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ABSTRACT

The major objective of this project was the preparation of instructional packets for vocational orientation at the elementary level. A developmental workshop and related seminars on this theme involved five teachers, two counselors, and a principal, all for the elementary grade levels, in addition to various state agencies and educational personnel in a year-long exemplary project. About 56 occupational modules were developed, and 38 were tested in the participants' schools and other pilot Arkansas schools. The materials were reproduced in booklet form after necessary changes, revisions, and evaluation. Occupational information was secured by interviewing students, parents, and local employees and used in preparing these integrated career awareness packets for a social studies curriculum. Audiovisual aids, bibliographies, and resource materials were gathered and reviewed prior to statewide dissemination of the packets for use by elementary teachers during the 1972 school year. A teaching guide resulting from this project will be used in local pilot programs in vocational education for small Arkansas schools at that time. (AG)

THE DEVELOPMENT OF VOCATIONAL ORIENTATION PACKETS FOR USE BY TEACHERS IN THE ELEMENTARY SCHOOLS

Project Number: C7121 PL 90-576

FINAL REPORT

August, 1972
Department of Education
Division of Vocational, Technical and Adult Education
Little Rock, Arkansas

FINAL REPORT

Project #C7121 PL 90-576

Project Title: The Development of Vocational Orientation Packets for Use by Teachers in the Elementary School

Director: Grady Knight
Coordinator of Program Planning, Evaluation and Exemplary Programs
Division of Vocational, Technical and Adult Education
Department of Education
Little Rock, Arkansas

Project Leader: Mrs. Delma Turner
Supervisor of Elementary School Guidance
Department of Education
Little Rock, Arkansas

Duration of Project: May 1, 1971 - June 30, 1972

The Problem: Youth in the elementary grades are regarded as very impressionistic and in general, through contacts with their parents and teachers, acquire certain concepts and ideas regarding careers (work) that may affect them throughout their lifetime. The cry for relevancy in the public school curriculum suggests that there are certain inadequacies in the present system and suggests the need for some adjustments or changes. As educators face the charge for reorientation of the education system, it is very possible, and has been strongly suggested by many groups, including the Federal Congress, that the development of a system of vocational (career) guidance and vocational education can bring about the development of a sub-system in the education program, reaching from kindergarten

throughout the work life of an individual.

It has been suggested that one of the goals for vocational guidance in the elementary curriculum is to develop in all youth respect for all work and that this concept become one of the basic elements of the educational curriculum in the elementary school. It is not to be implied that youth should make an occupational choice at the end of elementary school, but rather that they develop attitudes toward work that will enable them to make decisions at a later time with, hopefully, an open mind. A Task Force on Vocational-Technical Education, established in one of the major cities in the country, concluded in its report that there is a need for career (occupational) orientation and exploration during the early years of school. The report suggested that exploration of the world of work ought to begin at the kindergarten level and be an integrated part of the curriculum through all grade levels. The group further recommended that each student should be given a realistic concept of the actual content of all levels of occupations from unskilled jobs to semi-skilled and skilled craft levels, technical and service occupations, business and clerical occupations, through the professions. The report emphasized that the program should be structured and conducted without prejudiced opinions or value judgements as to the relative worth or importance of the various ways the citizens of this country make their contributions to society. A second goal which appropriately relates to the one just mentioned is to motivate all youth to want to take their place in the world of work. This goal suggests the concept of "do

something" rather than "be somebody." The "be somebody" complex may very well be one that causes parents to "force" their children into decisions that are not only unwise, but unreal, due to the implications of status. The "be somebody" complex suggests identity with positions providing social status to the individual and his parents - doctor, lawyer, merchant, chief. Are parents and educators willing to admit an obsession with the socially acceptable professions to the extent that all other occupations are reduced to a level of menial tasks and stripped of the pride of achievement that goes with such work?

People in the large city soon learn the importance of sanitation department workers when collections are stopped because of a strike or curtailed because of the lack of labor. People who accept welfare as a way of life lose the satisfaction that comes only with achievement through work. Work in itself is a means by which man earns his daily bread, earns self-respect and respect of others, and a self-discipline necessary for effective citizenship in a democratic society.

It isn't unreasonable to accept the premise that acceptance and implementation of a program of Vocational Orientation in the elementary school could develop in all youth respect for work and motivate them to develop a desire to want to find and accept their place in the world of work. To make a beginning and to offer assistance to teachers this project was focused upon the development of resource and instructional materials that are geared to youth at various grade levels in the elementary school.

The knowledge and skills of teachers, counselors, educators, and others representing the elementary school were utilized. The project was aimed at career orientation, and many persons who are now using the materials were involved in their development.

Objective of Project: The major objective of the project was the preparation of instructional units aimed at providing vocational orientation for elementary school children, grades one through six. This was done by involving elementary school personnel and other educational specialists who had expertise and experience in the preparation and use of vocational orientation materials or who were willing to give special attention to developing and trying out of such materials as a basis for the development of a career awareness book for statewide use.

Procedures: The project involved a workshop and related seminars on vocational orientation for elementary school children conducted under the direction of the Division of Vocational, Technical and Adult Education during the period of May 1, 1971, to June 30, 1972. A number of supporting agencies were involved, including Guidance Service of the State Department of Education, personnel from the University of Arkansas, public school personnel, and consultants.

The key participants were five elementary teachers, two elementary counselors and one elementary principal who assisted in the preparation of the materials, tried out the materials during the 1971-72 academic year, and assisted in the revision and refinement.

The major part of the developmental work was done through workshop activity during June and July, 1971. The participating personnel spent four weeks working together and in smaller groups on different grade levels developing the orientation materials.

During the first week of the workshop, the project staff was involved in orienting the participants to a career awareness concept focusing on the social studies curriculum. It was emphasized that career awareness was to be an integral part of the education structure rather than additional subject matter tacked on to the curriculum.

Muc'. of the second week was devoted to developing occupational modules to be used with the social studies curriculum. Occupational modules were developed which would be common to most communities in Arkansas. After several modules had been drafted by the participants, they were provided with guides for making personal interviews in their local communities. The third week was spent in their local communities interviewing parents of students and other employees working in typical occupations in that locale. These teachers were encouraged to use tape recorders when possible to secure occupational information for refining modules already developed and in developing additional ones.

The participants spent their final week in the Department of Education. During this week they reworked the occupational modules and made use of information collected in their home communities as well as information from textbooks to be used in

their local schools.

Upon concluding the workshop, the project staff devoted some four weeks to further refining the materials and coordinating bibliographies and support materials. Furthermore, the project staff reviewed all audiovisual aids in the Department of Education and resource materials provided by various companies for possible use by participants in the career awareness project.

Some 56 occupational modules were developed and 38 were compiled for testing. These materials were tested in the parent schools of the participants and the pilot schools participating in Arkansas' exemplary project. The teachers were involved in a series of meetings during the year regarding problems, changes, and revisions that should be made in the materials.

After all necessary revisions and changes had been made, two educators were employed to edit the materials prior to developing the final draft for printing. These two consultants were elementary administrators with considerable experience in teaching and supervising elementary teachers and were very helpful in preparing the final draft.

The revised materials were reproduced in booklet form and are being disseminated statewide for use by elementary teachers during the 1972-73 school year.

Evaluation: A simple evaluation instrument was used by participating teachers to check the effectiveness of the use of the materials upon students. The instrument was designed to ascertain the students growth in knowledge of occupations and their change of attitudes toward the various occupations. Results showed that students

who participated in the program were more knowledgeable of the world of work and had a better attitude toward "blue collared" type jobs.

Results: The materials developed were designed to help elementary teachers to integrate career awareness within the framework of the existing curriculum. All occupations were not included due to the lack of time and funds; however, resourceful teachers will develop additional units relevant to the businesses and industries in the local community. As a result of this project, a book titled "Elementary Teacher's Guide, CAREER AWARENESS" has been published. Copies have been mailed to all State Directors of Vocational Education. It is now being used in nine schools that are participating in an exemplary project entitled "Pilot Occupational Education Programs for Small Rural and Sub-Urban Arkansas Schools" and will be put to use in other schools during the 1972-73 school year. Copies are being mailed to elementary principals throughout the state.

DOCUMENT RESUME

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ABSTRACT

This report contains the results of a pilot test which represents the first complete field test of methodological work begun in October 1967 under a Federal grant for the purpose of job analysis in the health services. This 4-year Health Services Mobility Study permitted basic research, field testing, practical application, and policy involvement to be applied to 12 job titles in ambulatory patient care in a community health center. Persons interested in upward mobility, relieving manpower shortages, health manpower development, health education, or delivery of health services will find useful these extensive suggestions for career ladders with curriculum content necessary for sequential job development. Task descriptions are presented, in addition to job lattices, task sequences, and curriculum designs. Numerous tables, charts, and other resource materials present the data. (AG)

HEALTH SERVICES MOBILITY STUDY

Research Foundation, City University of New York

SUGGESTIONS FOR JOB AND CURRICULUM LADDERS IN HEALTH CENTER AMBULATORY CARE

A Pilot Test Of The Health Services Mobility Study Methodology

Research Reports Nos. 4 and 5

346 Broadway/New York City, New York 10013

SUGGESTIONS FOR JOB AND CURRICULUM LADDERS IN HEALTH CENTER AMBULATORY CARE

A PILOT TEST OF THE HEALTH SERVICES MOBILITY STUDY METHODOLOGY

by
Eleanor Gilpatrick

Research Reports Nos. 4 and 5

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CAUTIONARY NOTE

The reader should be aware of the fact that this document reports on the results of a pilot test of the Health Services Mobility Study's job analysis methodology. The task data collected were not subjected to normative evaluation and do not necessarily represent ideal performance levels. The results are therefore subject to review and revision before they are implemented.

Please note that this document reports on the HSMS methodology and a vast amount of field data. However, the document is not a method manual, nor are all the field data reproduced here.

Persons wishing to utilize the contents of this document are reminded that the material contained herein is copyrighted and subject to revision. Please contact the Health Services Mobility Study for further information on the method, on the data, or about use of this document.

The research reported herein was performed pursuant to: (a) a grant from the Office of Economic Opportunity, Washington, D. C.; (b) a Special Manpower Project contract with the Manpower Administration, U.S. Department of Labor under the authority of the Manpower Development and Training Act; and (c) a contract with the Health Services and Mental Health Administration, Department of Health, Education and Welfare.

