Systems Analysis

For a "New Generation" of Military Hospitals

Volume I: Development of the New Generation Hospital

Final Report

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SYSTEMS ANALYSIS FOR A "NEW GENERATION" OF MILITARY HOSPITALS

VOLUME 4
DEVELOPMENT OF THE NEW GENERATION

FINAL REPORT
TO THE ADVANCED RESEARCH PROJECTS AGENCY
OF THE DEPARTMENT OF DEFENSE

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SYSTEMS ANALYSIS
FOR A "NEW GENERATION" OF MILITARY HOSPITALS

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4.1. INTRODUCTION

This volume deals with the prototype hospital in particular. Although other volumes make many references to this hospital, they are generally oriented to the entire "new generation" of military hospitals, of which the prototype is to be the first.

The systems analysis completed under the present contract is simply a pencil-and-paper evaluation to identify desirable innovations, adapt them as necessary to constraints in the military health care system and to each other, identify their likely costs and benefits, and lay out a program for their development and implementation. The prototype hospital is the test bed in which these new concepts can receive experimental evaluation.

Many of the new concepts which have been recommended in Volumes 2 and 3 do not need further development; except for possible minor adaptation, they can be adopted directly in the prototype program. Others need some development before they will be ready for evaluation; these, which are identified at appropriate places in this report, have been assembled and arranged in a coherent R&D program in Section 4.4 of this volume. Those which can be developed in a short-term program (less than 18 months) can be ready for installation and evaluation when the prototype hospital opens.

We have made a distinction between concepts which must be evaluated and concepts which require some experimentation. The former have well defined applications and easily recognizable costs and benefits. These include light care facilities, vacuum trash and linen collection, convenience foods, laboratory automation using existing commercial equipment, etc. The concepts that require experimentation (which includes evaluation) cannot be completely developed on paper; their practical application will undoubtedly evolve further when they are tried out. These include training and utilization of nonphysicians in primary care, most computer applications for clinical data, and innovations in the planning process.

Because the prototype hospital is to serve as a test bed for evaluation and experimentation, it will be necessary to collect more detailed data on its operation than would be appropriate in most hospitals. In our original proposal we speculated about a computerized management information system which would combine operating data with fiscal data to produce measures of efficiency for all departments of the health care system; we speculated that such information could be tied to some kind of incentive system rewarding those who ran especially efficient operations.

Having explored the idea in more detail, we have become skeptical of the feasibility of working out such a computerized system at this time. So many problems remain in the computerization of processes which work with clinical data that it would be premature to consider a more complex management information system. The crude measures of efficiency defined and computed in connection with Project PRIME (see Section 1.3) go some distance in this direction, but they do not depend on computerization.

The real difficulties lie in modifications to the incentive scheme. Currently, hospital personnel pay little attention to measures of efficiency, because so little of the expense incurred is actually under their control. By and large, however, military hospital personnel are aware of the need for efficiency and do their best to achieve it within the constraints under which they must operate. We have been unable to conceive a scheme which goes much beyond present incentives and present measures of efficiency, though we do have a few suggestions, which are presented in Section 4.3.

For evaluation and experimentation with novel concepts in the prototype hospital, we suggest a permanent evaluation committee which includes the commander and executive officer, a staff, and perhaps a contractor. It will be responsible for designing the evaluatory experiments and carrying them out in cooperation with those members of the hospital staff directly involved. The costs and benefits we have derived from pencil-and-paper evaluations should be used as a guide for experimental evaluations in the prototype hospital.

4.2. PROTOTYPE HOSPITAL AND HEALTH CARE SYSTEMS

4.2.1. INTRODUCTION

The prototype hospital will be the test bed in which the innovations which survived the systems analysis phase will be put to experimental test. However, it is also certain to be regarded as a showplace for the "new generation" of military hospitals. At one time we regarded these two roles as inimical; novel concepts are bound to run into problems when they are put into practice, and this fact is inconsistent with a showplace. But as the features of the prototype have taken shape, we have become more confident of their feasibility and benefits, and we believe that the prototype can indeed be regarded as representative of the "new generation," not only of military hospitals but civilian hospitals as well.

Nevertheless, the experimental nature of many of its features must be kept clearly in mind by those responsible for its creation and operation and by observers. Otherwise, they will lose sight of the prototype's essential contribution--the testing of new concepts.

4.2.2. FEATURES OF THE PROTOTYPE HOSPITAL

Instead of stating generalized conclusions about layout for the prototype hospital, we have devised a procedure by which good layouts can be obtained, taking proper account of the needs of departments for physical proximity, site constraints, relationships to existing buildings and roadways, and possible growth or adaptation. In physical form, the prototype hospital is unlikely to differ from more conventional hospitals: outpatient facilities will comprise the lower floors, nursing wards will comprise the top floors, and shared services (laboratory, X-ray, pharmacy, food service, etc.) will be in-between. These generalizations are true for virtually any hospital, unless there are very unusual site constraints, because of basic requirements for physical proximity. Samples of layouts, generated using RELATE, illustrate this point and are included in this section.

The major changes that are seen in the prototype facility reflect the creation of a light care facility, which in military hospitals we have studied would make up from 25% to 60% of the beds, and the elimination of the kitchen by using convenience foods. However, there are

important changes in the design and construction philosophy, arising from new techniques in the planning process and introduction of building systems and modular design.

Revisions in the planning process are to make the process more rational, improving communication among participants, and shortening the time from conception to occupancy. These goals can be achieved by using:

- planning units as the basic repository of design and operating data,
- computer-aid layouts to produce form diagrams in the early stages of planning,
- modular design in the original concept and carrying it through to the building form,
- multitrack scheduling to overlap design phases and construction phases.

Closely related to the new design process is a point of view reflected in building systems. After reviewing applicable building systems, we have concluded that the concepts being developed for the Veterans Administration are the most promising for DOD hospitals. Of the concepts available, it is the best among those which can be ready for the prototype hospital. Since such systems are still under development this conclusion requires review to be sure that the VA system meets all DOD requirements, but as of now we have not found any shortcomings. Unlike some building systems, which are essentially kits of parts, the VA system is a set of constraints which define zones in which various building elements are allowed. In this way, interference among structural elements, utility elements, partitions, elevators, and equipment is eliminated, and designers of each can proceed simultaneously. The VA system uses rectangular space to achieve this end; spans are 22 feet in one direction and up to 120

