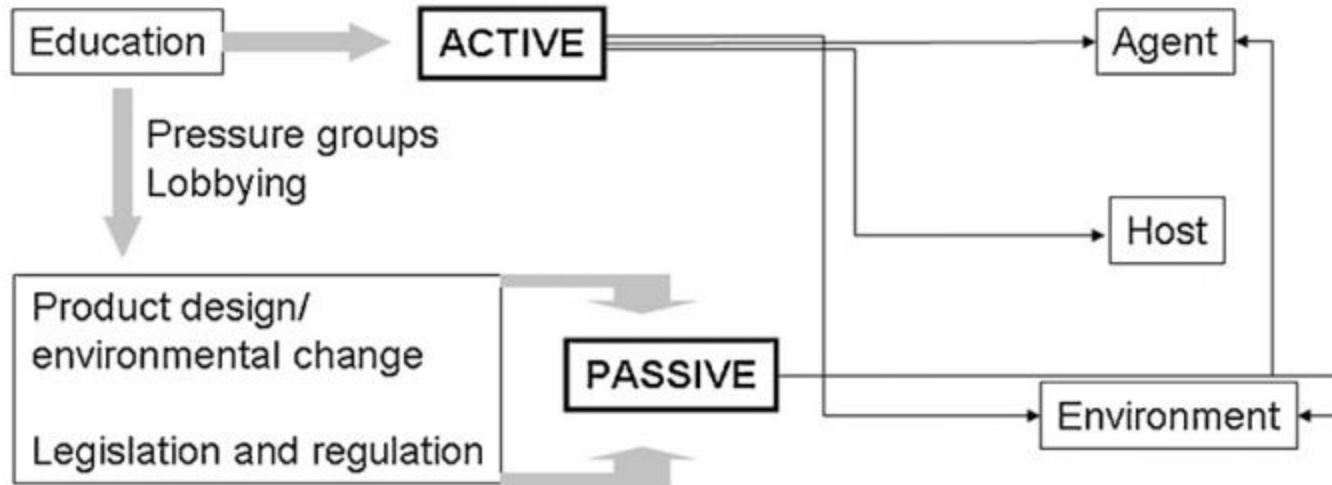
Information from references 3, 8, and 9.

(Lloyd et al., 2012)
(WHO, 2007)

PREVENTION

STRATEGIES TO REDUCE HARM FROM INJURIES

PARAMETERS OF INJURY OCCURANCE



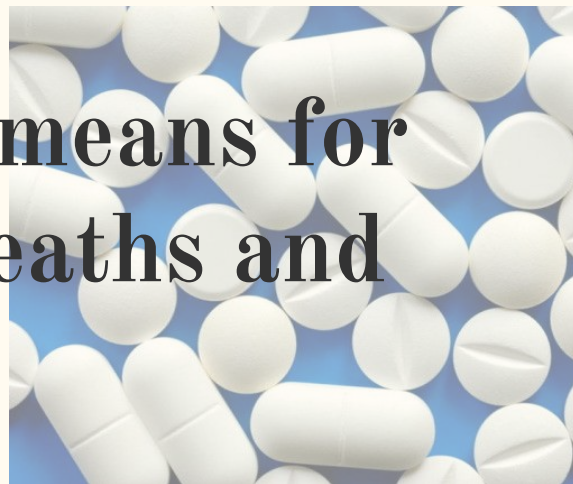
Conclusion



<http://technotes.alconox.com/detergents/liquinox/cleaners-water-labs-w-heavy-metals/>



<http://www.asbestosandfiresafety.com/asbestos-gallery.html>



<http://www.ubergizmo.com/2015/05/novartis-robotic-pills-diabetes/>

Prevention is a primary means for reducing burn related deaths and disabilities.

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12. WHO. (2007). *Management of burns*. Retrieved from http://www.who.int/surgery/publications/Burns_management.pdf

Questions

What absorptive dressing is most frequently used to deal with partial thickness burns?

1. Silver nitrate
2. Iodine solution
3. Silver sulfadiazine
4. Mafenide acetate
5. Cerium nitrate

Which of these are not a zone of burn, as described by Jackson's Wound Theory?

- A. Zone of Coagulation
- B. Zone of Inflammation
- C. Zone of Stasis
- D. Zone of Hypoemia
- E. Zone of Hyperemia
 - i. A, C, D
 - ii. A, C, E
 - iii. A, B
 - iv. B, D
 - v. C