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It would be impossible to fully acknowledge all the people who have been involved in bringing this pilot test to a successful conclusion. We wish to thank our Project Officers and the Federal agencies who had faith in us and supported our work, the staffs of the various health care institutions that permitted us to do preliminary testing, and the various consultants who contributed to the Knowledge Classification System and other aspects of the method. Our gratitude to them is very great. Special thanks go to the HSMS staff, as well.

We would like to specifically acknowledge the help of Dr. Earl E. Davis, our Chief Consultant, who contributed the major technical content of our methodology and who was responsible for evaluating it. The HSMS staff directly involved in the pilot test included Irene Seifer, Senior Research Associate, who was responsible for training the HSMS field team in use of the method and led the field work. The field team included Albertine Brown, Sharon Donenfeld, Lynn Jackson, Manual Ramos and Fred Sack. Jeff Koeppel and Paul Corliss carried out the curriculum overlap work. Data processing was carried out by Paul Corliss with the assistance of George Squillace. Stephen I. Jasik designed some of the special computer programs which prepared the data for later factor analysis. Julia M. Caldwell and Raye Rush provided the support work.

Our very special thanks go to Dr. Regina McCormack who, while on leave from the University of Virginia, became interested in our work and its relevance to the needs of the Dr. Martin Luther King, Jr., OEO Health Center. Because of Dr. McCormack's interest and faith we were invited to conduct our pilot test at the Center. Dr. William Lloyd, the Center's Project Director, and the staff at the Dr. Martin Luther King, Jr. Health Center gave us unstinting cooperation and encouragement in spite of very heavy work pressures. We hope that our results are sufficiently utilizable to have made their efforts worthwhile.

Our thanks also go to the following program directors who reviewed our task data in connection with the curriculum overlap analysis reported in this document. They include Dr. John Sandson, Professor of Medicine at the Albert Einstein Medical School; Sister Miriam Kevin, Associate Director at the St. Vincent's School of Nursing; Professor Harriet Levine, Program Director of Nursing at the Staten Island Community College; Mr. Clarence Modeste, Program Director, School of Radiologic Technology at Columbia Presbyterian Medical Center; Mrs. Ruth Knapp, Program Director, Helene Fuld School of Practical Nursing, Hospital for Joint Diseases and Medical Center; and the Training Staff at the Dr. Martin Luther King, Jr. Health Center.

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PREFACE

The Health Services Mobility Study (HSMS) has had the unique privilege of being funded to develop a methodology for job analysis over a period of four years. This has permitted basic research, scientific field testing, practical application and policy involvement. The Study is sponsored by the City University of New York (CUNY) through its Research Foundation and the Hunter College Institute of Health Sciences. The Study's Director, Dr. Eleanor Gilpatrick, holds the rank of Associate Professor at the Hunter College Institute of Health Sciences.

This Report contains the results of a pilot test which represents the first complete field test of methodological work begun in October, 1967, under a grant from the Office of Economic Opportunity. The Study was subsequently funded jointly by the Manpower Administration of the Department of Labor, the Health Services and Mental Health Administration of the Department of Health, Education and Welfare, and the Office of Economic Opportunity.

The reader will note that the Report is listed as Research Reports Numbers 4 and 5. The original plan was to have separate reports on the job ladders and on the related curriculum ladders. However, once the analytical work was near completion, it became apparent that the two parts are too intimately intertwined to be presented as two separate documents. Since Research Reports Numbers 4 and 5 constitute the "Final Report" contracted for with the Health Services and Mental Health Administration, the designation has been retained in the title.

CHAPTER 1

INTRODUCTION

This is a report on the first pilot test of the Health Services Mobility Study's (HSMS) method of job analysis. After several years of preparation, development, testing and revision, the method has been applied to twelve titles in ambulatory patient care in a Community Health Center.

There are two sets of results. The first set indicates that the methodology can be applied and that it "works." The second set of results are based on the specific content of the test data. We are able to report on the task content of several possible job ladders and to recommend the curriculum content of the education needed for the sequences.

This report will be of interest to several types of audiences. First, as a report on the methodology, it will be of interest to anyone concerned with providing upward mobility and/or relieving upper level shortages. Second, for those concerned with providing upward mobility within patient care, the actual content of the pilot test titles and tasks and the recommended ladders have generalizable relevance. Third, for those concerned with providing the education for health care occupations, the skill and knowledge content of the results will also provide informative and suggestive insights. Finally, anyone interested in health care service delivery or in health manpower should find something of interest in the Report.

ORGANIZATION OF THE REPORT

This document reports on an enormous amount of data. To provide the most readable and interesting format, much of the raw data, which would require several volumes, are not presented. The reader will be able to obtain raw data to meet his needs by contacting the Health Services Mobility Study. The Appendix tables provide most of the background data needed for the reader who wishes fuller elaboration of the statements in the text.

Chapter 1 tells the reader about the approach of the Health Services Mobility Study and sets the methodology within a framework of current manpower problems in the health services industry. It also provides a summary of the pilot test results.

Chapter 2 describes the HSMS methodology as it was applied, and presents a description of the pilot test and the titles it covered. Chapter 3 discusses the general results of the pilot test and their implications. Chapter 4 goes into greater detail and presents the actual task sequences identified by the method and the related curriculum content requirements. Chapter 5 talks about practical application of the results in job restructuring and curriculum, assuming no desire for major reorganization. Chapter 6 discusses more idealized applications of the results and presents job ladders that require job restructuring and redesigned curricula, assuming a willingness on the part of the institutions to undertake major reorganization. Chapter 7 makes some final comments on general policy and describes the spin-off applications of the method in performance evaluation and curriculum design.

BACKGROUND

It can be said about the American economy that more and more jobs within it require specific training, and that proportionately more items purchased in the market place are services rather than goods. The health industry, which produces health services, is the most dramatic embodiment of such market shifts. Not only has the rate of technological change in health care been rapid, but the demand for health care has risen in major proportions, while the supply of health care manpower has been critically short and more and more in need of specific training.

In a classical labor market the changing conditions of demand would have resulted in a shift of manpower to fill the changing manpower needs of the industry. But this has not occurred because the market in health manpower has not been a classic one. To begin with, it is only recently that health services have been viewed as the products of an industry which must allocate scarce resources efficiently or pay the economic consequences. Second, while health care delivery institutions have tended to develop internal training for the manpower needed to utilize the new technologies, the new functions have been immediately hedged with credential barriers such as licensure or certification, and professional associations have sprung up to guard the new titles, regardless of the relationship of the new functions to existing functions. As a result, there is a proliferation of credentialed health care occupations which overlap and duplicate functions. Because they are credentialed, these titles generally require formal, accredited training. The training in each case

assumes no prior experience or training in health care, and, therefore, there is the probability of enormous overlap across educational programs.

The proliferation of credential barriers has not stopped institutions from adapting actual job functions to internal needs. The results of both is the fact that almost all health occupations are dead ends. Not only is the aide locked into a title; the nurse, the cook, and the internist are also at dead ends. For the individual to be mobile in this industry the burden falls on him or her to obtain the required, often redundant training needed for entry into a new, credentialed title. The irony is that, once the individual has obtained the credentials, there is no guarantee that the required credentialed training will be relevant or fully utilized in the new institution or job.

The health industry has another type of bind, in that it has been stultified by the sex images attached to the credentialed titles. It may be because women were conceived of as temporary members of the labor force that the Nurse Aide, Licensed Practical Nurse and Registered Nurse functions have been allowed to remain segmented, go-nowhere occupations. (In point of fact such workers show long years of devoted service.) In any case, more attention was paid to the conditions facing these occupations only after it was determined that there were critical shortages in nursing, that the occupations could be carried out by men, and that men eschewed the feminine sound of the titles. In all likelihood, men also eschew the dead-end nature of the jobs. In the drive towards overcoming inner-city and hard core unemployment, and in the politically motivated

concern for the unemployed male head of house and returning veteran, terms such as "medic" and "physician's assistant" became popular. As in all other cases, the tendency is to segment, with no attention to existing occupations or the relationship to existing functions. This time the new titles have male images, and the nurse is again locked in.

In an industry in which the physician and hospital administrator is assumed to be male, and the nurse and dietary worker is assumed to be female, there has been a tendency to develop administrative enclaves in nursing and food service which run as separate entities. Many trained professionals have had to rise to administrative levels if they were to rise at all, thus giving up the very functions that attracted them to health care in the first place.

The greatest social cost in the health industry lies in the education and training of its manpower. There are shortages of schools and shortages of properly trained skilled and professional personnel. The greatest waste in the health industry lies in the allocation of functions to personnel and in the redundancy of training requirements. It is an irony of the industry that its employment structure is shaped like a pyramid, with large numbers of semi-skilled employees at the aide level available without serious shortages, while the shortage structure is shaped like a pyramid resting on its apex, with the largest numbers of shortages near the top. This would be an ideal industry for the development of upward mobility programs utilizing its existing labor force. Yet, institutional barriers have, up to the present, inhibited the implementation of such solutions.

The Health Services Mobility Study set itself the job of creating a basic methodology which would make possible the elimination of shortages through the utilization of existing manpower. It sought to minimize educational resources through the utilization of prior knowledge and experience, and thus make possible upward mobility for individuals by utilizing the skill and knowledge links between tasks and jobs. In other words, by focusing on what is learnable and transferable in the content of tasks, the investments in education could be utilized in the creation of job progressions.

The Study set itself this assignment knowing that certain key pitfalls had to be avoided. The first was that the quality of professional level service could not be distorted. The judgmental and theoretical aspects of professional service had to be respected, acknowledged and accounted for. Second, the skilled aspects of being sensitive to peoples' needs, of being responsive to the charge of caring for people's lives, health and well being, of being able to make decisions, see implications and draw conclusions, all had to be respected, acknowledged and accounted for. Third, the difference between the rote performance of clinical procedures and the comprehending application of information and concepts had to be accounted for. The difference between these distinguishes transferable knowledge from non-transferable, procedural information. Finally, we knew that we would have to look at work as it is currently being performed before we could go on to talk about sequences and job ladders that would actually draw on prior training. We knew we

would have to look at tasks as they are performed, regardless of the titles in which they are found, and let the data results lead us to our conclusions about levels, sequences and ladders.

The HSMS system of job analysis has four components. The first is task identification; the second is identification and rating of each task on 16 skill scales; the third is the identification and rating of the knowledge needed for each task within an organized system of knowledge classification. The fourth component is the statistical manipulation of the task data so as to identify the interrelated skills and knowledge categories and then to identify task sequences based on the families of interrelated skills and knowledges. From these results job ladders are designed.

