

THE MEDICAL WASTE AUDIT

Hospital-generated medical waste has direct and indirect consequences for every major management function within the hospital. It has a significant financial impact on both the operating and capital budgets. It is a major concern from a human resource perspective, since it involves specific training activities and associated risk management and legal liability issues. Medical waste also has major implications for plant management and engineering staff, since it involves the flow of materials throughout the facility and the use of a wide range of equipment from pushcarts to the most sophisticated medical diagnostic hardware and waste disposal technology. And it has serious implications for long-term planning because it involves extensive regulation by local, state, and federal agencies. Finally, medical waste is one of those highly charged public relations issues which can lead the hospital into a damaging adversarial relationship with its own community if it is not effectively managed.

The great challenge of improving the efficiency of any hospital operating system is its interdepartmental nature. The generation, handling, and disposal of medical wastes involve virtually every department within the hospital. Hospitals need to enhance the coordination of multiple and diverse activities and also to charge a single administrator with the overall responsibility for

A
Framework
For
Hospitals to
Appraise
Options and
Financial
Implications

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the system's performance. To achieve that level of focus, managers must first comprehensively describe the total system and specify the roles of

Summary The generation, handling, and disposal of medical wastes involve virtually every department in the hospital. To enhance coordination, managers must comprehensively describe the total system and specify the roles of key functions and individuals.

Hospitals produce about 77 percent of the approximately 500,000 tons of regulated medical waste produced annually in the United States. The amount produced by different hospitals varies, primarily because of differences in "waste-management practices." The Environmental Protection Agency is trying to develop a greater understanding of the types of medical wastes that are infectious, methods of transmission, and the likelihood of transmission in the handling and disposal of waste within the hospital environment.

To ensure that medical waste is being handled and treated in the most cost-effective manner and with the least health risk to employees and the community, hospital administrators must undertake a comprehensive appraisal of the activities associated with the generation, handling, and disposal processes. A "medical waste audit" requires the following steps:

- Generation profile to identify origination points, categories or types of waste, and associated generation rates
- Inventory of handling practices, including existing regulations, procedures and protocols, training programs, definitions regarding waste segregation, and documentation
- Review of current disposal practices and existing and developing alternatives
- Cost analysis



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key functions and individuals. A useful framework for such an appraisal is an audit that verifies the total range of functional activities included within an operating system and their financial implications. In addition, hospital administrators must be aware of current practices and future regulatory developments so they can have a comprehensive framework in which to evaluate the costs and benefits of various medical waste-management options.

CURRENT PRACTICE, FUTURE DEVELOPMENTS

Within the past few years, public concern about possible transmission of disease from exposure to medical waste has reached alarming levels. Media reports of needles and blood vials washing up on our nation's beaches, along with the continuing focus on the increasing number of AIDS patients, stimulated the call for strict regulations to prevent the recurrence of such incidents. Responding to these public concerns, Congress



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*S*afeguarding creation requires us to live responsibly with it, rather than manage creation as though we are outside it. The human family is charged with preserving the beauty, diversity, and integrity of nature, as well as with fostering its productivity.

—U.S. Catholic Conference, *Renewing the Earth*, 1992



enacted the Medical Waste Tracking Act (MWTa) of 1988 (see John M. VanLieshout and Paige A. Freeman, "Comprehensive Waste Regulation Dumped," *Health Progress*, May 1990, pp. 62-65). Through the MWTa, Congress established a two-year demonstration project for tracking medical waste and required the U.S. Environmental Protection Agency (EPA) to establish tracking and management standards for certain medical wastes. The EPA is also required to submit a series of reports to Congress on a number of topics related to medical waste. The *Medical Waste Management in the United States: First Interim Report to Congress*, submitted in May 1990, is of crucial significance to hospital managers because it provides insight into future regulatory requirements on medical waste handling and treatment.

The Hospital as a Generator of Medical Waste In this report, the EPA estimates that hospitals produce about 77 percent of the approximately 500,000 tons of regulated medical waste produced annually in the United States. The remainder is produced by a large number of different categories of waste generators that produce small quantities of medical waste. These small-quantity producers include physicians' and dentists' offices, long-term care facilities, laboratories, and clinics.

