Wound care

A Series of Unfortunate Events

- We will dose your Gentamycin
- We will dose your Vancomycin
- We will dose your Heparin
- We will dose your Warfarin
- We will do your wound care

Centers of Excellence

Center of wound care excellence

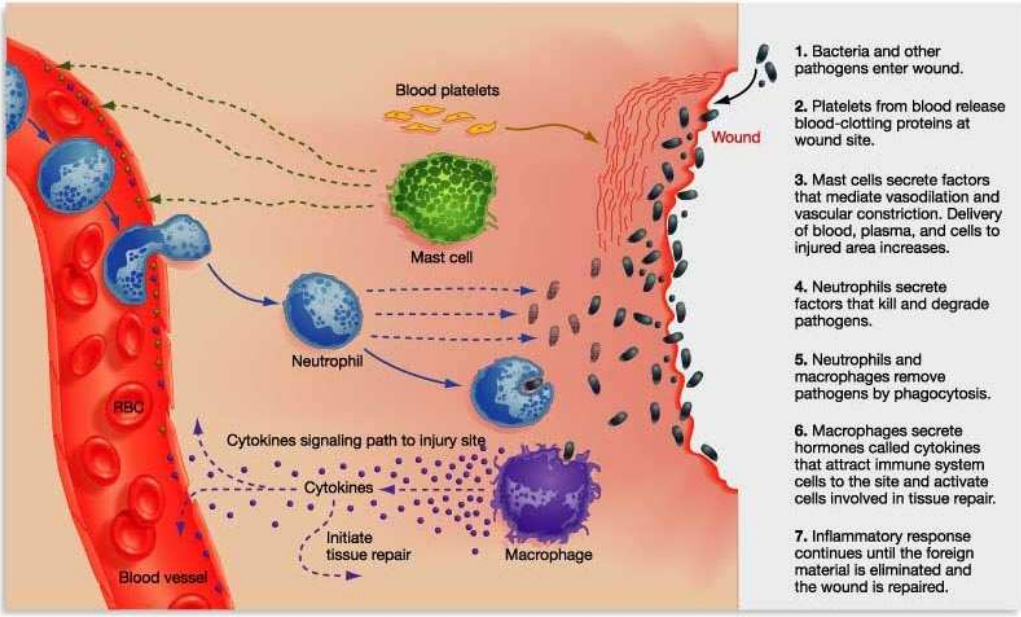
Center of humility & honesty

Research

Animal models show that wounds, including chronic wounds, heal in four phases. Some combine first two.

Phases:

- Hemostasis
- Inflammation
- Proliferation or Granulation
- Remodeling or Maturation



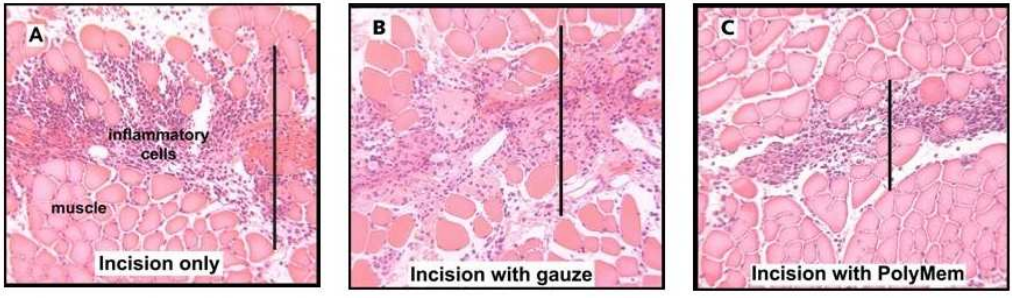
Research

Hemostasis (within minutes)

- Vasoconstriction, platelets, ADP, thrombin, fibrin and stable hemostatic plug.

