Hospital sepsis

FOCUS

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AMERICAN MEDICAL ASSOCIATION
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PRESENT

HOSPITAL SEPSIS
A COMMUNICABLE DISEASE

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The 18th century, the age of reason, was a time of hospital building.
Trying to heal the sick, man in his ignorance had devised a reservoir of sepsis. A few perceptive physicians observed that uncleanliness, overcrowding and failure to isolate infectious patients encouraged the spread of disease.
Following Pasteur's discoveries in the mid-19th century, the realization came that such hospital conditions spread disease because they spread organisms.
We began to grope for new techniques to control disease. The age of antisepsis had begun.
Joseph Lister stands out among the pioneers of that century. It was he who said, 'You must be able to see with your mental eye the septic ferments as distinctly as we see flies or other insects with the corporeal eye.'

…YOU MUST BE ABLE TO SEE WITH YOUR MENTAL EYE THE SEPTIC FERMENTS…

'If you can really see them in this distinct way with your intellectual eye, you can be properly on your guard against them.'
This was our temper when the 20th century came in. We had learned to see Lister's septic ferments with our mental eye. Our understanding had minimized cross infection. We were on

our guard. And today? Since the therapeutic revolution of antibiotics, we rely too much on antibiotics and not enough on asepsis; our guard is down. Liberal visiting privileges and division of labor have pyramided the number of people who contact the patient and crowd the corridors. Each exchanges bacteria with the patients and with each other.
Once again, many of our hospitals are reservoirs of uncontrolled infection, because of the complication of antibiotic resistance. And the source of hospital sepsis? Originally, it is this, the infected patient.

Mrs. Sarah Allen had had a ten-year history of boils and pimples.
She was hospitalized eventually to discover the cause of the continued skin sepsis. The staphylococci which caused her difficulty were alien to the hospital. And it was this fact that made her useful in tracing the spread of infection.

A single room was disinfected for this particular investigation. The walls were sprayed with germicidal detergent and squeegeed dry.
The furniture was washed with germicide and the bedding sterilized. The floor was flooded with detergent germicide and the film of water picked up with a vacuum cleaner.

BEDDING
FLOOR
AIR

After disinfection, cultures were taken of the bedding, floor and the air. The environment prepared to house Mrs. Allen's organisms was relatively aseptic.
Cultures were taken again after 24 hours of occupancy. The technique of culturing the bedding was simply to press it against the medium. The floor was cultured by swabbing a given area. The septic solution was then mixed with a culture medium. The air was cultured by using a Wells centrifuge which passes a measured quantity of air into a tube. Centrifugal action throws dust and bacteria against the medium on the wall of a tube.

BEDDING – 24 HOURS

These bacteria accumulated during the first 24 hours of occupancy.

FLOOR – 24 HOURS
AIR – 24 HOURS

CARBUNCLE

Phage typing identified the bacteria isolated in the experiment. The translucent spots in the fourth square of each upper row indicate that bacteria from all cultures were destroyed by phage 79. This confirmed the source of organisms as being Mrs. Allen.

BEDDING

FLOOD
AIR

Cultures were taken on subsequent days.

BEDDING – DAY 7

This was the appearance of the cultures taken on day 7.

FLOOR – DAY 7
AIR – DAY 7

BACTERIA PER SQUARE INCH

The rise in the count of bacteria per square inch on bedding from admission through the seventh day was this.

BACTERIA PER SQUARE CENTIMETER

The floor count per square centimeter.

BACTERIA PER 5 CUBIC FEET

The air count per five cubic feet.

There was no moisture in Mrs. Allen's surroundings and hence no place for organisms to multiply. The rise in bacteria during the seven days, therefore, represents an accumulation only. The air counts charted here are averages.
However, throughout a given day, the variation during different activities is significant. An air sample taken while the bed is being made gives a better idea of the increase in the room's bacterial population.

BED MAKING

Bed making contributes a remarkable number of organisms to the surrounding air. During the period of no activity, the count was 11 bacteria per five cubic feet of air, during bed making, 160 or more.

BACTERIA PER 5 CUBIC FEET

Other cultures showed this rise and fall.

BED MADE
VISIT

BATH
MEAL
COVERS

Here, the patient straightens her bedcovers, and a period of no activity in the evening.

What part of the patient precisely is the source of the accumulating organisms?

NOSE
CARBUNCLE
FINGERS
HAIR
FECAL SWAB

Evidently, Mrs. Allen's carbuncles are only local manifestations of systemic bacterial disease. She's shedding bacteria from her whole person.

TOES

This becomes obvious when we culture the bathroom fixtures that she contacts.