The EPA has determined that the quantity of medical waste produced by hospitals and other waste generators varies greatly. For hospitals, some of this variability is attributable to characteristics such as bed size and the volume and types of services offered. However, the variability in the quantity of medical waste produced has more to do with differences in waste-management practices at hospitals.¹ For example, hospitals with their own incinerators have little incentive to minimize the amount of infectious waste segregated from other wastes; they simply burn more. Moreover, hospitals have different opinions on which wastes should be considered infectious. Differences in practices among the hospitals should not be surprising, however, since infectious waste definitions vary considerably among federal, state, and private agencies.² It can cost 20 times as much to dispose of infectious wastes as to dispose of general waste. Therefore, without a clear and uniform definition of what constitutes infectious waste, many hospitals can be expected to treat a larger proportion of their waste as infectious than is necessary, driving up healthcare costs.

Health Hazard Assessment To determine what type of regulatory control of medical waste is appropriate, the key question is which components of the total medical waste stream pose true health hazards. In the absence of complete dose-

response and exposure data from the scientific literature, the EPA has developed a health hazard assessment approach with the following steps: identify and categorize medical waste, identify types of pathogens present in medical waste and their disease-causing potential, estimate the quantities of pathogens present in each category of medical waste, and determine the probability of disease transmission associated with the pathogens in each type of infectious medical waste.³

The result of this process will be a greater understanding of the types of medical wastes that are infectious, methods of transmission, and the likelihood of transmission in the handling and disposal of different types of waste within the hospital environment. Not only will this information be useful in crafting future regulations, but it will also provide hospital administrators with some sense of the parameters of effective waste-management practice. Unfortunately, pending the development of that level of specific knowledge, hospitals will need to proceed with medical waste management assuming potentially greater health hazards than are scientifically verifiable.

Medical Waste Handling After medical wastes are generated, but before they are treated, they must be segregated, packaged, stored, labeled, marked, and transported. The regulations established by the EPA on March 24, 1989, refer to these activities as "handling." The EPA has studied current practices in waste handling for on-site and off-site disposal. The majority of medical waste is transported off-site for disposal in municipal landfills, packaged in plastic bags, and treated as general municipal solid waste. Depending on state or local regulations, these wastes may be compacted, placed in secondary containers or additional packaging, and subjected to additional treatment (e.g., autoclaving) before transport. With on-site incineration, less care is taken to segregate medical wastes from other wastes, secondary containers are rarely used, and wastes are often moved about the facility in open carts.

The EPA has also extensively studied storage and transportation of medical waste. Storage practices of hospitals vary depending on the volume of waste generated, the location of the facility, whether refrigeration during storage is necessary, the frequency of pickups, whether off-site or on-site disposal is used, and general aesthetic considerations. Waste generators' transportation practices also vary, but trucks are the most common method.

Regulations recently promulgated by the EPA have established standards governing the handling of medical waste. In waste intended for off-site disposal, generators must segregate sharps

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and fluids from other waste "to the extent practicable." Packaging materials must be rigid, leak resistant, impervious to moisture, and strong enough to prevent tearing and bursting. In addition, containers for sharps must be puncture resistant, and containers for fluids must be leak resistant. Containers holding untreated regulated medical waste must be labeled "infectious waste" or "medical waste" or with the universal biohazard symbol. Package outer surfaces must be marked to identify the generator, the transporter, and the date of shipment. Storage of waste should be done in a manner to protect the integrity of the packaging, prevent further deterioration of the contents, and prevent access of ani-

mals and unauthorized persons.

Medical Waste Disposal Methods Currently, hospitals and other organizations use a number of methods and techniques to treat medical wastes. No systematic investigation of the effectiveness of each of these methods of waste disposal has been carried out.⁴ However, hospitals can identify meaningful criteria to use in such an evaluation (see **Box**).