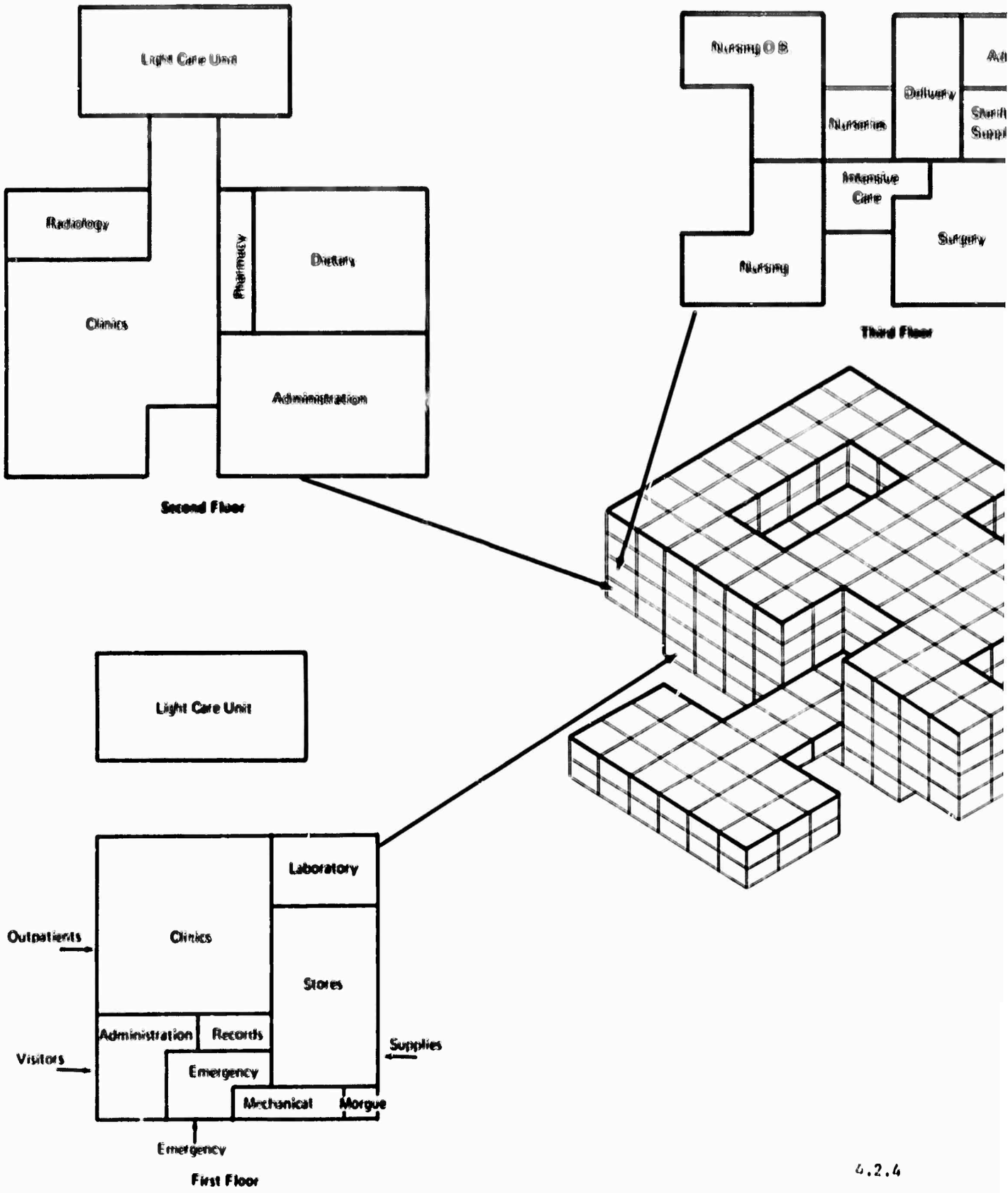
load on the other. There is no essential dependence on structural elements, which can be steel frame or reinforced concrete. The design is modular and fully adapted to modular planning.

Examples of the effect of these new principles on design are illustrated in Figures 4.2.1, 4.2.2, and 4.2.3, which show hypothetical redesigns of the hospitals at Fort Ord, Jacksonville, and March AFB, respectively. A light care facility has been added to each hospital, and the number of acute care beds is correspondingly diminished. Except for March AFB, whose size does not justify it, the light care facility is a separate structure connected to the main hospital in accordance with the principles described in Section 2.3.

Related dispensaries, if the size of the base justifies adding them as separate facilities, will be modern structures more fully equipped than is usual now, in accordance with the concepts introduced in Section 2.4. Their number and size would, of course, depend upon actual needs at whatever site is selected for the prototype hospital.

Other new features of the hospital have been elaborated in Volume 2. Briefly summarized, they are as follows:

- The rendering of primary care to a considerably greater extent by nonphysicians supervised by physicians;
- Placement of dental restorations by dental assistants working under a dentist's supervision in circular operatories;
- Ward unit managers and, until an information system is operating satisfactorily, ward clerks;
- Somewhat more automated equipment for performing laboratory tests, a standard laboratory computer system, and a new fast analyzer system connected to terminals in dispensaries, clinics, and wards;
- Unit packaging of 200 commonly prescribed drugs, central dispensing of injected medications from the pharmacy, and automatic dispensing (within the pharmacy) of unit-packaged drugs for outpatients;


Light Care Unit
Radiology
Clinics
Pharmacy
Dietary
Administration
Second Floor
Nursing O B
Nursing
Delivery
Nursing
Intensive Care
Surgery
Third Floor
Light Care Unit
Outpatients
Clinics
Laboratory
Stores
Administration
Records
Visitors
Emergency
Supplies
Mechanical
Morgue
Emergency
First Floor