TOILET SEAT

It becomes obvious when an infected patient is allowed to leave an isolation room.

CORRIDOR

These are colonies of Mrs. Allen's organisms shed during the simple act of walking by. Ordinary dressings do not confine bacteria to the lesion. Moisture seeps through the gauze, evaporates and leaves bacteria to be scattered, as shown by this culture of the outer surface of Mrs. Allen's dressing.

DRESSING

When a dressing is handled carelessly, it isn't hard to visualize the spread of organisms to the hands, clothes and nose of the examiner.
The physician's actions should set the pattern for safe hospital practices each time he cares for his patient. Another major source of organisms is the spray from conversation and breathing. In slow motion, the word pipette *looks like this.*
A conclusion of the investigation is this: the infected patient is the source of hospital sepsis, a readily communicable disease. Isolation techniques, such as the use of prepackaged sterile dressings, masks, gowns and ultraviolet curtain, disinfection of shoes and hands, are essential to keep the bacteria within the patient's room.

If not properly confined, bacteria can travel from the source of infection by dozens of routes. They are carried by feet, hands, clothing and noses. They circulate by soiled linen and improper ventilating systems. They are spread by blankets, dressings, pills and mops, by any article that enters and leaves the room. But the action of each of these spreaders is not simply that of carrying a few bacteria from an infected patient to some other patient. Each also becomes a reservoir and some of these reservoirs may become serious multipliers. For instance, a culture of mop water taken at the end of the day may not yield an overwhelming picture of sepsis. But the same water presents a different picture the next morning.

MOP WATER
END OF DAY

MOP WATER
OVERNIGHT

Other common multipliers are damp soiled linen, dressings, moist soap, bedside water, the air-conditioning system and the nasopharynx. Every hospital is a complex of possible multipliers, reservoirs and spreaders of bacteria. Consider one of the many possible trails, bacteria spread from nose to skin to clothing to floor, where they can live for long periods in the dust. The bacteria are picked up on a mop, where overnight they multiply.
Bacteria from this rich new source are painted generously throughout the hospital. The film of water dries. The bacteria are scuffed into the air. They may be carried into the air-conditioning system. From here, they are fed back into the entire ventilation complex. As these various processes go on with dozens of interwoven multipliers and spreaders, gradually, there is created a septic environment. The problem of each hospital is to discover which multipliers and spreaders are responsible for sepsis in that particular hospital. Steps can then be taken to block the feedbacks at various points.
There are practices common to many hospitals that may be a source of trouble. Mopping is one. We will mop Mrs. Allen's floor from a pail actually being used in another part of the hospital on this day. The water contains only the usual detergents used in this hospital.
A culture was taken from the floor when it was again dry.

BEFORE MOP
AFTER MOP

Here is a comparison with the earlier culture taken before mopping. Mops may leave more bacteria on the floor than they remove because the usual germicide is not effective in large wads of textile. It is better to use a vacuum cleaner or treated cloth. Still better results are obtained if the floor can be flooded periodically with a detergent germicide which is picked up with a wet vacuum.
After this treatment, a culture demonstrates that for practical purposes the floor is eliminated as a source of bacteria.

BEFORE MOP

AFTER MOP
WET VACUUM

Once the floor is properly treated, the bed remains as the principal reservoir.

BACTERIA PER SQUARE INCH
TOP
PILLOW
BOTTOM

A typical bacterial count showed top sheet 160, pillow 176, and bottom sheet 240.

CLEAN

By comparison, a clean sheet showed only 3.4. It is obvious that sheets and covers should never be whisked into the air. When sheets are changed, relatively few bacteria are scattered if the sheets are loosened and rolled up. Soiled linen must be collected in a bag and not removed until it is put in the washer. If soiled linen is carelessly handled, the trail of bacteria is not hard to imagine.
If sorting of linen is done before washing, the air becomes heavily loaded, for when the bacteria multiply in the moist linens, the concentration becomes enormous. These airborne organisms may contaminate freshly washed linen and be redistributed to the wards. Also they are an occupational hazard for the laundry worker. Soiled linen should remain in the bags in which it has been collected. The laundry is then washed just as it comes from the wards. Sorting can be done after tumbling. This means that dressings and other trash must be kept out of laundry bags.
A germicidal textile lubricant added to the final rinse will prevent the multiplication of organisms, as shown by the culture of treated and untreated linen swatches. The area of inhibition around the two treated swatches shows the germicidal effectiveness of the linen. Clean linen should be redistributed in covered laundry trucks and never in those used for collection of soiled linen.
Sanitary processing during the laundry cycle can eliminate a possibly serious trail of infection. Another reservoir in which bacteria await the next patient is the mattress. Plastic covers protect mattresses and pillows and make disinfection with a long-acting germicide easy. Blankets present a more serious problem. This one, which was sterile when first put on, has been used by Mrs. Allen for seven days.