THE HOSPITAL MEDICAL WASTE AUDIT

To ensure that medical waste is being handled and treated in the most cost-effective manner and with the least health risk to employees and the community, hospital administrators must under-

THE MEDICAL WASTE AUDIT

WASTE GENERATION

Origination Points

Operating rooms
 Special care units (ICU, CCU)
 Standard patient care units

- Medical-surgical
- OB/GYN and nursery

Emergency room
 Ambulatory, outpatient clinics
 Laboratory (including pathological)
 Dialysis unit
 Others as defined

Medical Waste Categories

Cultures and stocks of infectious agents and biologicals
 Pathological wastes (tissues, organs, body parts)
 Waste blood and blood products
 Sharps (needles, syringes, pipettes, scalpel blades)
 Contaminated carcasses, body parts, or bedding exposed to infectious agents
 Surgery and autopsy wastes exposed to infectious agents
 Laboratory wastes exposed to infectious agents
 Dialysis wastes
 Discarded medical equipment and parts contacted with infectious agents
 Biological waste and materials from contaminated isolation areas
 Other waste material deemed to pose health or environmental hazard

Generation Rates

Volume per operating room, per surgical procedure
 Volume per patient day
 Volume per emergency room visit
 Volume per outpatient visit
 Volume per laboratory test
 Others as defined

WASTE HANDLING

Existing Regulations

State
 Federal
 Local

Definitions Regarding Waste Segregation

At points of origination
 For all waste categories

Written Procedures and Protocols

Segregation
 Packaging
 Storing
 Labeling
 Marking
 Transporting

Training of Personnel

Identification of training needs
 Integration with risk management activity

Documentation

Regulatory compliance
 Managerial control
 Cost analysis
 Information dissemination

WASTE DISPOSAL

Current Disposal Practices

Incineration (on- and off-site)
 Steam sterilization
 Gas sterilization
 Chemical disinfection with grinding
 Thermal inactivation
 Irradiation
 Microwave treatment
 Other methods

Review of Disposal Alternatives

Existing technology
 Developing technology
 Effectiveness criteria (nonfinancial)

- Destruction of pathogens
- Reduction of mass and volume of waste
- Render waste unrecognizable
- Training needs
- Pollution potential
- Hazard potential

COST ANALYSIS

Personnel costs
 Energy costs
 Parts and supplies
 Vehicles, equipment, insurances, fuels
 Training costs
 Space costs
 Licenses, permits
 Legal fees
 Capital costs
 Information costs
 Other costs as determined



take a comprehensive appraisal of all the activities associated with the generation, handling, and disposal processes. Such a "medical waste audit" will require the following steps (see **Box**, p. 71).

The Generation Profile: Sources by Category In this first step in the audit, managers must identify the origination points within the hospital for medical waste, the categories or types of waste generated, and the approximate volumes or generation rates associated with each origination point–category combination.

- *Origination points.* These origination points should be definable in terms of function (e.g., emergency room, operating rooms, intensive care units, standard patient floor, blood bank) and total square footage.

- *Medical waste categories.* The universe of hospital-generated medical waste must be organized into a number of discrete categories, including cultures and stocks of infectious agents and associated biologicals, pathological wastes, waste human blood and blood products, and sharps. The categories must be mutually exclusive for counting purposes so that the volumes can be accurately determined.

- *Generation rates.* This is somewhat more complex. Ultimately managers should be able to relate the volumes of particular categories of waste to points of origination using an indicator of utilization specific to the area's function. Generation rates might be described, for example, in volume (pounds, gallons, bags) per surgical procedure in the operating rooms, per visit in the emergency room, or per patient day on standard nursing units. The ability to establish generation rates from points of origination by category of medical waste is essential for effective management and control. Most hospitals will need to determine generation rates initially by direct observation and weighing of waste materials.

Inventory of Handling Practices Little systematic information is available on how hospitals' medical waste-handling practices vary. Since the real level of health hazard associated with the handling of various categories of waste is uncertain, hospital managers must carefully communicate and monitor handling instructions and protocols:

- *Existing regulations.* All existing regulations should be reviewed on a routine basis. Key department heads and other personnel should be briefed on any regulatory changes anticipated at local, state, or federal agencies.

- *Written procedures and protocols.* Every hospital employee who is involved in any way with the segregation, packaging, storing, labeling, marking, or transporting of any category of medical waste should have a written set of instructions.

- *Training programs.* Educational programs

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should be held routinely for personnel involved in medical waste handling and disposal. Occasionally, hospital associations and units of state and local government will provide such programs for hospital employees. Medical waste handling should be part of the general hospital orientation program for all new employees. Departments with a continuing exposure to various types of medical waste (e.g., nursing, laboratory, housekeeping) should schedule refresher programs on waste handling, being careful to include employees on all three shifts.