4.2.4

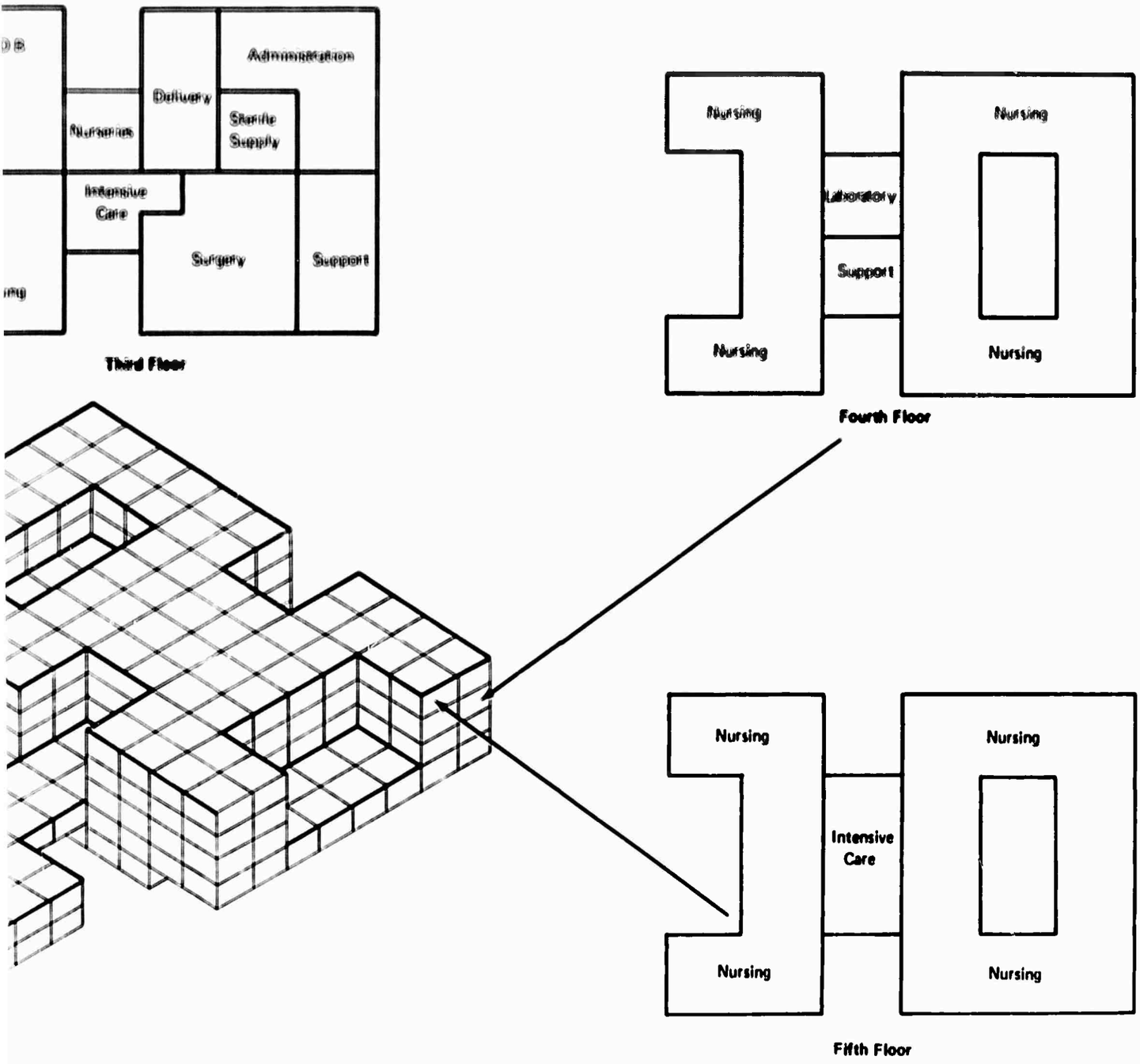
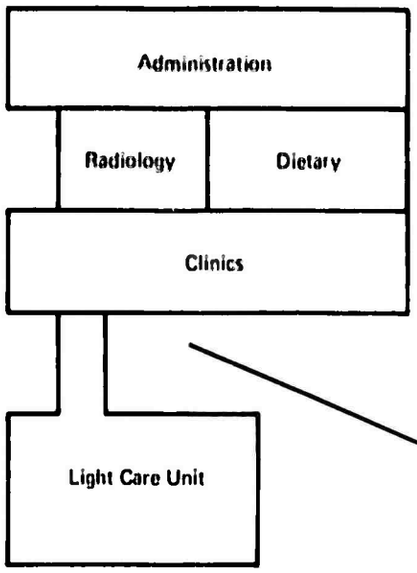
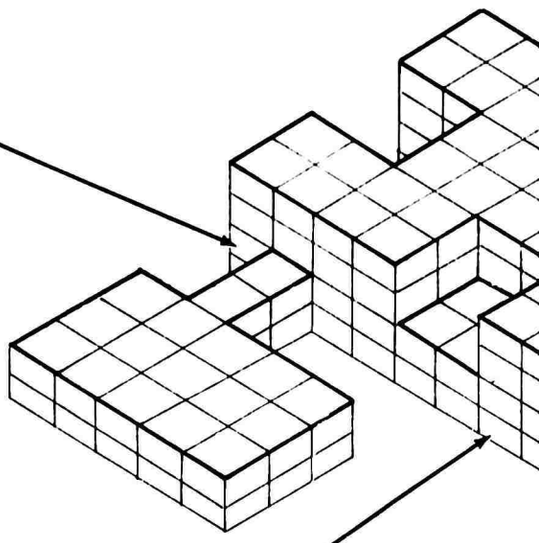
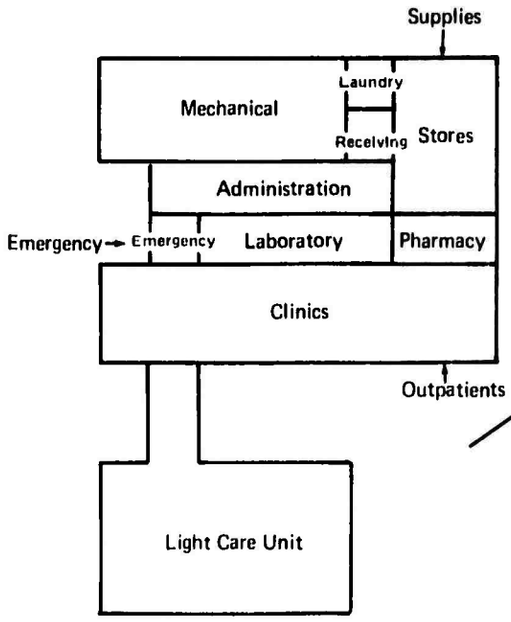