BLANKET

Her organisms will contact the next patient unless the blanket is again sterilized.
Another reservoir for bacteria, usually unsuspected, is bedside drinking water. When a patient drinks directly from a carafe or from a cup which also serves as the lid, saliva contaminates the remaining water and bacteria are free to multiply. When this carafe is

collected with others to be refilled and redistributed, another spreader is set loose in the hospital.
One solution is the use of disposable liners. Tasteless, odorless germicide should be added to the water supply of icemakers to maintain purity of the cubes during distribution. Carafes should be filled directly from a water tap.
There are many other articles in the hospital that may be responsible for transmitting bacteria from a septic patient. Some are so obvious that we routinely take special precautions. Others such as soap however, are rarely suspect, though soap is actually a nutrient medium and can become a hazardous feedback.
The air itself is still another source of trouble. Even if it were possible to isolate all septic patients behind walls, many hospitals are so designed that it is difficult to isolate patients from each other's air and airborne bacteria. Air, which is often recirculated, would carry Mrs. Allen's organisms to any room serviced by the system. But beyond this simple spreading of bacteria, an untended air conditioner can also become a multiplier. Bacteria grow in the moisture on the refrigerator coils or in the humidifying pan. A few organisms going in may return after a time as a cloud.

C
SURGERY
NO 8

B
SURGERY
NO 5

A
SURGERY
NO 6

This feedback can be checked by regular maintenance. Baffles tend to accumulate slime of bacteria. They should be washed periodically with a detergent germicide. Also, a bacterial agent should be added to the humidifying water. This treatment prevents an air conditioner from becoming a multiplier, though any system that recirculates air may broadcast the available organisms.
The whims of air currents however, are not as simple as this. Ventilating systems distribute air under positive or negative pressure. Open doors and windows cause it to flow unpredictably. If doorways are left open in stairwells, a convection chimney forms. Elevator shafts, dumbwaiter shafts and laundry chutes add their bit, chiefly through piston action.
The air current thus created – here shown by the movement of smoke – may be carried through an open door. It may pass over soiled linen, down the hall, up an open stairwell. The current may carry its bacteria to areas where they are a real hazard.

NURSERY

The problems of controlling air currents are different in each hospital. Some can be solved by a little care. Some may require readjustment of ventilating equipment or hospital design. Not all of our sepsis problems are inanimate however. The human part of our environment perhaps presents the most complex problem of all. We are all colonized. We all scatter organisms from our noses, our skins, and our perineum. Some of us, though apparently in good health, become multipliers, and a source of serious infection to others. Such individuals certainly must not work where they can endanger patients. They have no place among hospital personnel.
There are those that may have active skin infections. They, too, should absent themselves while their infection is communicable.
Others who do not have infections themselves may spread bacteria from patient to patient. This could be an orderly who moments before was emptying soiled laundry.
The number of bacteria scattered from a healthy nasopharynx is of no great significance, but when the respiratory track becomes diseased, bacteria multiply several thousand percent. Here is a sneeze in slow motion, the person has a cold.
Masks on a healthy person may be adequate, though typical masks are only about ten percent efficient. When a person has an upper respiratory infection, masks are totally inadequate. Masks soaked by perspiration are no barriers to a cough or sneeze.

These are some of the problems that every hospital faces, problems introduced by the patient infected with resistant organisms. It is not hard to recognize bacteria in a drawing as they're spread by a mop. It is easy to eliminate a carrier by fading her out of a drawing. It is quite simple to state that we must use care.
It is not so simple, however, to deal with these complex practical problems or even to see the septic ferments in our own hospitals. But once we realize what our problems are, the trails across infection can be stopped. We can regulate pails and mops. We can supervise soiled linen. We can sterilize blankets in formaldehyde. We can control ventilation, drinking water, each item that leaves the septic room. We can emphasize hand washing and personal cleanliness. We can develop ways of isolating the infected patient. The techniques are available.
This is an overall hospital problem. Everyone contributes. Each of us must be willing to supervise constantly and to be supervised. And above all, each of us must be able to see with his mental eye the septic ferments.

…YOU MUST BE ABLE TO SEE WITH YOUR MENTAL EYE THE SEPTIC FERMENTS…

BACTERIOLOGIC INVESTIGATION DONE AT THE PETER BENT BRIGHAM HOSPITAL, BOSTON BY RUTH B. KUNDSIN, SC.D.

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