- *Definitions regarding waste segregation.* Appropriate managers should review existing definitions regarding infectious medical wastes. Where no definitions exist, they should be developed, perhaps with appropriate external consultation. In the absence of complete knowledge of the infectious potential of each category of medical waste, the relative costs and benefits of different segregation and handling scenarios should be reviewed using different assumptions concerning the ratio of infectious to noninfectious waste.

- *Documentation.* Detailed documentation of medical waste generation, handling, and disposal is absolutely essential for analytical purposes, managerial control, and regulatory compliance. Documentation has four principal objectives: (1) to ensure compliance with all regulatory requirements, (2) to ensure all generated wastes are appropriately disposed of, (3) to ensure appropriate safeguards where infectious wastes pose a potential health hazard, and (4) to allow a quantitative analysis of costs associated with various aspects of handling and disposing of medical waste.

Review of Disposal Practices and Alternatives The preliminary findings of the EPA's medical waste-tracking demonstration show that the disposal of medical wastes will be much more complicated and expensive in the future. Although on-site incineration is still the least expensive method of disposal, changing technology and added regulation will dramatically increase its costs in the future. Landfills are more reluctant to accept medical waste, and with increased community opposition to new landfill sites, land disposal costs for both incinerated and nonincinerated (noninfectious) medical wastes can be expected to increase. Many hospitals, even those with their own incinerators, are analyzing the alternative of participation in some regional incineration project. Shifting wastes from on-site to off-site disposal will increase all the costs of on-site management and transport.

- *Current disposal practices.* Managers should determine the current method of disposal for all categories of medical waste. Many hospitals have



no single locus for decision making for medical waste disposal. As a consequence, they frequently use multiple disposal methods and multiple contractors for the same type of waste disposal.

• *Review of disposal alternatives.* Hospital managers must be careful to identify both existing and developing methods of medical waste disposal. General hospital wastes such as foodstuffs and cardboard boxes, and some nonmedical hazardous materials such as certain chemicals, are the subjects of recycling technology research. Managers must complete a detailed assessment of the handling practices associated with each type of disposal, as well as an assessment of the effectiveness of alternative methods of disposal using nonfinancial criteria.

Cost Analysis For every activity related to medical waste generation, handling, and disposal, managers should undertake a comprehensive cost finding and cost analysis. The cost categories in such an assessment include:

- Personnel (salary and fringe benefit) costs associated with medical waste handling and disposal by unit of origin and personnel category (e.g., nursing, housekeeping, dietary)
- Energy costs (electric, gas, oil), including reductions for energy recovery associated with disposal
- All parts and supplies included in both scheduled maintenance and work-order processing related to medical waste activity
- Vehicles and small equipment (including maintenance contracts, all insurances, fuels, and lubricants)
- Costs of training programs (voluntary and required for regulatory compliance)
- Costs of space allocated to storage of medical wastes
- Regulatory compliance administrative costs (licenses, permits)
- Legal fees
- Capital costs (major equipment, facility renovations, modifications to major systems required for waste handling)
- Information system costs
- All other cost elements as determined by the audit

Cost accounting and analysis are essential if the hospital is to make good management decisions regarding waste handling and disposal. For example, on-site incineration is probably the most cost-effective means of disposing of medical wastes in the short run. However, increasingly stringent requirements on equipment (e.g., pollution control devices) will escalate future capital outlays and operating costs. Regional, centralized incineration projects may prove more cost-effective for certain hospitals than maintaining their

own, on-site incinerators. Such an important decision should be made, however, only after the hospital has analyzed all the major cost elements, projected the impact of future technology, and assessed the relative health hazard and legal liability risks of each alternative.

A PILOT AUDIT

The medical waste audit methodology described above is being pilot tested at St. Joseph Hospital, Tampa, FL. For the fiscal year ending June 30, 1991, the hospital had 19,876 inpatient admissions, 152,000 inpatient days, and 11,295 surgical procedures (7,639 inpatient and 3,656 outpatient). The objective of the study is to demonstrate the feasibility, validity, and utility of the audit methodology.