Inflammation (- 4 days post-injury)

- Erythema, neutophils, phagocytosis, macrophages, chemotactic and growth factors



Research

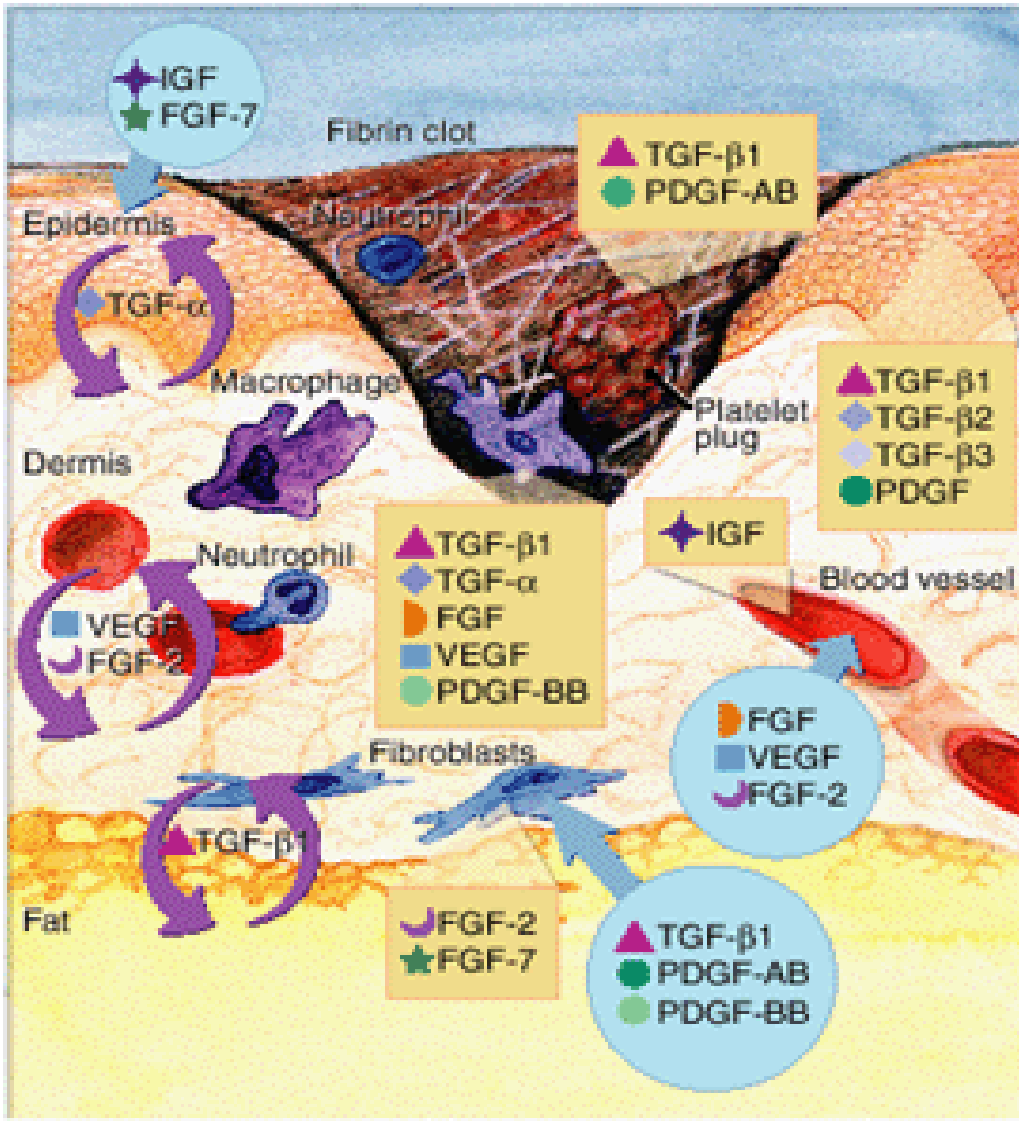
<u>Proliferation, Granulation, Contraction</u> (day four to 21)

- pebbled red tissue in wound base, fibroblasts, collagen, pericytes, angiogenesis, epithelialization.

<u>Maturation</u> (up to 2 years)

- tensile strength, fibroblasts.

Molecular biology



Hemostasis (within minutes)