SUMMARY OF RESULTS

1. The Health Services Mobility Study has been able to achieve a task definition which is applicable to tasks at the physician level (or any other professional level) as well as tasks at the lowest levels. It accounts for the contingencies and emergencies which can periodically arise in tasks and thus does not water down professional performance by over-fragmentation of tasks.

2. The HSMS has been able to develop and apply 16 skill scales which are usable in the field, are fairly reliable and can be applied to all tasks, regardless of content.

3. The HSMS has been able to develop a System for the classification of knowledge which can be used in varying settings. The scale devised for use with the System makes it possible to rate each task for the level of knowledge in a subject that has been identified as being required for task performance.

4. The computer-based statistical procedures "work." That is, the advanced form of factor analysis used results in group-

ings (factors) of skills and knowledges which are interpretable, make sense, and satisfy statistical criteria for "good" factor results. Moreover, the counter-rotation of these skill and knowledge factors results in factors of tasks which permit the arrangement of tasks into hierarchies which reflect the relationship of task requirements to the groupings of skills and knowledges. It was thus possible, with some further analysis, to arrange these hierarchies into sequences or levels, so that actual stages and ladders could be devised.

5. The data results are of such a nature that lattices as well as ladders were designed. For each, the data indicate the skill and knowledge content necessary for a given rung. Thus, the data also make it possible to identify the additional training needed to go from one rung on a ladder to another which is laterally, vertically or diagonally related to it.

6. There is preliminary evidence to warrant the restructuring of several of the jobs studied on purely practical lines to provide for better allocations of tasks to jobs.

7. There is preliminary evidence to warrant the granting of advanced standing in credentialed academic programs for current incumbants in non-credentialed or lower-level titles, even without alteration of current job structures.

8. The distinction between professional and lower-level tasks appears to have two aspects. First, in health occupations, the sheer quantity of knowledge categories increases at upper levels; second, there is a sharp rise in the level of comprehension required at upper levels even where the knowledge categories have already been covered. The task sequences suggest, however, that jobs can be structured to provide for graduated increments in the number of subject areas and in the levels of the subject areas required.

9. Six sets of task sequences have been identified from the task data covered in the pilot test titles in ambulatory patient care. Two begin at the professional level and can only be reached by a lattice-like movement from the other four. These two deal with surgery and with diagnosis and prescription of care within the fields of internal medicine, obstetrics-gynecology and pediatrics. The other four cover female care, physical treatment, social service and counseling (behavioral functions), and machine related care and radiology.

10. The task sequences suggest that traditional distinctions in specialties may not be as relevant for ladders as functional specialties. Where skills are involved, the sequence of tasks ensuring continued clinical practice may be more important than the assignment of tasks according to traditional specialties.

11. Four ladders have been designed based on the task sequences which can be followed at the Center studied provided that changes in job structure, formal curricula and licensure can be achieved. These cover Medical, Psychological and Social Health Maintenance; Physical Care and Treatment; Female Care; and Machine Related Care and Radiology.

12. The pilot test data suggest that the task sequences are somewhat truncated when applied to a narrow group of twelve titles; the results should be richer, more generalizable and more viable when the data base is widened to other types of institutions and to other titles.

CHAPTER 2

THE PILOT TEST AND THE METHODOLOGY

By March of 1971, much of the HSMS methodology in job analysis had been devised and most aspects had been field tested in discrete parts. The time had come to test the method as a system. The need was to apply the method in an institution where the results would be of interest, and to cover a large enough number of titles so as to provide meaningful results.

THE PILOT TEST

At that time HSMS was invited to test the methodology at the Dr. Martin Luther King, Jr. Health Center, which is an entity of Montefiore Hospital in the Bronx. The Center is an OEO, ambulatory care, community health center that has pioneered in the provision of family-oriented medical care.

The needs of the Center involved its senior staff in a concern with the development of primary care practitioners in the setting of a Family Health Team. The goals of upward mobility are shared by most OEO Centers, but other goals such as the delivery of special services to fill community needs, the development of jobs for neighborhood residents, in-service training programs, and attractive salary levels for entry-level employees have often been given greater priority when there seemed to be a conflict of objectives.

It was agreed that task analysis could provide information about the functioning of the Family Health Team, leading to the development of a primary care practitioner. Though this was the chief concern of the Center, the HSMS goal of identifying possibilities for upward mobility for Center employees was accepted as compatible, and both institutions expected to benefit from the analysis.

It was agreed that the Study would be allowed to analyze titles beyond those involved in the Family Health Team if it included all the titles then represented in the Team. The result was a pilot test design that originally included the tasks of thirteen individuals in as many titles. There was only one performer per title because it was considered probable that all or most of the tasks for a title could be identified by working with a single performer in the title.

The Family Health Team

The objectives of the Dr. Martin Luther King, Jr. Health Center with respect to the Family Health Team are that it should provide primary care services to families and that the Team should coordinate the provision of comprehensive health and social-medical services with the provision of medical and social specialty services.

The Family Health Team is considered to be a vehicle which can "expand the scarce resources of the physician through the utilization of other health team members." At the time the pilot test was begun, the basic Team consisted of Family Health Workers, a Nurse Practitioner, an Internist, and a Pediatrician. Sometimes the Obstetrician-Gynecologist

was regarded as a member of this core. The Team is focused on the delivery of care to all the members of a family so that the family's functioning as a social unit and the interrelationship of its medical, social and environmental needs and problems can be constantly perceived and taken account of.

The Center, through its Units and clinics, provides the specialty services needed. Since the Center is a division of Montefiore Hospital and is professionally a division of the Albert Einstein College of Medicine, both the Center staff and patients receive the benefits of the related hospital privileges and access to faculty.

The Nurse Practitioner is essentially a public health nurse who is trained as a primary practitioner in pediatric care, obstetrical care, and some adult chronic disease maintenance. The role also included coordination of the Team members.

The Center found that the Team did not automatically function effectively, and considered whether the nurses should receive more clinical training so that they could personally render much of the primary care services to families and also manage the Team. It was also felt that there was a need to train a group of physicians who were interested in making the clinical practice of medicine more social in its orientation, who were sensitive to patients' needs, and who were motivated to learn how to work effectively on a health team. Even before the HSMS was invited to collect task data about the Team, the Center had deemed it important to study the functions of the entire Team prior to any focusing on one member of the Team, especially since leadership and management was involved.

The approach of the Health Services Mobility Study is probably well adapted for some of these purposes because it permits identification of tasks regardless of the titles in which they are found. The insistence on examining titles beyond those of the Team promised to raise certain implications, not only about the paths for upward mobility, but about the relationships between Team and Unit staff and the relationship of each to the families being served. The Units offer clinical care.

The Titles

Figure 1 presents the thirteen titles originally chosen for the pilot test. The titles are arranged in rank order by approximate maximum annual salary level.

After the pilot test work had begun, it became apparent that the difference between the tasks of the Lead X-ray Technician and the X-ray Technician was not one of degree, but of number. That is, the two titles overlap completely with respect to X-ray tasks, but the Lead title includes some semi-supervisory or administrative tasks. Since there was a great time pressure, the tasks were combined, and the Lead X-ray Technician and the X-ray Technician were treated as a single title. Thus, twelve titles remained.

In the case of the two LPN titles it was learned that the LPN is expected to serve in both the Emergency Room and in the Unit at one time or another. Since the tasks are somewhat different in each location, two separate performers were retained. Since the methodology identifies identifical tasks as the same regardless of title, LPN overlap tasks are counted only once in the computer analysis.

Figure 1.

TITLES OF PILOT TEST
PERFORMERS BY SALARY LEVEL

Annual Maximum Salary Range as of 3/72	Job Title
$30,000-$40,000	Radiologist[a] Obstetrician-Gynecologist Internist* Pediatrician*
$13,000-$15,000	Nurse Practitioner*[b] Lead X-ray Technician
$11,000-$12,999	Nurse Practitioner*[b] X-ray Technician
$8,000-$9,000	Family Health Worker* Licensed Practical Nurse-Emergency Room Licensed Practical Nurse-Unit
$7,000-$7,999	EKG Technician (Medical Assistant) Medical Assistant-Unit Dark Room Aide

* Asterisk denotes member of Family Health Team.

[a] Actually is employed on a half-time basis.

[b] Nurse Practitioners may receive increments as they complete training in specific areas. The lower salary level includes community health tasks and then rises to cover pediatric care tasks. The upper salary level includes maternal and child care tasks and then rises to cover adult care tasks.

Note of Caution

The twelve titles represented in the data collected reflect the work carried out during the months of April, 1971 through December, 1971. Since only one performer was covered per title for the mostpart, all the possible tasks per title may not have been collected. With only a fraction of the titles represented at the Center covered, it must be emphasized that the resulting task sequences and ladders only suggest the potential of task families. Given that the job structures at the Center are constantly in flux, the reader cannot assume that task assignments to title are still exactly as represented in these data. And, since the task data were not evaluated in normative terms, the reader must not assume that existing task structures represent the ideal or most desirable procedures, structures or performance levels.

THE METHODOLOGY

The chief objective of the HSMS job analysis methodology is to relate job activities (tasks) to one another in families and hierarchies which reflect related, learnable skills and knowledge, and from this information to design job ladders and lattices. The HSMS job analysis method is based on the premise that, if the jobs in a ladder (upgrading sequence) are arranged to reflect rising levels of related skills and knowledge (education), the educational costs and training time between each step on a ladder can be kept to the minimum needed to bridge the gap

between the jobs. This would be far less than that required to train for each job "from scratch" or for job sequences unrelated in skills or knowledge.

For this reason, the job task is the basic unit of observation. It is evaluated in terms of the levels of the skills and knowledges required for its performance. The skills as well as the knowledges cover only learnable behavior. The resulting job ladders emphasize the continued use of the skills and knowledges already learned or added to in a progression from one level on a ladder to another.

The Task

The definition of a task in the HSMS method is designed to result in a unit of work which can be moved from one job to another without disrupting other activities. The task is a unit of work which is smaller than that of a job as a whole or, in most cases, than that needed to produce an entire product such as a health service or a manufactured item. The task reflects individual work activities which, in many cases, will be a step leading to or assisting in the production of a final product. The task relates to the performer's output rather than the institution's product. (Products are the units which are sold.)

The task is composed of elements. The element is smaller than the task and is involved in defining the task. The elements of a task are the smallest possible meaningful units of work resulting from physical and/or mental activity. In contrast with the task, elements do not have

identifiable, usable outputs which can independently be consumed or used, or which can serve as an input in a further stage of production by an individual other than the performer. A task is identified as follows:

1. The output of a task is the result of an independent stage in a production process in the context of the current organization of work activities in the institution.