FIGURE 4.2.1 **FORM DIAGRAM FOR HYPOTHETICAL REDESIGN OF WALSON ARMY HOSPITAL**



Second Floor





First Floor

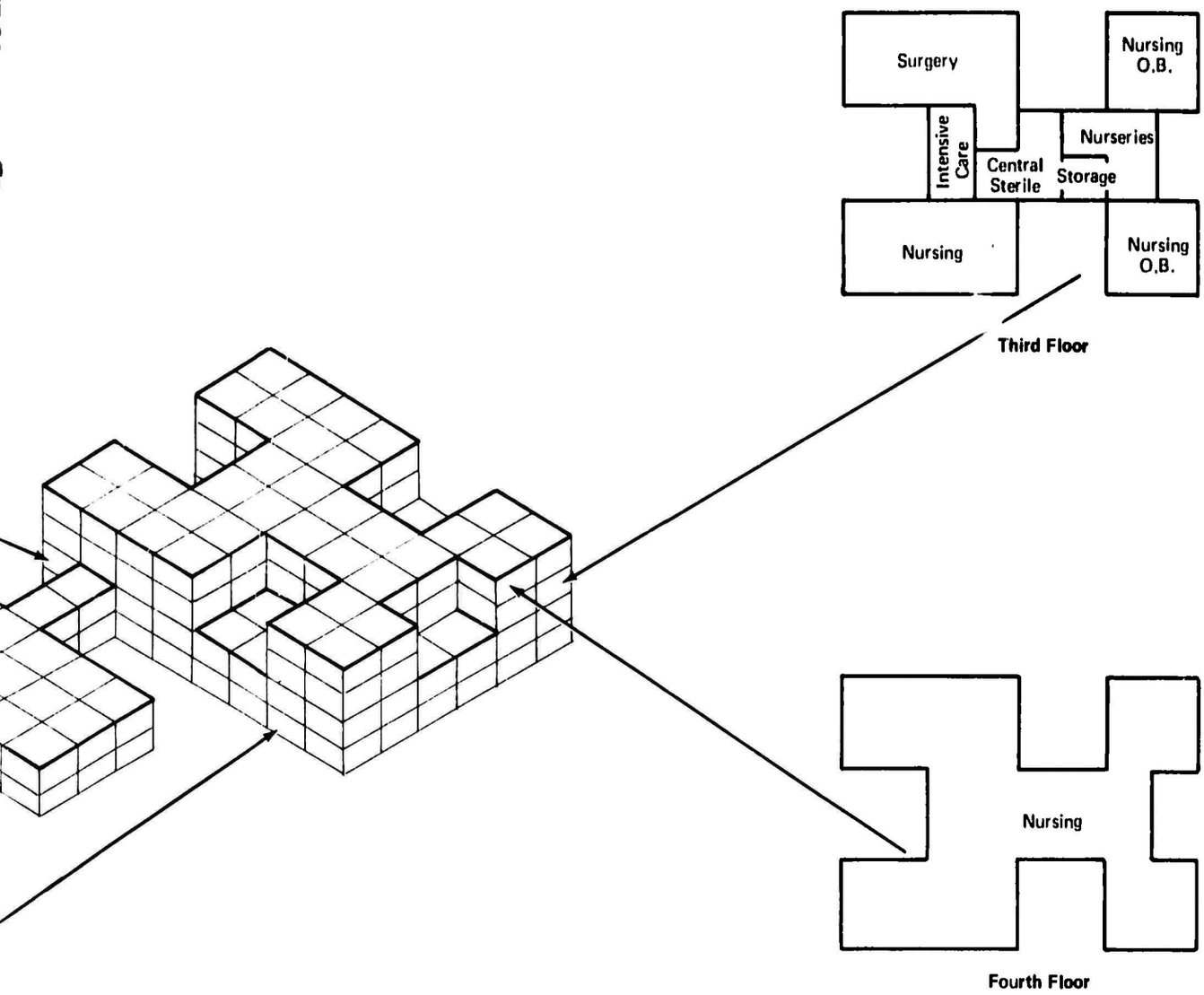


FIGURE 4.2.2 **FORM DIAGRAM FOR HYPOTHETICAL REDESIGN OF JACKSONVILLE NAVAL HOSPITAL**

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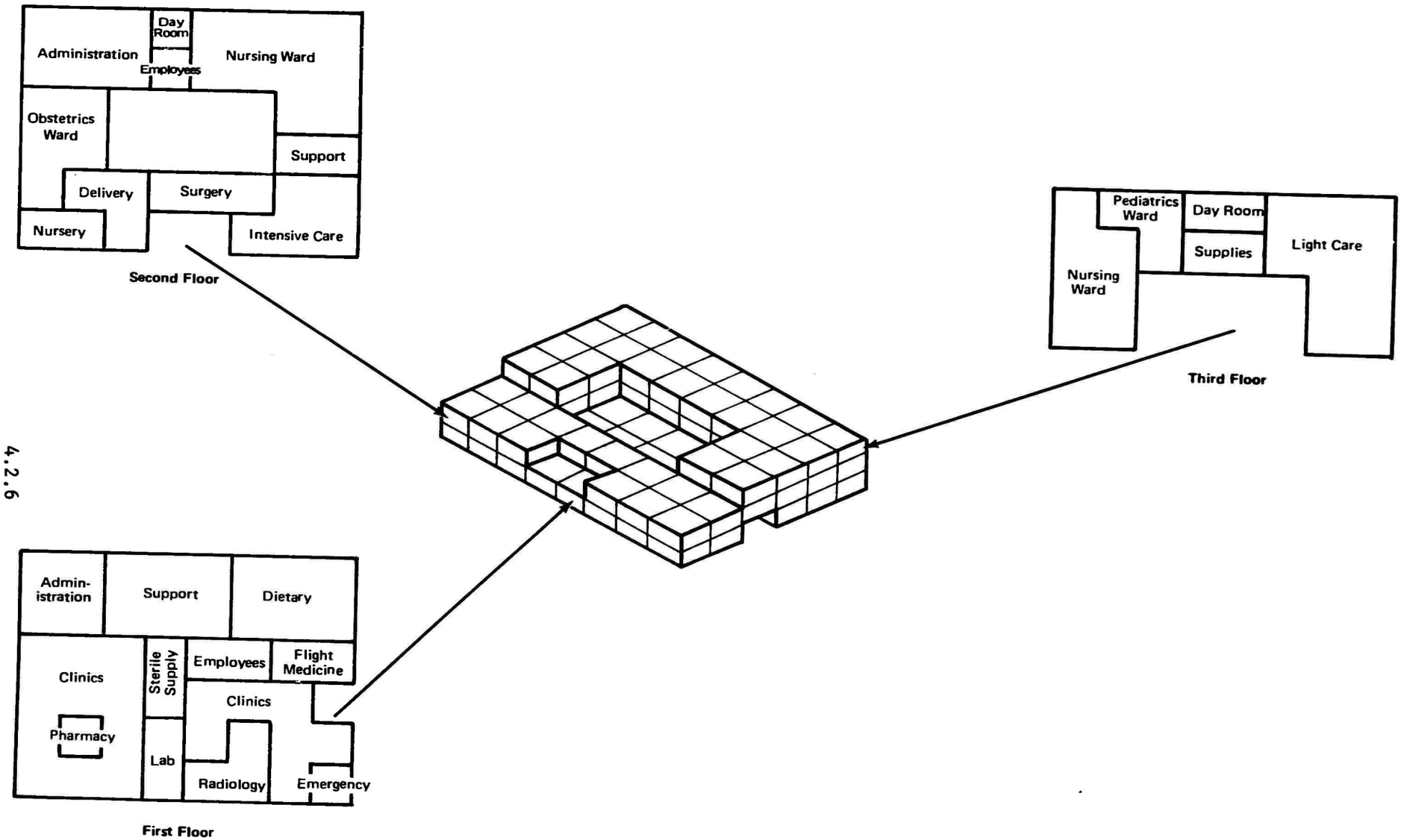


FIGURE 4.2.3 FORM DIAGRAM FOR HYPOTHETICAL REDESIGN OF MARCH AFB HOSPITAL

- Computerized inventory control in pharmacy and supply;
- Vacuum trash and linen collection;
- Total convenience food service;
- Television links between the hospital and at least one dispensary for remote consultation with specialists;
- A computer-based hospital information system for communication of clinical data (ordering and reporting) and inpatients' work charts, for records of patients' admissions, transfers and discharges, and for summaries and reminders;
- Computerized recording of schedules for outpatient visits and schedule print-outs;
- Computer aids for nurse duty-scheduling;
- Automated log-in and log-out of patient records (health record folder and X-rays); and
- Development of computerized report composition, history-taking, and aids to diagnosis.

4.2.3. EVALUATIONS AND EXPERIMENTS

The R&D program presented in the next section assembles those concepts which currently are insufficiently developed to enable us to be certain of their costs or ultimate benefits. Nonetheless, they are all innovations which have stood the test of scrutiny by health care professionals, and much of this report is taken up with examination of their potential advantages and disadvantages. When they reach the testing stage, either in the prototype hospital or elsewhere, their application should be regarded as experimental evaluation, and the results will surely include goals for adaptation and improvement.

Similarly, the concepts which already are sufficiently defined and developed will require evaluation. It is too soon to establish evaluation protocols, but the essential criteria for experimental evaluation are defined in each of the analytical evaluations contained in this report.