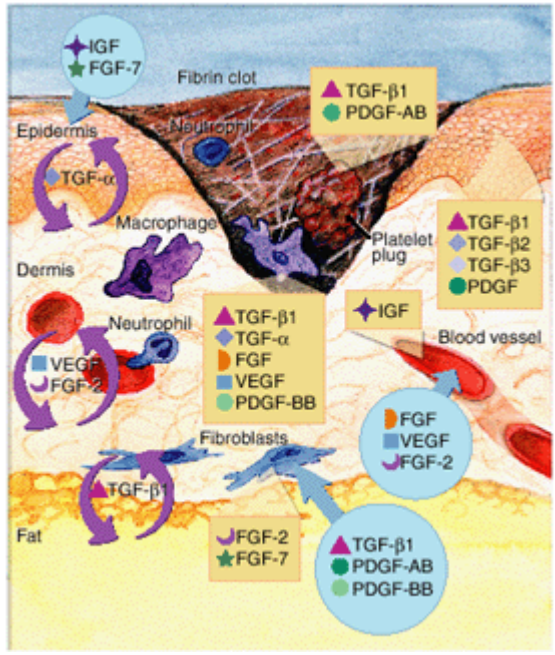
- Platelets seal damaged blood vessels, which themselves initially constrict but ultimately relax.
- Platelets secrete vasoconstrictive substances but prime role is to form stable clot.
- ADP, from damaged tissues, causes platelet aggregation and adherence to exposed collagen.
- Other secretions stimulate intrinsic clotting cascade through production of thrombin, in turn forming fibrin from fibrinogen.
- Fibrin mesh strengthens platelet aggregate into stable hemostatic plug.
- Platelets also secrete platelet-derived growth factor, initiating subsequent steps.

Inflammation

- Erythema, swelling and warmth often associated with pain up to 4 days post injury.
- Leaking blood vessels release plasma and PMN's into surrounding tissue.
- Neutrophils phagocytize debris and microorganisms and provide first line of defense against infection, aided by local mast cells.
- Fibrin degradation products attract macrophages to phagocytize bacteria and provide a second line of defense. Also secrete variety of chemotactic and growth factors, fibroblast growth factor, epidermal growth factor, transforming growth factor beta and interleukin-1 which direct next stage.

Proliferation, Granulation and Contraction

- Day four to 21, characterized by pebbled red tissue in wound base.
- Replacement of dermal tissues and subdermal tissues in deeper wounds and wound contraction.
- Fibroblasts secrete collagen framework on which further dermal regeneration occurs - specialized fibroblasts are responsible for wound contraction.



Proliferation, Granulation and Contraction

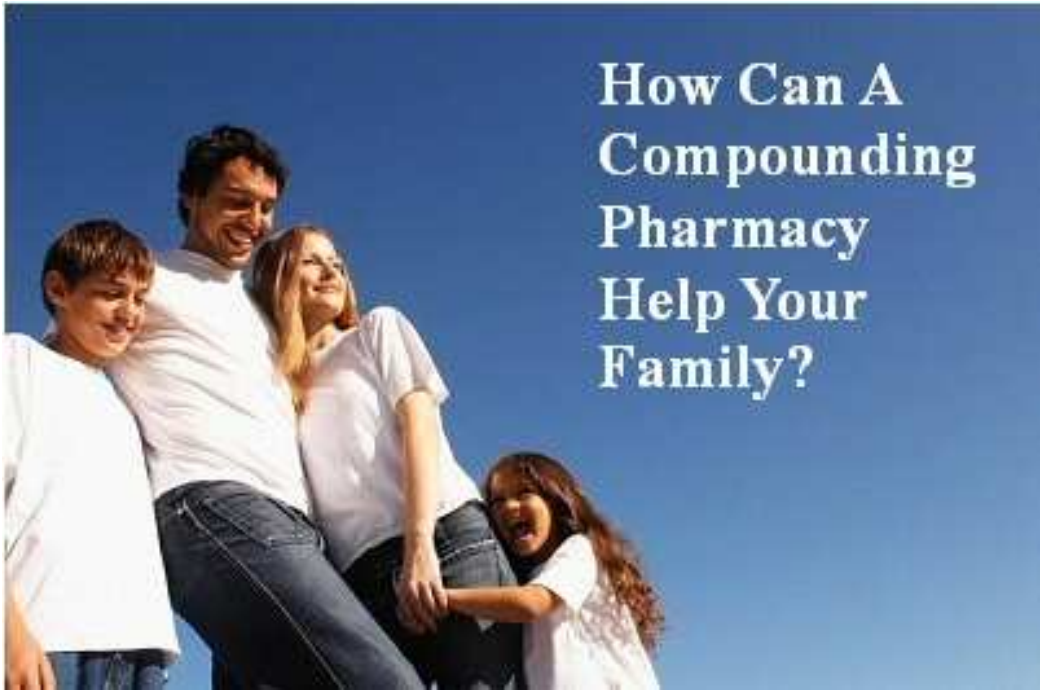
- Pericytes regenerate outer layers of capillaries and the endothelial cells which produce the lining, angiogenesis.
- Keratinocytes are responsible for epithelialization.
- In final stage of epithelializtion, contracture occurs as keratinocytes differentiate to form protective outer layer or stratum corneum.