Because surgery generates the largest amount of medical waste in most hospitals, coordinators decided to study the hospital's operating rooms in the first phase of the audit. This phase had two specific objectives: to identify categories or types and volumes of medical waste that surgery generated and to determine the appropriate waste generation rate to associate with a unit of work output (i.e., the surgical case).

Methods The preliminary studies were conducted in outpatient surgery, inpatient surgery, and cardiac surgery. Study investigators anticipated that each type of surgery would generate different volumes of medical waste, although the nature and magnitude of those differences were unknown.

Under normal circumstances, all waste is bagged in the surgical suite and taken to the soiled utility room. For purposes of the study, three categories of waste were separated in the surgical suites and bagged and weighed before going to the utility room. This ensured that medical wastes originating elsewhere would not be mixed with surgical wastes. In some instances staff were asked to estimate the degree of a container's fullness so that weight approximations could be made.

Study investigators divided the medical waste into three categories based on the kind of container into which it was deposited: *red bag* waste (e.g., wrappers, sponges, gloves, bottles, paper goods), *suction canister* waste (e.g., body fluids, irrigation solutions), and *sharps container* waste (e.g., scalpels, needles, small syringes, glass ampules).

The results of the surgical phase of the audit are summarized in the **Table** on the next page. For all surgery, an average of 14.22 pounds of medical waste per case was generated, nearly all of which (93 percent) was contained in red bags. Regarding the weight of medical waste per case, the audit identified a significant difference

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between inpatient (17.31 pounds, excluding cardiac surgery) and outpatient (8.85 pounds) surgery. Cardiac surgery generated, on average, 25.43 pounds per case. The nearly 2 to 1 ratio of inpatient versus outpatient waste was reflected in all three waste streams.

Survey Benefits As a result of the survey, it is now possible to estimate the waste type and volume a given surgical procedure will generate and thus project overall surgical waste based on surgical volume. For example, for the year ending June 30, 1991, we now estimate that inpatient surgery produced 132,231 pounds of medical waste, outpatient surgery produced 32,355 pounds, and cardiac surgery produced 19,072 pounds—for a total of 183,658 pounds, or nearly 92 tons.

The survey will also improve the ability to identify inexpensive ways of handling and disposing of medical wastes. For example, at least 30 percent of total surgical waste can be eliminated from the infectious waste stream by using handling methods that segregate it from potentially infectious

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waste. The ability to estimate the amount of waste created by various forms of surgery performed at anticipated volumes will also allow St. Joseph to compare various disposal options and more accurately project disposal costs.

In addition, an effective medical waste audit will improve the ability of hospital efficiency experts, regulators at all levels, and health policy analysts to understand the hospital as a waste generator. The new information provided will also help settle important questions concerning the advisability of regional incineration versus on-site incineration, improve health hazard assessments for medical waste streams, and enhance the efficacy of new disposal technologies. Finally, similar data from a national sample of hospitals would allow analysts to understand factors that create differences in various hospitals' medical waste generation, handling, and disposal.

The pilot test of the comprehensive waste audit is continuing at St. Joseph Hospital, with similar

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SURGICAL WASTE VOLUMES AND PER CASE GENERATION RATES

	Inpatient Surgery (N = 132)*	Outpatient Surgery (N = 153)	Cardiac Surgery (N = 37)	All Surgery
Suction Canister Waste				
Total canisters used	73	96	53	
Canisters/case	0.55	0.63	1.43	0.69
Total fluid volume weight (lbs)	110	71	44	
Fluid volume weight/case (lbs)	0.83	0.46	1.19	0.70
Sharps Container Waste				
Total containers	132	141	54	
Containers/case	1.00	0.92	1.46	1.02
Sharps weight (lbs)	46	28	12	
Sharps weight/case (lbs)	0.35	0.18	0.32	0.27
Red Bag Waste				
Total red bags used	166	220	163	
Red bags/case	1.26	1.44	4.41	1.70
Total red bag weight (lbs)	2,129	1,256	885	
Red bags weight/case (lbs)	16.13	8.21	23.92	13.26
Total Waste				
Total weight (lbs)	2,284	1,354	941	
Total weight/case (lbs)	17.31	8.85	25.43	14.22

*Outpatient and cardiac surgery represent 10 days of observation; inpatient surgery represents 5 days of observation.