2. "What is used" in a task includes all the things which the performer is expected to be able to use or choose from to produce the identified output.

3. The kind of recipient, respondent or co-worker involved in a task reflects the characteristics or condition of the persons involved which determine the knowledge needed on the part of the performer in dealing with them.

4. Individual tasks are identified through the combining of information on output, what is used, and the recipient, respondent or co-worker in a manner compatible with the task definition. Individual tasks are differentiated or judged to be duplications or overlaps of each other based on these data.

The HSMS Definition of a Task

A task is a series or set of work activities (elements) that are needed to produce an identifiable output that can be independently consumed or used, or that can be used as an input in a further stage of production by an individual who may or may not be the performer of the task.

1. In principle, someone other than the performer of the task must be able to use or consume the output of the task.

2. Theoretically, it should be possible for there to be an elapse of time between tasks.

3. A task includes all the possible conditions or circumstances which a single performer is expected to deal with in connection with a single production stage.

4. A task includes all the elements that require continuous judgment or assessment by the same performer in order to assure the quality of the output.

5. A task includes all of the elements needed to produce an output which can be independently used or acted upon without special explanations to the next performer in the next stage of production.

6. A task includes all the elements needed to complete an output to a point at which another performer (who would continue with the next production sequence) would not have to redo any elements in order to continue.

7. A task includes all the elements needed to complete an output to a point at which another performer, in order to continue with the next stage of production, need not perform extra steps.

8. The task must not require that, for another performer to continue with the next stage in a production sequence, current institutional arrangements would have to be changed.

9. A task must be sufficiently broad in statement that it can be rated on its frequency of occurrence. (See Appendix B.3).

10. Two tasks are the same if their elements result in the same output, require the same things to be used (including the alternatives to be chosen among in what is used), and if the kind of recipient, respondent or co-worker involved is the same in terms of what the performer needs to know in order to deal with the person.

The HSMS task definition permits the acknowledgment that much professional level training is used primarily for the emergency or contingency situation, but must nevertheless be accounted for in the task's identification. For example, the task of delivering a baby through the vagina (normal delivery) must contain elements including the decision that complications warrant a change of procedure such as to Caesarian section, the choice of anesthetic, and the possibility of responding to cardiac arrest -- if the performer of the "normal" delivery is the one who must deal with these contingencies.

On the other hand, the definition permits the identification of a task in which the performer notifies a higher level performer of any emergency signs. Thus, the latter task could include only normal delivery and the reporting of complications. The reader will note that these are two different tasks because they require different skills and knowledges, have different outputs, different methods, and involve different co-workers.

Figure 2 is an example of the Task Identification Summary Sheet used to collect task identification data. The List of Elements, found in the right-hand column, describes the elements of the task in detail, and is presented in the sequence in which they are performed. The elements include initiating and terminating actions and any decisions, record keeping, or delegation of duties which are part of the task. In a complicated or high level task the List of Elements can be long and is continued on additional pages. Some tasks have taken as many as six pages.[1]

A narrower level of detail is found on the left-hand side of Figure 2. Items 1, 2, 3 and 4 cover the output, what is used, and the recipient, respondent or co-workers involved in the task.

A still narrower level of task detail that provides a fairly full description is found in the "Name" of the task. This is item 5

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[1] The reader will understand that space does not permit the presentation of the Task Identification Summary Sheets for all the tasks covered in the pilot test. There were 273 tasks, among which there were many which appeared for more than one performer. Under some circumstances these data may be obtained from the Health Services Mobility Study.

Figure 2. EXAMPLE OF TASK IDENTIFICATION SUMMARY SHEET

Performer's Name_____ Analyst(s)_____ Dept._____
Job Title_____ Institution_____ Date_____

1. What is the output of this task? (Be sure this is broad enough to be repeatable.)

   Sutures removed from wound; healing evaluated; medications, bandages ordered or prescribed as needed; recorded.

2. What is used in performing this task? (Note if only certain items must be used. If there is choice, include everything or the kinds of things chosen among.)

   Patient's chart, pen;
   antiseptic, gauze; sterile gloves;
   suture scissors;
   forceps or tweezers; clamps (sterile);
   towels,
   tape, bandages, medications;
   institutional prescription form

3. Is there a recipient, respondent or co-worker involved in the task? Yes...(X) No...( )

4. If "Yes" to q. 3: Name the kind of recipient, respondent or co-worker involved, with descriptions to indicate the relevant condition; include the kind with whom the performer is not allowed to deal if relevant to knowledge requirements or legal restrictions.

   Patient needing sutures removed;
   subordinate (RN, LPN, Medical Asst.);
   adult accompanying child patient

5. Name the task so that the answers to questions 1-4 are reflected. Underline essential words.

   Removing a patient's sutures using antiseptic, clamp, scissors, forceps; evaluating healing; deciding on ordering antibiotics, medication, irrigation and/or bandaging; recording on patient's chart.

6. Classify the type of task:
   Preparation ( ) Execution(X) Termination( )

List Elements Fully

Performer may have decided to remove patient's stitches after having done the suturing originally, or patient may have been referred to performer for removal of stitches.

1. If appropriate, reviews patient's chart. May decide to delegate removal of stitches to RN. If so, gives orders.
2. Orders materials needed from subordinate.
3. Examines skin to note appearance of healing.
4. Explains to patient and/or adult what is to be done. Comforts patient.
5. Puts on sterile gloves. Sterilizes area with antiseptic and gauze.
6. Uses clamp to hold up stitches; cuts sutures with appropriate scissors. Pulls out sutures with forceps or tweezers.
7. Examines wound for signs of infection. May decide to irrigate with antiseptic or order wound irrigated.
8. May decide to prescribe antibiotics and explain to patient and/or adult how to take, or will administer or have subordinate administer. Writes and signs prescriptions.
9. May dress and bandage or have subordinate dress and bandage, specifying what to use and any medications. May order follow-up examination.
10. Enters record of what was done and any medication prescribed on patient's chart.

7. Check here if this is a master sheet..(X)

on Figure 2. The "name of the task" is actually a paragraph that summarizes the essential features of the task. Appendix Table A.1 presents the item 5's for the 273 tasks that were identified in the pilot test. Each task is listed by its code number. The same code number is applied to a task regardless of how many job titles in which it is found. There will be briefer task names used in the text of this report, but the task's code number will always be presented so that the reader can refer back to Table A.1 for the fuller discription.

Skills

A skill, in the context of the HSMS method, is displayed in action, in the carrying out of a mental or physical activity; it can be rated in terms of its degree or its level. Knowing how or why things function or what to do to things to make them work is knowledge. Using the knowledge requires skills. That is, one may know how something works, the principles of why it works, or what to do to it to make it work, but one needs skills in the act of applying the knowledge in a job task.

The critical distinction between skill and knowledge, given that they are both treated as learnable, is that knowledge is learned through didactic instructional means. Skills require practice if they are to be learned. Skills may first be presented in an instructional setting such as in a classroom or lecture room, but actual learning does not take place until there is practice. For example, a student nurse can learn the principles and mechanics of giving injections in a lecture setting. She is learning "introductory procedures." However, in order

to actually give an injection she must learn and use Object Manipulation skills. These are developed in the course of giving real or simulated injections. As anyone who has ever had black-and-blue injection sites knows, the best injection techniques require a great deal of practice if they are to be done properly.

The literature in the area of performance evaluation, job analysis and testing often treats the concepts of "skill" and "aptitude" as synonymous. For HSMS operational purposes they are distinctly different. The term "aptitude" is used to denote a person's capacity to acquire a skill. It refers to the ease with which an individual can learn a skill or the level of performance he can ultimately achieve in exercising the skill. For example, an individual can be taught the manipulative movements necessary to play a tune on the piano. Through practice he can acquire the skill of playing the piano. The ease and speed with which he learns and the eventual quality of his playing, however, is a function of his aptitude for music, covering both the knowledge and the skills involved in playing.

Scales

The HSMS method identifies sixteen learnable skills. Of these, three are manual; two are interpersonal; three relate to precision in the use of language; two deal with decision making; four cover general intellectual skills; and two are responsibility skills which relate to the recognition of the consequences of error in task performance. Each of the skills is represented by a scale.

Each of the HSMS scales has a name, an overall statement of its content, and an indication of what criteria (scaling principles) are to be used to differentiate each of its various numerical levels. Each numerical scale value (which can range from 0.0 to 9.0) is accompanied by a statement (descriptor) which describes the behavior warranting that descriptor's scale value. The descriptors use generic language, so they can be used for any task, in any industry.

The first descriptor for each scale is at the zero point. The descriptor at zero contains more than the simple statement that the particular skill is not involved. Each suggests the necessary minimum condition which must be met before a task can be rated above zero on the scale. The minimum condition for non-zero levels of the skill scales are at levels above expected, common behavior attainable with maturation. This is true for each zero point descriptor on each scale. Thus, the zero point descriptor assures that non-zero levels of the skills represent learnable attributes that are worth considering for clustering tasks and for designing curricula.

For each scale the minimum condition represents the key aspect of a quality which must be present. This quality and one or more additional qualities determine the way in which the levels of the scale rise. Each descriptor represents a level described in terms of the scaling principles involved. In some scales more than one principle is involved. The descriptors for the scale represent combinations of the levels of the principles which can be expected to be found in work situations.

The HSMS Skill Scales

Figure 3 presents an example of one of the HSMS skill scales. The reader will note that it has a name, an introductory statement about its content and scaling principles, and a series of numbered descriptors. The scale value of the descriptors for each scale and the actual number of descriptors used in the scale was determined by a statistical procedure called "equal appearing intervals," or Thurstone Scaling. Each scale was also designed to be self-evidently cumulative; that is, each scale level encompasses all the scale levels below it with respect to the skill involved.

The HSMS method identifies three manual skills which appear to be learnable through practice. They each deal with precision and coordination in the use of the body or its parts, and are essentially psychomotor skills. Locomotion deals with the body's movement through space; Object Manipulation deals with the movement, control and placement of objects, and Guiding or Steering deals with the control of objects moving in space in relation to external stimuli. All three are needed at non-zero levels once the task requires that some sort of predetermined standard be achieved.

The HSMS method includes two interpersonal skills. One deals with Human Interaction (Figure 3). It is exercised whenever a task requires the performer to come into contact with, or interact with, other persons. The second deals with Leadership, and is exercised whenever a task requires the performer to relate to subordinates so as to influence their work behavior.