Remodeling or Maturation

- Process involves remodeling dermal tissues to produce greater tensile strength.
- Principle cell involved is the fibroblast.
- Can take up to 2 years and explains why apparently healed wounds can break down dramatically and quickly if attention is not paid to initial causative factors

Optimized Local Wound Care

- In 1962, Winter described improved wound healing under moist conditions.
- Only more widely recognized and applied in clinical practice in last decade.



Advantages

- Decreased dehydration and cell death - repair requires neutrophils, macrophages, fibroblasts and pericytes that cannot function in dry environment.
- Increased angiogenesis - requires moist environment but also occurs towards regions of low oxygen tension such that occlusive dressings may act as stimulus.
- Enhanced autolytic debridement - neutrophil life is enhanced and proteolytic enzymes are carried to wound bed allowing for painless debridement.
- Increased re-epithelialization - cells must spread over wound surface from edges and have supply of blood and nutrients. Dry crusted wounds reduce this supply and provide barrier to migration thus slowing rates of epithelialization.

Advantages (continued)

- Bacterial barrier and decreased infection rates - occlusive dressings with good edge seals can provide barrier to microorganisms migration into wound. Wounds covered with occlusive dressings have lower rates of infection than gauze dressings.
- Decreased pain - moist wound bed insulates and protects nerve endings reducing pain and requires fewer uncomfortable dressing changes.
- Decreased costs - occlusive dressings have higher per unit cost than conventional gauze, but reduced dressing changes and increased healing rates may be cost effective in long term.

The Ideal Dressing

- Removes excess exudate and toxins
- High humidity at the dressing wound interface
  - Allows for gaseous exchange
  - Provides thermal insulation
  - Protects against secondary infection
  - Free from particulate and toxic components
  - No trauma with removal

Evidence basis for wound care

- Prospective, blinded, randomized trials
  - None
- Systematic reviews
  - None
- Consensus
  - Limited

Apparently, evidence not necessary to establish a 'Center of Excellence'