Since this evaluatory activity will extend over a period of at least two years and will be an addition to the normal operation of the prototype hospital, a permanent Evaluation Committee should be established. This committee will have the tasks of determining evaluation protocols, carrying out the experiments, collecting and analyzing the data, and reaching conclusions about the results. The committee should include at least the hospital commander, the hospital administrator, and representatives from OASD (Health and Medical, Systems Analysis, and Comptroller) and DDR&E. It has been abundantly proven in the course of systems analysis under this contract that adequate appraisal of new ideas for health care requires the points of view represented by many disciplines -- physicians, nurses, administrators, architects, facility planners, cost analyists, and engineers. A comparable group should make up the Evaluation Committee.

4.2.4. SCHEDULE

Figure 4.2.4 is a schedule of activities over the next four years as the "new generation" evolves. Included in this chart is the work already accomplished under our and Westinghouse's contracts, as well as subsequent activities involving additional research and development, planning and design of the prototype hospital, its construction, and finally evaluations of concepts embodied in the prototype after it has commenced operation some three and a half years from now.

Clearly, many of the innovations suggested in this report can be applied in other locations besides the prototype hospital. These include all of the new concepts which do not depend on structure, that is, those concerned with staffing and training, with new equipment like the fast analyzer and automatic drug dispenser, with most of the computer applications, and with convenience foods. Because occupancy of the prototype hospital is necessarily some time away, we believe that DOD will find it

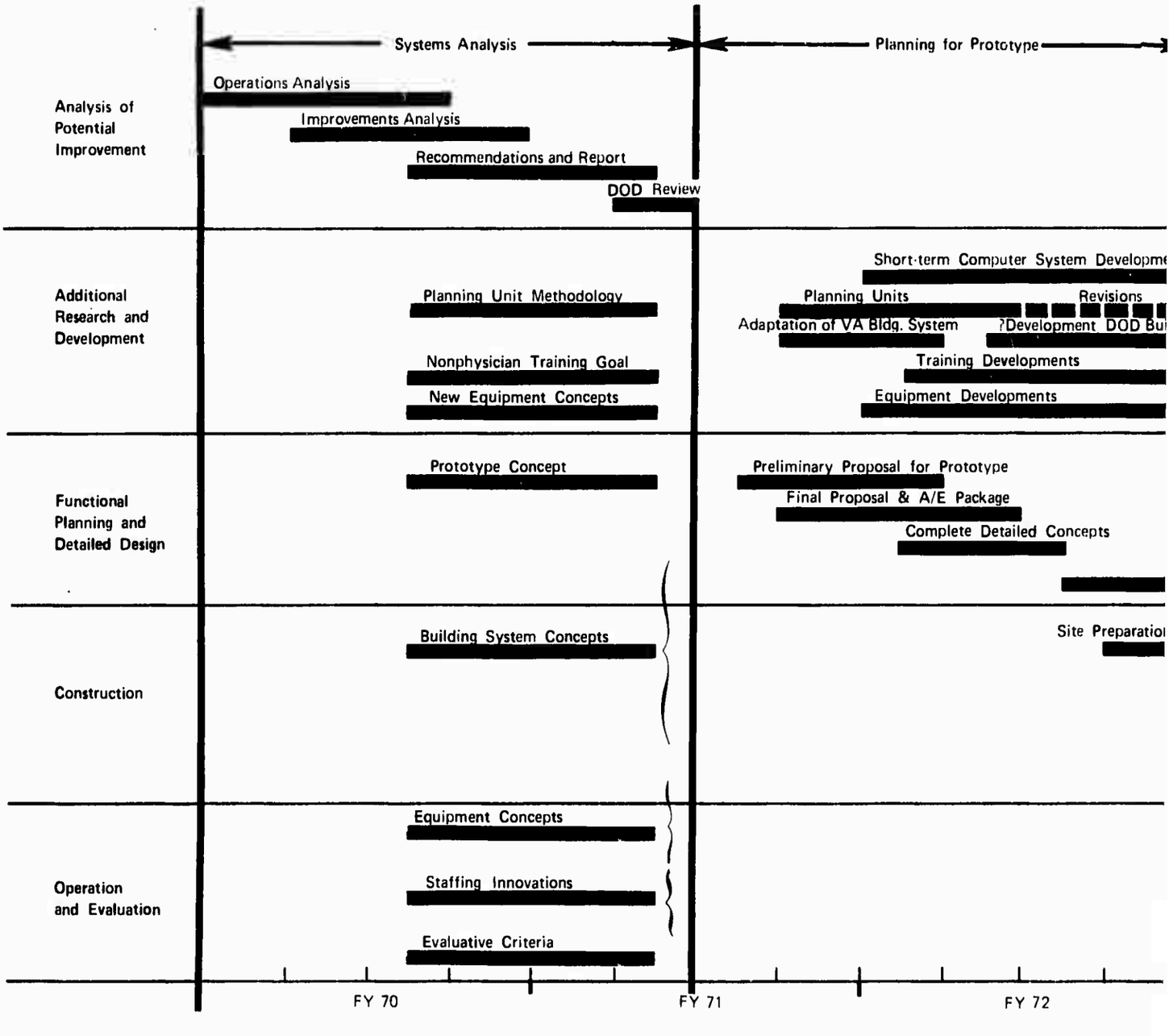
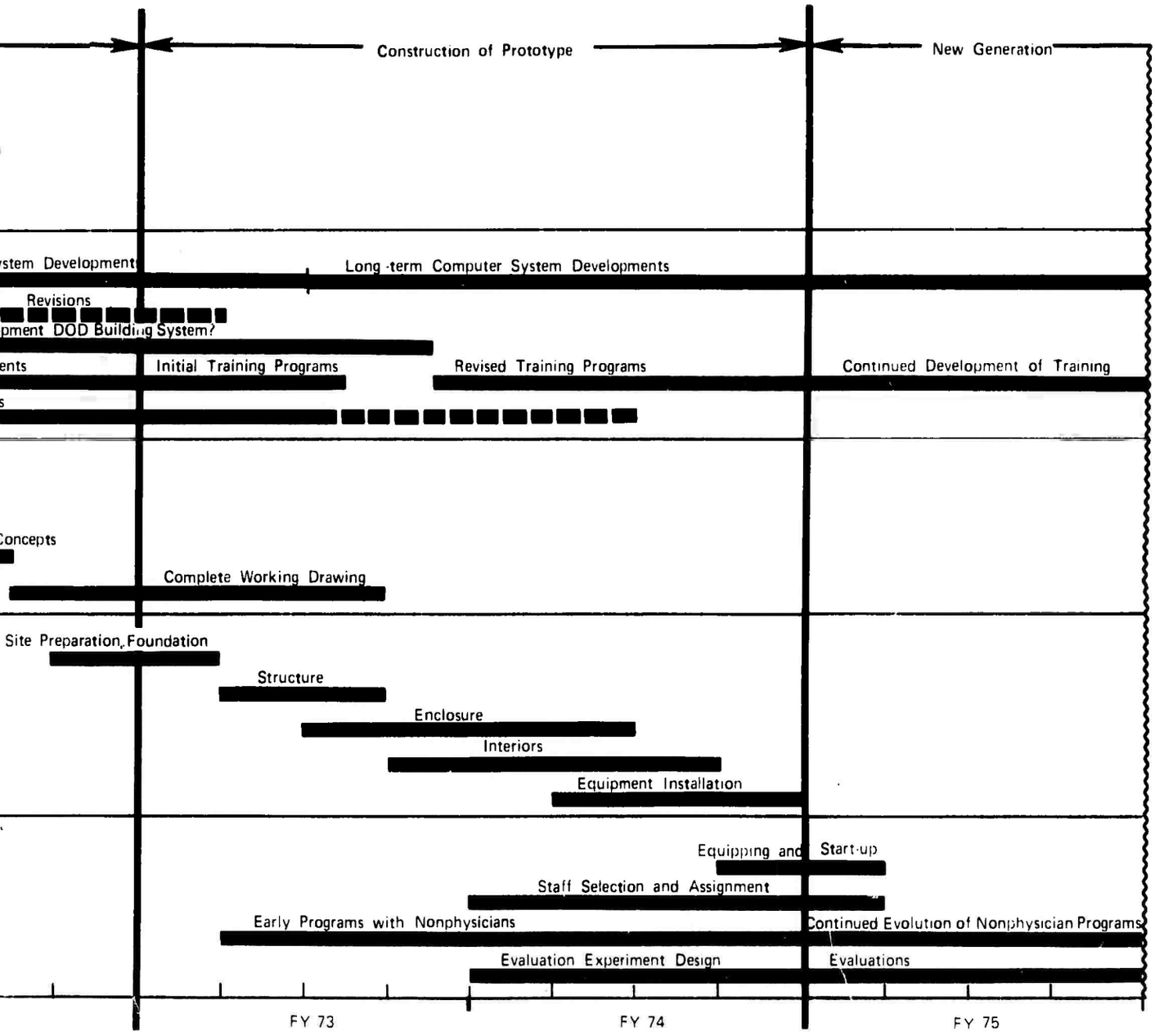