Figure 3. THE HUMAN INTERACTION SCALE

This skill refers to the degree of sensitivity to others required of the performer in the task being scaled. The skill involves the performer's perception of the relevant characteristics or state of being of the other person(s), the performer's attention to feedback as the interaction occurs, and the performer's appropriate modification of his behavior so as to accomplish the task. The skill is involved if the task requires any personal contact or interaction with others. The scale value of this skill rises as the degree of perceptiveness and sensitivity required of the performer rises, and as the subtlety of the feedback to which he must respond increases.

The level of this scale should not be determined by the level of knowledge required in the task.

SCALE VALUE	DESCRIPTIVE STATEMENT
0	The task does not require the performer to be in contact with or to interact with other people.
1	The task requires the performer only to be in general contact with other people. Very little sensitivity or awareness of feedback is required other than the need to take account of them in the performance of the task.
- 3	The task requires the performer to interact with others in the performance of the task. The performer is required to be somewhat sensitive to the other person(s)' relevant general characteristics or state of being and to be aware of very obvious feedback so as to adjust his behavior accordingly.
- 5	The task requires the performer to interact with others in the performance of the task. The performer is required to be quite sensitive to the other person(s)' relevant characteristics or state of being, and to be aware of fairly obvious feedback so as to adjust his behavior accordingly.
- 7	The task requires the performer to interact with others in the performance of the task. The performer is required to be keenly sensitive to and perceptive of the other person(s)' relevant characteristics or state of being, and to be aware of fairly subtle or complex feedback so as to adjust his behavior accordingly.
- 9	The task requires the performer to interact with others in the performance of the task. The performer is required to be keenly sensitive to and perceptive of the other person(s)' relevant characteristics or state of being, and to be acutely aware of very subtle or very complex feedback so as to adjust his behavior accordingly.

Both of these scales have scaling principles which describe the conditions under which the skill must be exercised, rather than the way the skills are manifested or the nature of the skills. This is because interpersonal skills may be exercised in ways that are unique to the performer, and reflect his individual personality. However, the skills do require behavior which can be learned by being practiced, regardless of the specific manner in which they are displayed. Thus, the levels of the skills, as called for in tasks, are a basis for task clustering.

There are three HSMS language skills. The language skills deal with the precision with which the performer uses language to convey meaning, independent of the knowledge he must have in order to use technical vocabulary. The language skills do not refer to knowledge of vocabulary. (Technical language is accounted for by the knowledge categories identified for the task.) The language skills also do not refer to knowledge of grammar, semantics, linguistics or literary form. Rather, the language skills deal with the level of precision required in the use of language to convey meaning. As with any other skills, they are learned through practice. The language skills cover Oral Use of Language, Reading Use of Language and Written Use of Language.

The HSMS method treats decision making responsibilities as decision making skills. The exercise of responsibilities may involve any number of other skills, but having to exercise the responsibilities, the

fact that tasks require decisions to be made, involves use of decision making skills which can be learned through practice. There are two decision making skills. Decision Making on Methods is relevant for any task except when the output is achieved in a totally pre-determined fashion so that the performer exercises no choice over methods whatsoever. Decision Making on Quality is applied to any task, assuming generally correct performance, whenever the performer can have some effect on the quality of his output.

The four HSMS General Intellectual Skills are called Figural Skills, Symbolic Skills, Taxonomic Skills and Implicative Skills. They cover task behavior such as dealing with the size, shape or form of things to achieve a figural standard; the mental manipulation of abstract symbols which are parts of systems of notation; the conscious application of, or creation of, conceptual classifying or organizing principles; and the drawing of non-obvious conclusions or inferences from information. These skills are learnable through practice and transferable from one task situation to another. Since General Intellectual Skills are usually learned and exercised in the application of knowledge, they can be confused with knowledge. But the knowledge actually serves as a vehicle through which the skills are learned and practiced. Thus, tasks which require diverse knowledge or subject matter may have in common some of the General Intellectual Skills necessary to apply the knowledge, and the skills are valid for use in clustering tasks.

Every task normally carries with it the danger that the performer will make errors in carrying it out. The performer's awareness of the seriousness of possible errors serves to keep him alert in the performance of the task. This sense of responsibility is learnable, and, as such, is treated as a skill on the basis of which tasks can be clustered. The HSMS method includes two such skills. One deals with the Financial Consequences of Error; the second deals with Consequences of Error to Humans. Both scales describe levels of seriousness of the consequences of an error considered to be the most serious, likely error for the task that can be made by a performer qualified to do the task.

Appendix Table A.2 presents the introductory paragraph for each of the HSMS scales and the number of tasks in the pilot test which were rated above zero on each of the scales.

The Knowledge Classification System

Since the aim of the HSMS task analysis method is to minimize the educational or training distances between jobs in job ladders, the method pays attention to knowledge as well as skills. The more that tasks require academically based advanced, or specialized knowledge, the greater the investment needed in education and training to perform them, and the more important it is to build ladders based on knowledge as well as skills. The concepts and definitions used for the HSMS Knowledge Classification System and its Knowledge Scale reflect the method's need to treat knowledge categories as variables which can be uniquely identified regardless of task and which can be treated as scalable in a manner similar to the HSMS skills.

Knowledge is information about facts and concepts and includes how or why things function or what to do to have them function. Knowledge may be acquired by formal didactic means such as in a classroom, or by less formal means such as self-study, personalized instruction, or by watching others.

The definitions and the categories which are part of the HSMS Knowledge Classification System reflect the uses of knowledge in work settings. The groupings of the categories reflect their functional uses. The categories were conceived of and devised to be additive and scalable in the same way in which the HSMS skills are additive and scalable (rising from low to high levels cumulatively, according to scaling principles). The categories require the effort of being learned in the context of a curriculum, and they can be applied in more than one setting.

The concept of the transferability of knowledge assumes that some kinds of knowledge are capable of being used in varying situations and that some kinds of knowledge are additive from lower to higher levels, i.e., that knowledge is scalable. The concepts of transferability and scalability of knowledge underlie the HSMS Knowledge Classification System.

The HSMS Knowledge Classification System's categories are limited to the following types of knowledge:

1. Subject categories which represent organized bodies of knowledge which can be conceived of as ranging in content

from simple to advanced levels and which can be required at varying levels in a variety of tasks.

2. Subject categories which are not merely the names of the individual steps of tasks.

3. Subject categories which, even at lowest levels of use, require a learning effort beyond every day experience and beyond the usual process of maturation. The learning effort involved may be formal or informal, but it must involve a conscious effort to be acquired so that it can be applied in different situations.

4. Subject categories which can be identified as being required in competent task performance.

Excluded are the procedures or arrangements characteristic of a particular institution (orientation knowledge). Such knowledge is learned in terms of "first you do this, and then you do that" and is not transferable. Also excluded is knowledge which cannot be scaled from low to high levels, and curriculum contents not applicable to work situations.

The subject categories which make up the Knowledge Classification System are presented in an outline form, in a system of progressive indentation. Each category has a unique, 8-digit identification code. The broadest level of the outline has a non-zero digit in the far left position. The progressive indentations continue the prior levels' digits, and have a non-zero digit in the position corresponding to the category's respective level of indentation. The categories are no more finely broken down than it was expected would be needed to identify in the field and scale. Figure 4 is a page from the Knowledge Classification System and indicates the way the system is laid out.