Consensus

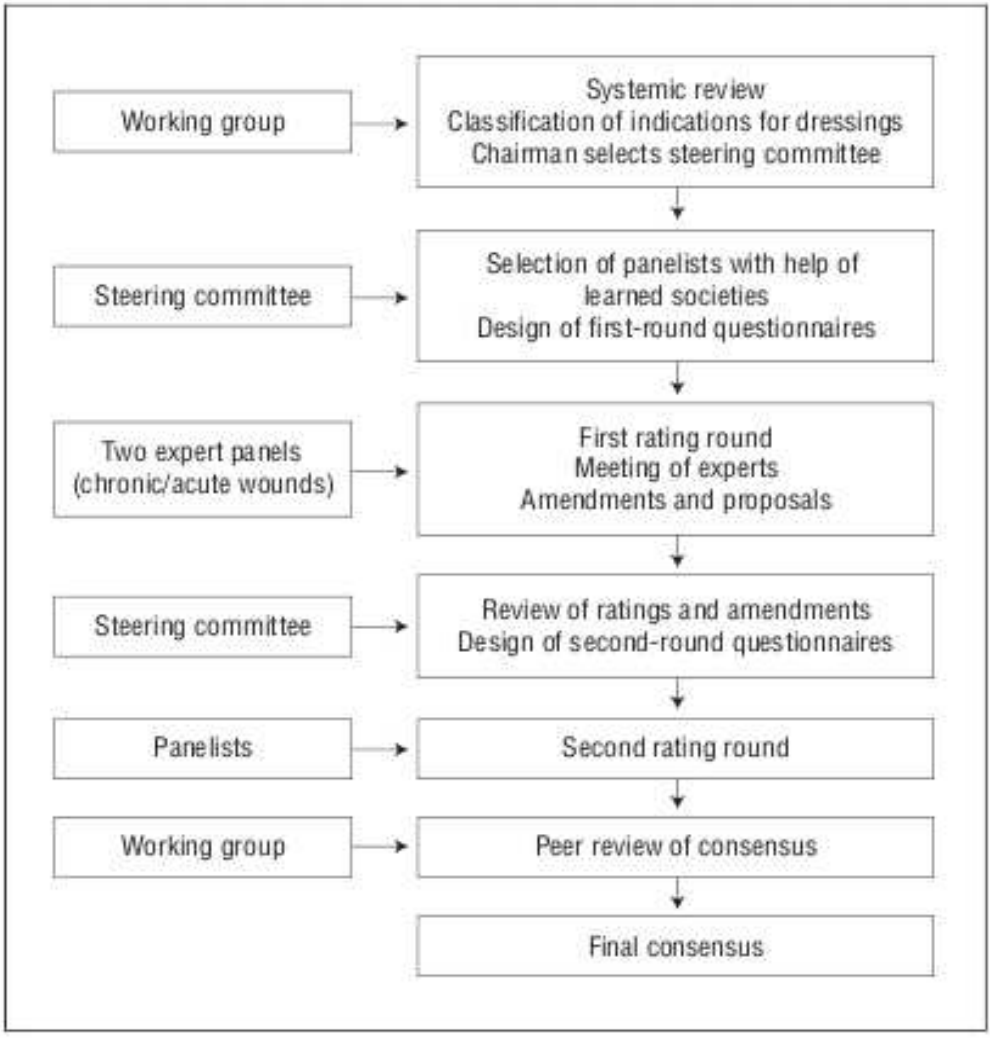


Figure 1. Flowchart of consensus method.

Consensus

- Alginate: alginate main component, supplementation by carboxymethylcellulose allowed
- Activated charcoal containing dressing
- Corticoid-supplemented paraffin gauze (added to the second questionnaire at the request of the acute wounds expert panel)
- Collagen: any dressing containing collagen
- Polymer foam dressing
- Hyaluronic acid supplemented: any dressing containing hyaluronic acid
- Hydrofiber: carboxymethylcellulose fiber dressings
- Hydrocolloid: polymer dressings with medium absorption properties and containing carboxymethylcellulose
- Hydrogel
- Low-adherent or "interface" dressing: with low rate of migration of the impregnating substance (thus excluding standard paraffin gauzes)
- Polyurethane film
- Silver supplemented: any dressing containing silver (other characteristics and silver kinetics unspecified)
- Standard paraffin gauze
- Woven gauze
- Unwoven gauze

Figure 2. Types of dressing.

Consensus

Table 2. Evidence for and Opinion on Use of Different Types of Dressing at Different Stages of Care for Chronic and Acute Wounds

Variable	Wound Type[a] or Cause	Level B Evidence (Literature Review)	Strong Agreement (Formal Consensus)
Stage of healing			
None in particular	Chronic	Hydrocolloid	None
	Acute	Foam, hydrofiber dressings	None
Debridement[b]	Chronic	Alginate	Hydrogel
	Acute	None	None
Granulation[c]	Chronic	None	Low adherence, foam
	Acute	None	None
Epithelialization[d]	Chronic	None	Low adherence, hydrocolloid
	Acute	None	Low adherence
Specific cases			
Fragile skin	Epidermolysis bullosa	None	Low adherence
Prevention of infection	Any cause	None	None
Infected wound	Any cause	None	None
Hemorrhagic wound	Any cause	None	Alginate
Malodorous wound	Carcinoma	None	Activated charcoal

Consensus summary

Variable	Wound type	Strong agreement
Debridement	chronic	Hydrogel
Granulation	chronic	Low adherence, Foam
Epithelialization	chronic	Low adherence, Hydrocolloid
	acute	Low adherence
Fragile	epidermolysis	Low adherence
Hemorrhagic	Any cause	Alginate
Malodorous	Carcinoma	Activated charcoal

Colloid

- chemical mixture - one substance dispersed evenly throughout another. Dispersed particles are only suspended in the mixture, unlike a solution, where they are completely dissolved within.
- Colloidal system consists of dispersed (or internal) phase and a continuous phase (or dispersion medium). Milk (liquid butterfat globules dispersed within a water-based fluid), is a colloid.

Hydrocolloid

- colloid system in which the colloid particles are dispersed in water. Depending on the quantity of water available, it can exist in different states, e.g., gel or sol (liquid).