FIGURE 4.2.4 SCHEDULE FOR DEVELOPMENT OF "NEW GEN



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advantageous to introduce these new concepts elsewhere so as to obtain experience and practical evaluation as soon as possible.

4.3. MANAGEMENT INFORMATION AND INCENTIVES

4.3.1. INTRODUCTION

In our proposal we elaborated a scheme whereby more management information was to be collected using a computer and new incentives were to be introduced to motivate the hospital staff to maintain efficiency. Although we were unaware of it at the time, this was the goal of Project PRIME, which was initiated in July 1968. That project has stagnated for several reasons, and we are not at all confident that we have found workable alternatives to it. The reasons that PRIME failed, at least in the context of military health care, seem to be these:

- Military personnel serve relatively short tours of duty, generally no more than two or three years, at each station. As a result they are often not around long enough to recognize what needs to be done nor motivated to change things since they will soon be leaving.

- Very little of the money spent to provide health care and health care services is under actual control of the local base: personnel are assigned from Washington, visiting teams determine staffing levels, civil service employees cannot be fired except for gross dereliction, and the hospital is charged with treating all comers who are authorized to receive care.

- Measures of productivity -- such as the composite work unit, which combines inpatient days, admissions, births and outpatient visits-- are unconvincing as a reflection of the actual workload.

- To prevent abuse, regulations usually forbid reallocation of money in the hospital budget as needs change.

- Ultimately, enthusiasm for PRIME flagged at the highest levels in DOD.

Basically, we believe that DRGM was on the right track, but we recognize that the conditions which led to its failure are not easy to change. The overall goal must be to place more responsibility for performance and allocation of funds at the local level. The VA Bronx has done this more completely than the others surveyed without any improvement in the cost of providing services. However, this procedure may yet bear fruit when combined with more stable levels of duty and frequent explicit comparison of each department's cost per unit of service (e.g., dollars per X-ray exposure, for radiology or dollars per laboratory procedure) with its own historical performance and with that of other military hospitals.

In the next section we comment briefly on a management information system. Following that, we present some recommendations related to incentives.

4.3.2. MANAGEMENT INFORMATION SYSTEM

The registrars' offices in military hospitals now compile extensive statistics on workload and cost. In principle, these statistics form the basis for businesslike management, but incentives and authority for using them in this way are weak.

At the time we believed that military hospitals should attempt to combine their fiscal data, which are presently computerized, with operating data, which will be computerized when a hospital information system has been developed. Having reviewed the state of the art in hospital information systems, however, we believe the day when this marriage can be brought about is still some years away. In any event, the problems of providing incentives and authority to respond to management information remain unsolved.

For these reasons we believe that it is premature to set about developing a full-scale computerized management information system for the "new generation" of military hospitals. When a working hospital information system has been developed, the accumulation of operating statistics will be a trivial extension. The accumulation of cost data by cost centers defined in the functional cost analysis (Volumes I and II) is already being done. It is clear, however, that accounting is not uniform in the

services nor even consistent within the services. (An examination of functional cost allocations reveals discrepancies which reflect varying definitions of budget categories.) Computing performance figures -- i.e., cost per unit of service -- can as well be done by hand as with a computer system, and we think that this will continue to be satisfactory for the foreseeable future. Our basic concerns, as we have said, are that the computerized system should be built up gradually and that modifications to authority and incentives must come before management data will have much meaning.

4.3.3. INCENTIVES FOR INCREASING PRODUCTIVITY AND LOWERING COSTS

In the course of this study, two members of our staff, a psychologist and a former hospital administrator, undertook extensive interviews with military health care personnel to elicit their attitudes and motivations in their jobs.

The personnel interviewed were as follows:

	Career	Non-career	Total
Physicians	28	32	60
Nurses	33	26	59
Corpsmen	25	27	52
Medical Administrators	21	18	39

The following recommendations are based upon these interviews and are made in an effort to increase motivation, both within the existing system and the "new generation" of military hospitals, to maintain or improve standards of health care at decreased cost. A number of these recommendations have arisen in other studies as well, and the services have begun to adopt some of them.

4.3.3.1. Financial Incentives

As matters stand, incentives are mainly psychological, although there are cash awards for suggestions. We recommend that each hospital department have a cost-center budget and that any cost savings per unit of service be shared with the department. The following model might serve as an example: if a departmental budget shows a savings of $20,000,

then $15,000 would be returned to the Department of Defense, $3,000 to the base hospital, and $2,000 to the department itself to be used in circumscribed but selectable ways (e.g., new equipment, educational conferences, personnel recreation).

A committed budget, on the basis of an annual periodic capitation payment for all personnel for whom care is to be provided, should be allocated to the medical service, and this commitment should not be withdrawable. The relationship between the base commander and the military care system would then be analogous to an industrial plant contracting for medical services. The authority to allocate funds within the base-level health care system would then be at the discretion of the hospital commander.

4.3.3.2. Physicians

A good deal can be done, we believe, to decrease the amount of dissatisfaction among military physicians. Increased satisfaction would result in better and more efficient production, as well as a higher retention rate, which would in turn result in cost savings.

Physicians' assignments should reduce duties for which they are overtrained or which do not reinforce their professional role, such as unduly large amounts of paper work (which can be relieved by a hospital information system) and primary screening work in the dispensaries (which can be relieved by expanding the role of nonphysicians).

Except during national emergencies, physicians should stay in one place for longer periods -- say, four to five years. Dissatisfaction did not appear to arise so much from moving frequently (although in many cases this was indeed a major cause of dissatisfaction) as from uncertainty about the location of the next post. Some uncertainty is inevitable in the Armed Forces, but this could be reduced.