Figure 4. SAMPLE PAGE FROM THE KNOWLEDGE CLASSIFICATION SYSTEM

```
         1   2   3   4   5   6   7   8
10000000 NATURAL SCIENCES

11000000     BIOLOGICAL SCIENCES

11100000         # History of the biological sciences*

11200000         # Genetics (For molecular and microbial genetics see
                     Molecular biology.)*

11300000         # Evolution*

11400000         # Biogeography*

11500000         # Ecology (Includes ecosystems and conservation.) (For
                     the physical aspects of air pollution see GEOSCIENCES,
                     CHEMISTRY, PHYSICS, and ENGINEERING AND TECHNOLOGY;
                     for the health aspects of pollution see Community
                     health and preventive medicine and Epidemiology.)

11600000         # Botany*

11700000           Zoology

11710000             # Invertebrate zoology*

11720000             # Vertebrate zoology (through mammalia, but excluding
                         humans)*

11730000               Human zoology

11731000                   Normal structure and function (The categories
                               listed below include both anatomy and phy-
                               siology except where otherwise specified.)

11731100                       # Regional anatomy (Includes head and neck,
                                   thorax (back) and abdomen, pelvis and
                                   perineum, lower and upper limbs, and
                                   skeleton.)

11731200                       # Topographic anatomy (relation of external
                                   manifestations to internal structure
                                   and function, e.g. location of pressure
                                   points, surface appearance of joints,
                                   muscles and bones.)

11731300                       # Hematopoietic system (Includes blood,
                                   red and white blood cells, platelets,and
                                   and bone marrow, liver and spleen in
                                   their blood forming function.)
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Only those categories which have a number sign (#) or are underlined (or both) are used for identification purposes. (The reason is related to the statistical need to turn categories into variables for clustering tasks.) The categories with number signs are called fine level categories; those that are underlined are broad level categories. In some cases categories have not been further subdivided even though they are broad; some broad categories are fine with respect to still broader categories. Such categories have both number signs and underlining. (Categories which will clearly warrant elaboration of subdivisions in future work are indicated with asterisks.)

When a job analyst identifies a category for a task he must consider its related broad-level category if the one chosen is fine; and must consider all its fine-level subdivisions if the one chosen is broad. This rule does not mean that the analyst must identify the broad (or the fine), but that he must consider whether the category is (are) required for the task.

The Knowledge Scale

One of the criteria for inclusion of a category as "knowledge" in the Knowledge Classification System is that tasks must conceivably require the category at varying levels. Thus, a category must be "scalable." The HSMS method uses a single scale for measuring the levels of all categories. Figure 5 presents the Levels of Knowledge scale. As with the skill scales, the Knowledge Scale has a name, an overall statement of its content, and an indication of what scaling principles are to

Figure 5. THE LEVELS OF KNOWLEDGE SCALE

This scale refers to the level of knowledge in a given subject category required of the performer in the task being scaled. The knowledge categories which are required for each task are identified, and each category is rated with this scale. To be rated above zero on the scale the task must require knowledge beyond the simple memorization of the overt steps of the task. The scale rises with the amount of detailed knowledge which must be consciously applied and with the depth of understanding required in the subject area, in terms of its content, the structure of its ideas and its uses. "Detailed knowledge" covers such things as technical or special terms or facts. "Consciously applied" means that the performer is able to (but need not) articulate his use of the knowledge in the task situation.

The level of a knowledge category should not be determined by the task's level on other knowledge categories or that required in other tasks in the job using the same knowledge category, nor by the level of General Intellectual skills which may be involved.

SCALE VALUE	DESCRIPTIVE STATEMENT
0.0	The task does not require the performer to consciously apply knowledge in this subject category which has been gained in a learning experience requiring more than the memorization of the overt steps of the specific task being scaled.
--	
--	
1.5	The task requires that the performer consciously apply a limited amount of detailed knowledge in this subject category, including such things as technical or special terms or facts.
--	
2.5	The task requires that the performer have a general awareness of this subject category in terms of its content, the structure of its ideas, and its uses. The performer must consciously apply a limited amount of detailed knowledge in this subject area, including such things as technical or special terms or facts.
--	
3.5	The task requires that the performer have a general awarenesss of this subject category in terms of its content, the structure of its ideas, and its uses. The performer must consciously apply a moderate amount of detailed knowledge in this subject area, including such things as technical or special terms or facts.
--	
--	
--	
5.5	The task requires that the performer have a considerable degree of understanding of this subject category in terms of its content, the structure of its ideas, and its uses. The performer must consciously apply a moderate amount of detailed knowledge in this area, including such things as technical or special terms or facts.

(continued on next page)

Figure 5. THE LEVELS OF KNOWLEDGE SCALE (continued)

SCALE VALUE	DESCRIPTIVE STATEMENT
--	
--	
7.0	The task requires that the performer have a considerable degree of understanding of this subject category in terms of its content, the structure of its ideas, and its uses. The performer must consciously apply a very great amount of detailed knowledge in this subject area, including such things as technical or special terms or facts.
--	
8.0	The task requires that the performer have a very deep understanding of this subject category in terms of its content, the structure of its ideas, and its uses. The performer must consciously apply a moderate amount of detailed knowledge in this subject area, including such things as technical or special terms or facts.
--	
9.0	The task requires that the performer have a very deep understanding of this subject category in terms of its content, the structure of its ideas, and its uses. The performer must consciously apply a very great amount of detailed knowledge in this subject area, including such things as technical or special terms or facts.

be used to differentiate each of its various numerical levels. Each numerical scale value (which can range from 0.0 to 9.0) is accompanied by a descriptive statement (descriptor) which describes the behavior warranting that descriptor's scale value. The descriptors use generic language, and can be used for any knowledge category.

The Knowledge Scale has two scaling principles and a minimum condition which must be met before a category can be identified at a non-zero level on the scale. The minimum condition is that the knowledge must take some expenditure of time and effort to acquire, so the knowledge is usable in another context; i.e., that it is transferable.

The two scaling principles deal with (1) breadth of knowledge and (2) depth of knowledge. The first scaling principle (breadth), reflects the minimum condition for a non-zero value on the scale. Breadth of knowledge, refers to the amount of detailed knowledge the performer must know about the subject. This covers the variety of topics, facts, procedures or other aspects of information covered by the subject. The second scaling principle deals with depth of understanding. It rises from "general awareness" to "considerable degree of understanding," to "a very deep understanding." The nature of the category determines the way depth of understanding is manifested, but depth of understanding always refers to the comprehension of the "hows," "whys," and "whats" of the subject.

Appendix Table A.3 presents the 201 separate knowledge categories that were identified for one or more of the pilot test tasks. It

also presents for each the number of tasks which required the category at some level above zero on the scale. Further references to knowledge categories will utilize abbreviated versions of the names presented in Table A.3; the reader can refer to these longer names by making use of the 8-digit code number of the category which is always presented with the category name.

Data Collection

Task analysis using the HSMS method proceeds in a series of stages. It is carried out by a team of two or more job analysis who are trained in the methodology. The method is designed to be learnable by persons who are not themselves health practitioners so that it can be part of the central manpower function of an institution. Prior to their field work, the analysts inform themselves of the general content of the jobs they will cover.

The methodology includes laying a groundwork during the scheduling period. During this time the analysts ensure that information about the task analysis work is disseminated to all the managerial levels that must be involved in arranging interview time with the performers. The performers themselves are met and informed about the task analysis. Where unions are involved, their cooperation is obtained.

The data collection begins with task identification, which is done primarily through interviews with the performer, but which allows for some observation of tasks that are hard to describe.

The sequences in task identification are as follows:

1. A team of at least two job analysts is required for task identification. The team must agree on the identifications, based on interviews (and observation). These identifications are entered on Task Identification Summary Sheets.

2. The preliminary identifications are submitted to the Director of the Project, who edits them for language usage and clarity, but who also reviews the identifications for conformity to the definition, and for completeness of information. A conference is held with the analysts involved, and, if any ambiguities remain, the analysts go back to the performer for further information.

3. The revised tasks are submitted to an expert at the institution, "the resource person," who reviews the tasks for accuracy in use of technical language, accuracy in procedural descriptions, and possibilities of task omissions. If the analysts cannot accept the changes or answer the questions, they go back to the performer for further information.

4. The revised tasks are presented to the performer for his approval. The analysts delete anything not done by the performer (or by someone in the title), make changes, and otherwise bring the tasks into closer conformity with what is actually being done by the performer or incumbents in the title.

After task identification, the revised tasks are the data base for which skill and knowledge data are collected. Skill scaling data and knowledge identification and knowledge scaling data are also collected in a series of interviews with the performer. In each case the team of analysts must agree about its final judgments. These are later reviewed for consistency.

Ideally, the skill and knowledge data should also be reviewed by a "resource person." In the case of the pilot test this was done by the Director of the Project and two general consultants. For this rea-

son, the specific data on skills and knowledge are to be considered generally indicative rather than normative. They are subject to modification with respect to scale levels and inclusion or exclusion of specific knowledge categories for specific tasks.

Preparation of Data

The HSMS method for clustering tasks into related skill and knowledge hierarchies uses a computer-based, advanced form of factor analysis. In the programs used the unit of observation is the task. Each task has a scale value on each skill scale, and a value on the knowledge scale for every knowledge category identified for any of the tasks being studied. The variables are the skills and the knowledge categories.

The data collected in the field are coded with identification information for each task and with the skill and knowledge data for each. There are an undefined number of data cards for the tasks. The first card tells the computer how many cards will follow for a given task. The next card is in a fixed format, and presents the scale values for each of the 16 skill scales for the task. Any other cards are numbered consecutively and are set up so that the ID number of the knowledge categories identified for the particular task are entered along with the scale values for each.

The HSMS Edit program receives the data cards in any task order, but always with the cards for a given task (observation) in numerical order by card number, beginning with the first card. The Edit program then performs the following functions:

1. A check is made to be sure that all scale values are in the correct range; i.e., it checks for gross keypunch errors.

2. A check is made to be sure that no task appears more than once; i.e., that only one set of data per task ID number will be "read in" to the computer.

3. The program "reads in" the tasks' scale values for the skill variables from the fixed format, and assigns ID numbers from 1 to 16 to the skill variables.

4. The program "reads in" the tasks' knowledge category values. This is done in a process which acknowledges and assigns a location to each different 8-digit knowledge category identification code, and assigns a variable number to each different one, starting from 17. For each category identified but not found for a given task, a scale value of zero is assigned by the computer.

5. The program produces a printed output which indicates what the variables are, from 1 to 16 as skills, and from 17 to n, depending on the number of knowledge categories involved. It allows the user to delete knowledge categories that do not appear on a sufficient number of tasks or to delete specific categories. It also shows the task locations and scale values for each knowledge category identified.

6. The program provides the user with the option of utilizing another program which "normalizes" the data. This is a nonlinear transformation performed on the data to bring them into a closer approximation to a "normal distribution." No major distortion of the data is involved, but the statistical problems encountered with a proliferation of zeros (when a large number of knowledge categories scale at zero for many tasks) can be avoided.