THE MEDICAL WASTE AUDIT

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studies being planned for the laboratory, the emergency room, radiology, standard patient rooms, intensive care units, and other areas.

PREPARING FOR THE FUTURE

Increasing levels of public concern are focusing attention on the hospital as a source of medical wastes. The EPA is now directed to uncover the true health hazards associated with infectious medical wastes. More stringent documentation, disclosure requirements, and regulation are sure to follow. Hospital managers can prepare for future regulation and manage their medical waste generation, handling, and disposal activities more cost-effectively. The hospital medical waste audit is the first step in this process. □

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NOTES

1. U.S. Environmental Protection Agency, *Characterization of Medical Waste Generation and Treatment and Disposal Practices in New York and New Jersey*, draft report submitted to Air and Waste Management Division, Region II, and Office of Solid Waste, January 30, 1989.
2. U.S. General Accounting Office, *Medical Waste Regulation: Health and Environmental Risks Need to Be Fully Assessed*, report to the chairman, Subcommittee on Regulation, Business Opportunities and Energy, Committee on Small Business, House of Representatives, March 1990.
3. U.S. Environmental Protection Agency, *Medical Waste Management in the United States: First Interim Report to Congress*, May 1990, pp. 2-7.
4. P. Layne, W. Westbrook, K. Hendry, and T. Pierson, *Review and Evaluation of Existing Literature on Generation, Management, and Potential Health Effects of Medical Waste*, Contract No. 68-01-7075, U.S. Environmental Protection Agency, November 1988.

A MOVEMENT GAINS MOMENTUM

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liabilities, hospital waste handling, and future issues and developments in waste management. Almost 400 persons participated. Representatives from 28 DCNHS facilities viewed the teleconference live via on-site equipment. Eight member facilities from the Sisters of Charity Health Care Systems, Cincinnati, participated in the conference as well. Tapes of the conference were made available to six other DCNHS members.

ENVIRONMENTAL CHECKLIST

As awareness of the importance of preserving planetary resources grows, providers will become increasingly interested in developing recycling and waste management programs. Hospitals just beginning such programs may find some of the following suggestions helpful:

- Contact other hospitals or systems with established recycling programs for suggestions on getting started and estimates of the potential net income recycling may generate.
 - Arrange for a staff member involved with a successful program at another hospital to give a presentation to managers and other employees explaining how the program was set up and what it has accomplished.
 - Determine whether a full- or part-time position should be established to coordinate recycling efforts, or specify which existing manager should coordinate the program.
 - Contact local recyclers to find out what materials can be recycled.
 - Have the communications staff publicize the program, give it a name, and create a logo.
 - Explore possibilities for working with business or community groups to increase recycling options, educate community members, and develop a community-wide campaign.
 - Ask employees who are enthusiastic about recycling to help coordinate the program.
 - Contact a medical waste management firm for information about disposal and recycling options and their costs.
- Phil Rheinecker

VALUES AND VISION

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healthcare ministry and dues-paying membership organizations, the task force has had to consider many competing interests and claims in the development of its approach to national health policy reform. The task force believes this plan is a good starting point for balancing those interests while retaining its credibility. However, the task force has certainly not answered every specific question.

In the final analysis, however, Catholic healthcare providers must recognize that, because we are talking about the *future*, we will never be able to address *all* of the *possible* obstacles that might arise. At some point, Catholic healthcare providers will have to press forward—much as our founders did—in faith, in charity, and in hope, with the certainty that what we are proposing makes sense “regardless of how it turns out.”

Direction can be found in these words by Sr. Joan Gallagher, CSA, from her foreword to *Pioneer Healers* (Sr. Ursula Stepsis, CSA, and Sr. Dolores Liptak, RSM, eds., Crossroad Publishing, New York City, 1989):

Today the healing mission and ministry requires new linkages, new forms of involvement and dialogue, to build trust, to enable all of us to move beyond our security to address the needs of the medically indigent, the lonely, the homeless, the abused, and the displaced. All of us have been created to share in the divine life through a destiny that goes far beyond our human capabilities. God now asks us to sacrifice and to reflect on our reverence for human dignity and on our service and discipleship, so that the divine healing for the human family and this earth can be fulfilled. □