Under the present system, advancement through the ranks tends to remove a physician from patient care. It should be made a matter of choice whether a physician becomes mainly an administrator or mainly involved in patient care. Many physicians do not wish to remove themselves from patient care to the extent that higher rank requires.

4.3.3.3. Nurses

At one time, recruiting nurses for military service was fairly easy. This is no longer so. In the civilian sector, the Florence Nightingale mystique has largely disappeared and has been replaced by an increased sense of professionalism, which finds expression in nursing specialization and a concentration on technical competence. A similar change is evident in military hospitals, and it should be fostered.

Nurses' duties should be clearly delineated and separated from administrative, messenger, and janitorial activities. Unit managers and ward clerks will help in this respect. Later on, a hospital information system will also contribute to freeing nurses from all nonprofessional duties.

4.3.3.4. Medical Service Officers

Just as the main incentive for physicians and for nurses is to be able to practice the career they have chosen, with as little interference as possible, the incentive for the medical administrator is to run his department in the best possible way with as much independence as is feasible.

Additionally, the medical service officer should be given a greater opportunity to pursue further education in his field with fewer delays than exist in the present system. Long delays result in losing many capable young men who would otherwise be retained.

An increasing number of women are entering the field of medical care and hospital administration. This fact leads us to suggest that medical service officers be recruited from nurses now in the service as well as from women who might make the military their career in return for a good training program.

4.3.3.5. Corpsmen

Use of paramedical personnel is increasing in civilian medical practice, allowing the physician more time to care for patients in need of his skills.

Many corpsmen have had extensive training and experience in the military and, as we have elaborated in Section 2.4. can certainly be used as physician assistants. Suitable career ladders would be of great importance in extending the role of corpsmen and nurses as physicians' assistants. Such ladders are already under development in the Army.

4.4. FUTURE RESEARCH AND DEVELOPMENT

4.4.1. INTRODUCTION

Aside from experimental evaluation of innovations in the prototype hospital, we have identified a number of other innovations which will require additional research or development before they are ready for evaluation. The original request for proposals spoke of short-term developments (that is, ones which could be carried out in 18 months or less) and long-term developments (that is, ones which could be carried out in periods between 18 months and five years). Therefore, we have classified each R&D effort in one of three categories:

- Short term (less than 18 months),
- Short term but continuing (that is, initial results can be available within 18 months but revision or extension will be required thereafter),
- Long term (18 months to five years).

All of these requirements for future R&D have been identified elsewhere in this report in connection with the various innovations under discussion. They are summarized here to give a coherent view to an overall R&D program to improve military health care.

If an R&D program were initiated soon, the short-term developments could be available for installation and evaluation in the prototype hospital about the time it is scheduled to open. We believe that this should be the goal.

4.4.2. COMPUTER SYSTEM DEVELOPMENTS

Our basic belief is that it is premature to develop an integrated management information system, and that various computer developments should be pursued independently with the expectation that some of them will be combined later on. We expect most of these developments to take place in the prototype hospital, though this is not entirely necessary. Doing the development in one place has the advantages of making the prototype a showplace for innovation, making the development program easier to manage, and assembling innovative people whose day-to-day contact may stimulate greater creativity.

Automated communication system for clinical data (short term but continuing). This program requires development of specifications for all the functions described in Section 2.5.7. The development should be undertaken with one of the suppliers already established in the field, of whom the front runners are National Data Communications and Lockheed Information Systems (This field is changing so rapidly, however, that all the suppliers listed in Section 7.5. should be considered.) The goal should be installation of a computer-based communications system in the prototype hospital. After the hospital has opened, an evaluation program will be required to establish the shortcomings and specific benefits of the system. While it will be natural to adapt one of the existing systems DOD's requirements are sufficiently different from civilian hospitals to preclude taking one off the shelf. Furthermore, we anticipate that considerable additional development will be required following the first installation in the prototype hospital.

Automated appointment scheduling (short term). This requires development of a computer program for scheduling of outpatient visits to the clinics. It would replace the manual files now in use in telephone centers and would provide CRT displays for the telephone operators and printed schedules for physicians. It can be part of the communications system.

Nurse duty scheduling (short term). This requires development or adaptation of a computer program for scheduling nurses for duty. Such programs have been developed already, but they need adaptation to the military situation. A scheduling program is run only occasionally -- typically it might produce a schedule for the month ahead but it would also have to be run each shift to take account of the actual patient needs and nurses actually available.

Automated inventory keeping for supplies (short term). This requires development of record keeping, stock ordering and usage programs for sterile supplies and general supplies.

Pharmacy computer system (short term but continuing). This requires development of computer drives for automated dispensing discussed below and in Section 7.3. In addition, it should maintain pharmacy

inventory and work should be undertaken on a program for compatibility checking. The latter will, of course, require continual updating and may take longer than 18 months to develop.

History-taking (long term). This requires development of new patient history records and a suitable branching questionnaire to go with them. Some work has already been done in this area, and it would be prudent to take advantage of it. The major problems are medical and lie in defining questions so that the reported history is useful to the military services for patients with and without complaints.

Report composition (long term). This refers to development programs which allow physicians in each specialty to compose reports by selecting phrases or inserting short pieces of data. The major problems are medical and lie in devising the phrases and requests for data. The experimental computer system can be combined with development of history taking programs.

Computer-aided diagnosis (long term). This requires developing programs to aid in reaching diagnoses. Such programs will have to be built up gradually from various medical specialties concentrating in specific areas such as coronary disease, pulmonary disease, orthopedic ailments, etc. The experimental computer system can be combined with history taking and report composition.

4.4.3. EQUIPMENT DEVELOPMENTS

In the course of our review of the state of the art, we have identified three items of hardware which can enhance military health care.

Multichannel fast analyzer (short term but perhaps continuing). In Section 7.6. we described a fast (GeMSAEC) analyzer for clinical chemistry, which permits almost instantaneous reporting of results. The basic concept is complete, although the cost estimates should perhaps be refined. Unless initial development proves harder than we presently contemplate, such an analyzer could be made available for the prototype hospital when it opens, where its practical utility can be evaluated.

Automated dispensing machinery for drugs (short term). In Section 7.3. we described equipment for dispensing about 200 commonly used drugs, chiefly for outpatient prescriptions. Such equipment presents no

essentially new requirements, and the major uncertainty is its cost and ultimate benefit. Such a system could be developed for the prototype hospital where it could be evaluated.

Record locator system (short term). The logical operation of this system, referred to in Section 7.5., would be combined with the computer-based communication system. To be developed is a way of identifying a label on a record either optically or magnetically by passing it manually through a reading device, which notes whether the record is being logged in or out and, if it is being logged out, its destination.

4.4.4. TRAINING DEVELOPMENTS

Extending the responsibilities of nurses and corpsmen as we have described in Section 2.4. will require additional training not only for the nonphysicians but for the physicians who supervise them as well. Similar remarks apply to dental assistants. These innovations are quite unlike equipment developments, and the use of nonphysicians should be regarded as an experiment. We expect that it will be some time before a completely acceptable program has been devised. The new training developments necessary apply to each of the skill categories identified in Section 2.4. (generalist corpsman, orthopedic/podiatry specialist, respiratory disease specialist, GU/GI/dermatology specialist, pediatric nurse practitioner, obstetrics nurse practitioner, chronic disease nurse practitioner, and dental assistants). Each can and should be developed by the time the prototype hospital opens, but further development will clearly be necessary as experience evolves.