- Many are derived from natural sources. Agar-agar is extracted from seaweed, gelatin is produced by hydrolysis of bovine and fish proteins, and pectin is extracted from citrus peel and apple pomace.

Hydrocolloid

- Hydrocolloid-based medical dressings are occlusive and do not allow water, oxygen, or bacteria into the wound.
- This may facilitate angiogenesis and granulation.
- Hydrocolloids also lower pH of the wound surface inhibiting bacterial growth.

Gel

- solid, jelly-like material with properties ranging from soft and weak to hard and tough.
- Mostly liquid by weight but behave like solids due to three-dimensional crosslinked network within the liquid.
- The crosslinks within give gel its structure (hardness) and contribute to stickiness (tack)

Hydrogel

- also called Aquagel, network of polymer chains that are water-insoluble.
- Highly absorbent (they can contain over 99% water) natural or synthetic polymers.
- Possess degree of flexibility similar to natural tissue, due to significant water content.

Uses

- breast implants
- burns
- creating/ maintaining moist environment.

Alginates

- Alginic acid is a viscous gum, abundant in cell walls of brown algae. It ranges from white to yellowish-brown, and may be filamentous, granular or powdered.

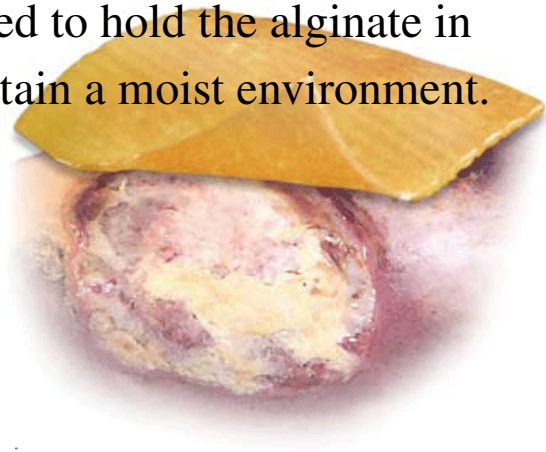
- Commercial varieties are extracted from seaweed, including the giant kelp.

Uses

- Pharmaceutical preparations such as Gaviscon.
- Mold in making in dentistry and prosthetics.
- Wound dressings that promote healing and can be removed with less pain than conventional dressings.

Alginates

- With moderate to heavy drainage, the alginate forms a gel when in contact with wound fluid. It can absorb 20 times its weight in fluid, and can be used in infected and noninfected wounds.
- Because it is highly absorbent, it should not be used with dry wounds or wounds with minimal drainage.
- An alginate dressing is packed into wound bed as primary dressing. A secondary dressing is added to hold the alginate in place and maintain a moist environment.



Alginates

- An appropriate secondary dressing is as important as correct primary dressing. Petrolatum gauzes or foams will secure the alginate and prevent drying. If wound is infected, the secondary dressing should be nonocclusive to permit monitoring and to avoid harboring bacteria.
- When secondary dressing is removed, hydration of the alginate should be assessed. If the alginate has absorbed wound exudate as intended, it will be in a gelled state and easy to remove from the wound. If tdifficult to remove or if fibrous material adheres to the wound base, the wound is drying out and use should be re-evaluated.

Foam dressing

- highly absorbent dressing, allowing less frequent dressing changes and reduced maceration.
- indicated in heavily exudating wounds, especially after debridement or desloughing, deep cavity wounds; weeping ulcers.
- maintains moist environment and absorbs four times more exudate than hydrocolloids. May have nonadherent wound contact layer + semipermeable polyurethane film top layer.

<u>Uses</u>

- treatment of heavily exuding chronic and acute wounds.
- available with or without adhesive border
- may be used under compression bandages

Activated carbon

- also called activated charcoal or activated coal, is carbon that has been processed to make it extremely porous with consequent large surface area available for adsorption or chemical reactions. [one gram of activated carbon has a surface area of approximately 500 m^2 (or about 2.17 tennis courts).
- further chemical treatment enhances adsorbing properties of material. Activated carbon is usually derived from charcoal.

3M to the rescue

Type	Example
Hydrogel	Tegaderm hydrogel wound filler
Low adherence	Advacare or Melolin low adherence dressing 5x5cm
Foam	Tegaderm foam dressing
Hydrocolloid	Tegaderm hydrocolloid
Alginate	Tegaderm alginate
Activated charcoal	Charcoal powder