7. The program places the final data onto tape files, where they are then inputs for the actual steps of factor analysis.

Factor Analysis of Variables (Skills and Knowledge)

Factor analysis deals with observations and variables. It examines the statistical relationship of every variable with every other

variable, and groups these in such a way as to best account for all the variability represented by the ratings of all the observations (tasks) on all the variables. A factor solution essentially groups related variables into arrangements which explain the data with fewer concepts than the sum of the original variables. A given factor essentially replaces a group of interrelated variables with a single construct which expresses the interrelationship within the group. Factor analysis usually results in the creation of two or more factors from a much larger number of variables.

In the case of the HSMS pilot test, 16 skills and 201 knowledge categories were the variables, and 273 tasks were the observations. (Duplicate or overlap tasks were not represented more than once, since each task code number is represented only once.)

The first stage of the factor analysis creates the "variable factors." These are determined by those skills and knowledges which tend to be interrelated and therefore can be expected to rise and fall together. This means that, for the purpose of curricula, variables which factor together should tend to be taught together, since they are usually needed at interrelated levels on their respective scales.

Since every variable is rated on every factor, what determines a variable factor are those variables which "load high" on the factor. Variables can load on factors within the range of $\pm$ .99. Variables which are positively interrelated on a factor will have the same sign. The + or - has no other intrinsic meaning.

Given the nature of the computer core storage needs for factor analysis, 217 variables are well beyond the limits of most computers. The HSMS program limits the user to 144. The 217 variables were easily reduced to 144, since it was obvious that a knowledge category must be required for a sufficient number of tasks to be relevant for job ladders. By using nine tasks or fewer as a cut-off point, a sufficient number of variables were eliminated.

Even 144 variables provide a problem with respect to interpretation and the selection of an optimum number of factors in the acceptable "solution." One criterion used is that the number of factors chosen must result in most variables having high loadings on only one factor, with each factor having several variables which load high on it. Another criterion used is that the factors chosen show stability in their high-loading variables across several factor solutions. The most important criterion, however, is that the factors must make sense.

Factor Analysis of Tasks

The procedure used for clustering the tasks is a modified version of the Tucker-Messick procedure for factoring an individual differences matrix.[2] The procedure was developed at the university of Illinois by E. E. Davis, H. C. Triandis, and L. Tucker. The HSMS version

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[2] Ledyard R. Tucker and Samuel Messick, "An Individual Differences Model for Multidimensional Scaling," Psychometrika, Vol. 28, December, 1963, 333-367.

is a new application and modification of the original technique[3]. The program's essential feature is that it permits the extraction of principal axis factors for both observations and variables (two modes), based on a co-variance or a correlation matrix of variables. It is then possible to rotate the variable mode to "simple structure" by a Varimax routine, and "counter-rotate" the observation mode (tasks).[4] This method has been dubbed "two-mode" factor analysis, while the simple factoring of variables is called "simple" factor analysis.

The decision determining the number of factors in the simple factoring of the variables determines the number of factors for the tasks. In fact, it is the interrelationships among the variables on a simple factor that determines a task's loadings on a given factor. In this report the variable factors are referred to in Roman numerals, while the task factors are referred in the words for the numbers. That is, Factor I for variables is reflected in the tasks of Factor One.

The "two-mode" program results in a print-out of the desired variable factors and the counter-rotated task factor solution. The output lists the tasks by code number and provides each task's loadings on each factor.

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[3] E. E. Davis and H. C. Triandis, An Exploratory Study of Intercultural Negotiations, Technical Report #26, ONR Contract #177-472, Nonr-1834(36), Urbana: University of Illinois, 1965.

[4] Counter rotation is done by obtaining the transformed characteristic vectors of the observation mode induced by the Varimax rotations of the variable mode.

The loadings of the tasks on factors are interpreted as follows. The sign of the variables (plus or minus) which makes up a given factor's chief character on the variable factor solution determines the sign to consider for the loading of tasks on the corresponding task factor. A task's loading on the factor is due to the combination of the variables present for the task, their loading on the corresponding variable factor and the scale values in the task for the variables. If a factor's characteristic sign is positive, tasks can load at any relatively high level such as 3.00 or 5.00 or can load at levels as low as .01 or .02. Tasks can also load at -.01 or -.5.00, which is much lower.

The rank order loading of tasks on factors is obtained by the tasks' arrangement from high to low within the characteristic sign, through zero, and from low to high in the opposite sign. These loadings are not normalized, and serve only as relative measures. This arrantement of tasks into hierarchies makes it possible to determine on which factor a task loads highest, as well as the relative order of tasks on a factor.

Task Sequences

Task sequences are obtained by first assigning tasks to the one or two factors on which they load highest. The skill and knowledge content and scale levels for these tasks are examined once they are arranged in ascending order of their loading on the factor.

From inspection of tasks'skill and knowledge requirements and the scale levels involved it is possible to determine various stages or

"levels" which would correspond to general educational levels. Seven levels were identified in connection with the pilot test.

IDENTIFICATION OF GROSS CURRICULUM OVERLAP

During the pilot test an attempt was made to locate the educational programs which account for the tasks studied and to explore possibilities that performers in some of the Center titles might be able to receive credits in academic institutions for the training they received at the Center. It was also decided to explore any indications, through the tasks being studied, that existing programs have a degree of overlap. The time available for this work did not allow any sampling of programs. Rather, one program of each kind mentioned was studied. The results of the test are therefore to be considered indicative or suggestive rather than totally representative.

Programs Involved

HSMS staff (to be referred to as curriculum analysts) identified a program to represent each type of credentialed training relevant to the titles studied in the pilot test. These included a medical school (It was decided not to go higher than this at this time.), three nursing programs (baccalaureate, diploma and associate degree), a program in radiologic technology, and an LPN program. Staff also contacted the Center's own training programs which cover Medical Assistant, Family Health Worker, and Nurse Practitioner. For each program a respondent or consultant was enlisted to cooperate in research to explore areas of curriculum overlap.

Procedures

The analysts worked with the task names as represented in item 5 on the Task Identification Summary Sheets. These were modified as follows:

1. Only one instance of a task could be represented.
2. Tasks which could not be easily differentiated from the point of view of curricula were merged.
3. Tasks which were so institutionally oriented that they could not possibly be reflected in formal curricula were eliminated.
4. The remaining task names were edited so as to eliminate specific references to the performer's title and edited to eliminate peripheral steps which could confuse the respondent when he or she was asked whether his curriculum covers the information needed to perform the task. Such steps as pick-up, delivery, or filling out institutional forms were deleted.

The same Task Content Instrument was presented to each respondent, who was personally instructed in its use. Appendix B.1 presents the Task Content Instrument used in the pilot test. It presents the edited task names and a selection of answers from which the respondent chose the best description of his program's relationship to the informational content of each task. The respondent had a choice of one of seven responses to choose from for each task listed. Item (f) allowed the respondent to disqualify himself with respect to a given task, and item (g) allowed the respondent to require further elaboration of the content of the task. Items (a) through (c) are written in such a way

that the educator is not forced to make a distinction between clinical training and academic training. The seven items were as follows:

CHOOSE ONE ITEM FOR EACH TASK

a. Curriculum covers all or most of the specific procedures of the task or all or most of the subject matter applied in the performance of the task.

b. Curriculum covers a significant amount of the procedures of the task or a significant amount of the subject matter applied in the performance of the task.

c. Curriculum covers a small amount of the procedures of the task or a small amount of the subject matter applied in the performance of the task.

d. Curriculum has no relationship to or bearing on the task.

e. The content of the task must have been mastered before the student is permitted to enroll in the curriculum program.

f. I do not know the relationship between the program and the task.

g. I need more information about the task.

The first set of collected data were nine completed sets of the Task Content Instrument, each referring to the same set of tasks. The results were then tabulated for the tasks by program, according to the letters (a) through (e) chosen by the respondent. In this way, a profile for each job title was developed, indicating in which program(s) the tasks of the job title are covered to some degree or another.

It was expected that a curriculum program bearing the name of the job title would include most of the tasks covered by the title, with some being covered by lower-level programs. What the analysts looked for

were the letters (a) through (c) found in any of the columns representing higher-level programs.

The curriculum analysts then judged whether the evidence of overlap for a given job title's tasks in programs above its own level warranted further exploration. The second part of the test was to find out whether there was gross evidence of any significant degree of overlap, based on the first results.

For each job title, the curriculum analysts assessed whether there were programs with sufficient evidence of significant overlap to warrant asking the respondent how big a portion of his curriculum was involved in the tasks of given performers.

"Significant overlap" in this context meant the probability that some advanced standing to shorten training time might be justified. Any number of tasks which might manifestly take minutes to teach would not add up to "significant overlap."

The curriculum analysts then prepared a separate Curriculum Significance Rating Instrument for each respondent, for each lower-level job title for which there was evidence that significant overlap existed. This meant that, if there were more than one lower-level title with evidence of overlap with a given program, a separate Curriculum Significance Rating Instrument was prepared for each. Any given respondent could have more than one Curriculum Significance Rating Instrument with which to deal. In

addition to these Instruments, overlap from program to program was explored, reflecting all the tasks accounted for by one program, regardless of job title, which were also accounted for by the higher-level program.

The Curriculum Significance Rating Instrument was composed of (1) general instructions: (2) the set of task descriptions which were checked (a), (b) or (c) earlier by the respondent and which were found among the tasks of a given job title below the level of the one referred to by the program; and (3) a rating scale on which the respondent indicated the portion of his curriculum accounted for by the training needed for the tasks listed. Appendix B.2 presents the instruction sheet and the rating scale for the Instrument. The rating scale is as follows:

CURRICULUM SIGNIFICANCE RATING SCALE

5..( )...The section of curriculum represented amounts to several courses or more in the program.

4..( )...The section of curriculum represented amounts to an entire course or major portions of several courses in the program.

3..( )...The section of curriculum represented amounts to a major portion of a course or minor portions of several courses in the program.

2..( )...The section of curriculum represented amounts to a minor portion of a course in the program.

1..( )...The section of curriculum represented amounts to a negligible portion of a course or several courses in the program.

The data collected with the use of the Curriculum Significance Rating Instrument indicate to what extent the educators in the "accepting" institution or program implicitly acknowledge the possibility of overlap with lower-level programs. Any rating of 3 or higher on the scale would

warrant following up with more detailed analysis or negotiations between the institutions. Detailed analysis would be needed to determine whether the curriculum being taught at one level and dealing with a given task content is actually the same or different from that taught at another level dealing with the same task. The pilot test period did not go on to a more detailed analysis.

RELATED DOCUMENTS

The HSMS job analysis methodology is reported in Research Report No. 3: A Job Analysis Method for Developing Job Ladders and for Manpower Planning. There are nine volumes. Part A deals with task identification: Part B deals with skills and scales; and Part C deals with the Knowledge Classification System Each of these three Parts consists of three volumes. One presents the method; one is a training manual for the job analyst; and one presents statistical results of the field tests, aspects of data processing, or other relevant background information. This report is not yet available for wide distribution since the methodology is still subject to revision.