Development of job descriptions, experience requirements, screening tests, and career ladders (short term but continuing). In Section 2.4. we have made a beginning on all of these matters for the various kinds of nonphysicians. However, there is a need for additional development, which is likely to be different (at least in some respects) for the different services since the original training and experience of candidates for this program and the range of complaints presented by patients are different. We have remarked that career ladders should extend to warrant officer ranks (or some equivalent), and it is not inconceivable

that, as comparable civilian programs spread, such experience may count toward an M.D. degree.

Development of curriculum content (short term but continuing). Again, in Section 2.4. we have outlined some of the curriculum content and duration of additional training necessary for these new jobs. However, the curricula require further development, again different for different services.

Development of standing orders and guidelines for management of diagnoses or problems (short term but continuing). Closely related to curriculum content are the rules under which nonphysicians will practice. There are many approaches possible, but two different approaches seem attractive and could be done simultaneously. One would be to write job descriptions, curriculum content, and guidelines which physicians responsible for the program feel are proper. The other would be to define a few "cases" or diagnoses that the corpsmen should work with, under close supervision, and do a critical incident and job analysis of what a prototype did. One would observe closely how and what a dermatologist, say, taught a corpsman to do for each disease in question and what he refused to let him do. Then a content analysis of this experience should be done. By combining both approaches -- theoretical and real-preceptorship -- it should be possible to avoid some of the problems of relying on either one alone.

Development of management training for physicians (short term but continuing). We have observed in Section 2.4. that physicians who participate in programs utilizing nonphysicians will require certain skills and knowledge not normally a part of medical training. These include pedagogical techniques suitable for the physician as a preceptor, principals of organization and management, practice with group dynamics, and some knowledge of quality control and audits. Furthermore, we believe that at first, anyway, physicians who believe in the efficacy of a program to use nonphysicians must be selected. Developing selection criteria and curriculum content is required.

Development of a problem-oriented record (short term but continuing). The problem-oriented record is described briefly in Section 7.5. and elaborated in Reference 1 of that section ("Medical Records, Medical Education, and Patient Care," by Lawrence L. Weed, M.D.). The original

impetus for the concept came from an attempt to computerize patient records, but the essential feature is insistence on explicit management of every problem noted. As such the problem-oriented record is precisely the right tool for less highly trained nonphysicians to use in disease management and for their preceptors to use in review and guidance. The Automated Military Outpatient Study (AMOS) is a promising effort currently under way in this direction.

4.4.5. BUILDING SYSTEMS AND PLANNING PROCESS DEVELOPMENTS

In Volume 3 a number of innovations to the planning process have been presented. Making them work in DOD is, we believe, both feasible and desirable. Many of the innovations described in Volume 3 fall under the rubric of building systems. In Volume 9 we reviewed all existing building systems of which we were aware and potentially applicable to DOD hospitals. We concluded that for the prototype hospital the system currently under development by the Veterans Administration offered the most promise. This conclusion was based not on a belief that the VA system is the best imaginable but on the belief that it is well-conceived and the fact that it will be available in time for construction of the prototype to begin on schedule. There is no reason, of course, why DOD cannot develop a building system for hospitals of its own, but if it elects to do so, it should regard it as a long term development.

Review of compatibility of VA system with DOD needs (short term). DOD hospitals differ from VA hospitals in several respects: the kinds of patients are different, requirements for clinics and support facilities are different, and typical locations are different (DOD hospitals are often remote from cities; VA hospitals almost never so). Our review of the VA system, which is still under development, did not reveal any incompatibilities with DOD requirements, but this question needs further exploration before adopting the VA system for the prototype hospital.

Development of DOD building system (long term). Conceivably, DOD user needs are sufficiently different from others to require development of its own building system, though we have no reason to think so. Or DOD may wish to develop its own system as an improvement on existing alternatives. This is a long-term R&D project which should be based on the principles enunciated in Volume 9.

Development of planning units and project summaries (short term but continuing). In Volume 3 planning units (normalized elements of operating data and facility requirements) were introduced. Several examples were given, but, if this composition of planning information is to be used, planning units for all elements (departments or other parts) of hospitals, light care facilities, and ambulatory care centers must be developed. It is crucial that revision continue after initial development; otherwise, planning units will simply be straitjackets on innovative design, much as the BOB guidelines have become.

Extension of RELATE program (short term). The RELATE computer program (RElationship LAyout TEchnique) described in Volume 6 is a useful tool for arriving at building forms which satisfy reasonably well requirements for physical proximity of departments. It uses a user-generated "affinity matrix" as the primary input. There are several extensions to RELATE which can enhance its usefulness. One is to develop rules for generating affinity numbers based upon measurable data such as flows of people between departments, flows of materials, and flows of information. A second is to add a graphics generator which produces the form diagram directly in isometric views.

4.4.6. LONG-TERM RECONSIDERATIONS

Our analysis has led us to discard certain innovative concepts which originally appeared attractive but ultimately proved to be undesirable. As the discussion in Section 1.4. on the future of military health care makes clear, there are many circumstances which could invalidate our conclusions. This is especially true of the negative conclusions. Therefore we recommend that long-term (say, five years) reconsideration to our conclusions be given. New and unforeseen technological developments, a shift in cost of labor, national health insurance, or reorganization of the military services could all change the economic balance on which our conclusions were based. The concepts which deserve this reconsideration are:

- Multiphasic testing,
- Disposable linens,
- Automated materials handling, and
- Automated patient monitoring.

Table 4.4.1 summarizes future research and development.

TABLE 4.4.1
SUMMARY OF FUTURE
RESEARCH AND DEVELOPMENT

COMPUTER SYSTEM DEVELOPMENTS	
Automated communication system for clinical data	S+
Automated appointment scheduling	S
Nurse duty scheduling	S
Automated inventory keeping for supplies	S
Pharmacy computer system	S+
History-taking	L
Report composition	L
Computer-aided diagnosis	L
EQUIPMENT DEVELOPMENTS	
Multichannel fast analyzer	S+
Automated dispensing machinery for drugs	S
Record locator system	S
TRAINING DEVELOPMENTS	
Job descriptions, experience requirements, screening tests, and career ladders	S+
Curriculum content	S+
Standing orders and guidelines	S+
Management training for physicians	S+
Problem-oriented record	S+
BUILDING SYSTEMS AND PLANNING PROCESS DEVELOPMENTS	
Compatibility of VA system with DOD needs	S
DOD building system	L
Planning units and project summaries	S+
Extension of RELATE program	S
LONG-TERM RECONSIDERATIONS	
Reconsideration of discarded concepts	L
EVALUATION COMMITTEE	
Evaluation of innovations in prototype hospital	L

LEGEND

S: Short-term development (less than 18 months)
S+: Short-term but continuing development
L: Long-term development (18 months to five years)

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