The HSMS curriculum analysis methodology is available under limited distribution in preliminary form. Working Paper No. 10, Preliminary Models for Curriculum Analysis and Curriculum Ladder Design contains the outline for the work done thus far. Research Report No. 6, A Model For Use of Task Data in Performance Evaluation and Trainee Selection covers the use of the HSMS data for normative evaluation of work performance and related uses. It is also available under limited distribution.

CHAPTER 3

GENERAL RESULTS OF THE PILOT TEST

This chapter discusses the general results of the pilot test. It covers the workability of the method, the characteristics of the variable factors and the characteristics of the task factors.

WORKABILITY OF THE METHODOLOGY

The pilot test provided the opportunity to test the methodology as an entire system. For the first time, a job analysis methodology was applied to all levels of job titles within an institution. As a result of applying the method as a system, it was possible to further develop the methodology and to gain insights into the general characteristics of the tasks.

Task Identification

The most difficult area of task identification was the application of the definition to professional level jobs, especially, physicians' jobs. The reason is that patients' specific conditions are myriad, and the actual nature of a particular patient's condition is usually not known until the examination is done. In many cases the physician will examine, take specimens, judge condition, delegate procedures to subordinates, and treat the condition during one continuous time period. In other cases only the most routine, minimal amount of examination is done. Applying the concept that the task's boundaries are set by the need for

continuity of the same performer's attention or judgment, a rough outline about the types of tasks to be expected at the professional level and their component elements was evolved.

There are usually two key types of tasks for the physician. The primary task's chief output is the diagnosis of the patient's condition and the determination of a course of treatment if there is a diagnosis of pathology. Variations of this same task occur when the physician cannot complete the task and refers the patient elsewhere, when the patient is diagnosed as being well, or when the patient had been referred by another with a review of the case needed rather than an initial work-up. The same task covers initial examination or revisit, diagnosis and prescription; it covers response to an acute condition, a chronic condition or a health check-up. These different initiating elements create variations of the same task.

The differences among physicians' tasks is in the scope of the performer's area of diagnosis. The Internist's recipient is a "non-child patient." The Pediatrician deals with the "pediatric patient;" and the Obstetrician-Gynecologist deals with "female patients." At the level of the Nurse Practitioner, diagnosis is replaced by "identification of abnormal conditions."

There is a basic framework for the primary task in which there are decisions to personally do or to delegate aspects of examination, recording, and specimen taking to others. Thus, it is more probable to

find that the physician's task elements overlap with lower level functions than that the whole task overlaps. Each delegatable element becomes a task for a subordinate, with its own limited output. The physician's primary task is tied together by the fact that one single person must decide on the patient's condition and decide what to do. The basic outline for the diagnosis and prescription task is presented below. Not every step is included in every instance of the task.

1. Initiating element (description of all conditions which can bring the patient to the performer).

2. Review of information (referral, chart, case history, or collection of new data).

3. Interview with patient to gain information about condition.

4. Decision by performer on what examination procedures to follow and what specimens to take while examining, or:

   Decision on immediate referral.

5. Decision on delegation of aspects of examination or specimen taking.

6. Explanation to patient of what will be done.

7. Examination and specimen-taking, divided by parts of the body and/or functions.

8. Continued discussion with patient to gain information about condition.

9. Review of findings to decide whether more information is needed. If needed, ordering of tests or referring for tests.

10. Arrival at diagnosis and decision on course of action. Assessment of immediacy of care needed; delegation of action or referral; writing of prescriptions.

11. Discussion, instruction and counseling of patient regarding 9 or 10, above.

12. Prescription of special diet if appropriate.

13. Provision of reinforcement, reassurance.

14. Decision on follow-up by subordinates, or revisit, or personal follow-up.

15. Checking back with Dr. or counselor if patient was referred.

16. Recording.

The basic diagnosis and prescription tasks in the pilot test are tasks 9, 39 and 55. The Nurse Practitioner's counterpart tasks are 83, 85, 86, 88 and 89. (See Appendix A, Table A.1.)

The second key task of the physician has many variations. It is the administration of a course of care or treatment. It is separated from the diagnosis task because, though it may follow the latter immediately in time, it can be done by a different performer. The treatment tasks usually require a review of the prescribed care unless the same performer has just determined the course of action.

The performer decides whether the prescribed care is still warranted based on a review of information and consideration of contraindications. He then may delegate the actual administration of medication or treatment or may perform specific treatments himself.

There are as many types of "decision whether to go ahead with treatment and doing treatment" tasks as the performer's areas of competence and type of patient allow. Some are grouped together in one task. Thus,"administering medications"may cover all the types of administration possible. "Care of injuries"is grouped, but"suture"is treated as a sep-

arate task. In each treatment task the decision to do it has come about in the diagnosis and prescription task of the performer (or some other performer). Where review of the prescribed treatment is involved, it is in the treatment task.

Performance of chemical tests, interpreting lab slides, and similar activities are treated as separate tasks if the continuity of the performer for a diagnostic output is not required. Reading a patient's X-rays is part of the physician's diagnosis task, but interpreting an X-ray for another physician is a separate task according to the definition.

Teaching, supervisory, administrative, and conference tasks are separately identified even when teaching is done in connection with providing patient care. The elements of the teaching tasks may or may not include planning, evaluating students, examining, and deciding when the student can have duties assigned.

Tasks involving surgery, when the performer leads the operation, include the pre-surgery examination, decision on whether to go ahead, delegation of procedures to others during surgery, and dealing with any emergencies or post-operative problems. The insight that surgery is essentially a task of continued diagnosis and prescription before, during, and after the operative procedures are actually carried out, was gained during the pilot test. (Surgery is done at the hospital after being prescribed.)

The pilot test resulted in the identification of 273 separate tasks, some of which were found in more than one performer's job. (One

task, code number 227, was a "dummy" task. It was added to use the code number when it was discovered that the number had inadvertently not been assigned to any task. Thus, there were really 272 tasks.)

The number of tasks per performer were as follows:

Job Title	Number of Tasks
Radiologist	8
Internist	30
Obstetrician-Gynecologist	21
Pediatrician	26
Nurse Practitioner	46
Lead X-ray tech, X-ray tech.	18
Family Health Worker	63
LPN (Emergency Room and Unit)	82[a]
EKG Technician	12
Medical Assistant-Unit	34
Dark Room Aide	9
Total Tasks:	273

[a] LPN-Emergency: 53; LPN-Unit: 51. There are 21 overlap tasks between the two LPN titles.

Skills and Knowledge

The pilot test period indicated that the analysts could apply the scales with little difficulty, and that the language of the Knowledge System could be understood and applied provided that the job analysts were careful to prepare themselves beforehand and maintained a close check on whether they and the performers were, in fact, talking about the same subject area or task. Some revisions were made in the skill scales and the Knowledge System as the pilot test progressed.

THE FACTOR STRUCTURE OF VARIABLES

The most exciting part of the pilot test was, in one respect, the actual computer work. For several years, while the method was being developed, it could not be fully known whether the factor analysis programs would yield statistically adequate and interpretable results. In addition, there was no way of predicting beforehand what would be learned about the ways in which skills and knowledge variables interrelate in the world of patient care.

As indicated in Chapter 2, the 273 tasks called for 217 variables including the 16 skills and 201 knowledge categories. These were reduced to 16 skills and 128 knowledge categories for purposes of factor analysis.

The simple factoring of variables was very satisfactory. There was no doubt that the six factor solution was the most appropriate. Six factors account for all but three of the variables. The addition of factors such as in a seven or eight factor solution yields no different factor structure; while fewer factors, such as in a five or four factor solution simply loses variables and interesting results.[1]

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[1] The six-factor solution accounts for 73 percent of the variance. (Variance refers to a statistical measure which reflects the different scale values of each of the variables as found in the tasks. The greater the range and distribution for the scales in the task data, the greater the variance.) The fact that the large number of variables are accounted for by a small number of factors with as much as 73 percent of the variance accounted for is considered statistically very satisfactory.

On inspecting the loadings of each variable on each factor it became evident that there are six, almost independent factors when factor loadings of .50 and higher are used to designate each factor. However, since loadings from .41 to .50 still have some influence on the character of a factor and help explain it, loadings of ±.41 or higher will be used in the discussion of the factor structure of variables. As a result of the lower criteria, 51 variables appear on more than one factor.

As Figure 6 indicates, Factor I accounts for 89 of the 144 variables. It also accounts for 33 percent of the variance. The meaning of this factor becomes clearer as the other factors are examined. It turns out that this factor refers to the basic skills and knowledges needed for surgery, diagnosis, prescription and teaching at the professional level.

Figure 6. DISTRIBUTION OF VARIABLES IN FACTORS

	Skills	Know.Categories	Total Variables	Variance
Total in Pilot Test Factoring	16	128	144	73%
Accounted For By Factor At ±.41 or Higher:				
Factor I	5	84	89	33%
Factor II	0	49	49	17%
Factor III	2	7	9	6%
Factor IV	7	8	15	5%
Factor V	3	11	14	6%
Factor VI	0	18	18	6%
Accounted For At ±.41 On More Than One Factor	3	48	51	
Unaccounted For At ±.41 On Any Factor	3	0	3	
Total Accounted For in Analysis	16	201	217	

The fact that there are 89 interrelated variables determining Factor I points up the dramatic fact that in health the professional levels are represented, not only by higher levels of knowledge, but by a

very wide variety of essential knowledge. This is the nature of diagnosis, prescription and surgery.

Figure 7 presents the 89 variables for Factor I in descending order of their loadings on the factor. Subjects in Normal Structure and Function, Pathology, Pharmacology, Surgery, First Aid, and many other related fields are represented. Their role in Factor I is, not that they are the only variables to consider when the tasks partaking of this factor structure are identified, but that these variables all tend to be needed if any are needed, and at interrelated levels.

The most important skills for Factor I involve Leadership (delegation of duties and teaching); Taxonomic Skills, clearly related to diagnosis; Figural Skills,most related to surgery; and Implicative Skills, most obviously needed for deciding on what to do next. The interrelationship of the skills and knowledge indicate that these will rise and fall together. They must, therefore,be taught in a similar fashion.

Returning to Figure 6, the reader will note that Factor II also shows the interrelationship of a large number of variables. This factor accounts for 17 percent of the variance and is determined by 49 knowledge category variables. On inspection of these variables in Figure 8, it becomes apparent that this is a factor involving diagnosis, treatment and care of pediatric patients, but may also cover chronic care. It includes the subject areas of Growth and Development and aspects of diagnosis and care in which the Center's emphasis on combining a behavioral orientation with medicine is reflected.

Figure 7 . INTERRELATED VARIABLES DETERMINING FACTOR I
p. 1 of 5

Category Number	Category Name	Factor Loading
12323000	Drug excretion	.92
12322000	Drug distribution	.91
12321000	Drug absorption	.90
12313000	Drug dose-response relationships	.90
13900000	Biochemical processes and mechanisms	.88
11743100	Biochemistry of nutrients	.86
12335000	Drug synergism	.86
11743200	Physiology of nutrients	.85
11731930	Autonomic nervous system	.84
11731920	Peripheral nervous system	.84
12342200	Drugs acting on the blood and immunologic system	.84
11732400	Metabolism	.83
11731640	Liver, biliary system, and pancreas	.83
12333000	Drug resistance (of a non-genetic nature)	.83
12342100	Drugs acting on the cardiovascular system and smooth muscle	.83
11731910	Central nervous system (brain and spinal cord)	.82
12342800	Drugs acting on the nervous system	.81
12341200	Antiprotozoal/antimetazoal chemotherapy	.81
11732300	Homeostasis of fluids	.81

Note: Factor loadings represent the degree to which skill and knowledge variables partake of the factor. Loadings are standardized and range from ±.00 to ±.99. Loadings of .41 or higher are shown. These variables tend to rise in an interrelated manner.

Figure 7 . INTERRELATED VARIABLES DETERMINING FACTOR I (continued)
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Category Number	Category Name	Factor Loading
11735500	Endoscopy	.81
11731610	Mouth, pharynx (digestive function), esophagus	.79
11731620	Stomach and small intestine	.79
11731630	Large intesting (colon) and rectum	.79
12342300	Hormones and drugs acting on endocrine glands and accessory reproductive organs	.79
12342600	Drugs for allergy, cough, vomiting and the dermato-mucosal surfaces	.79
12342700	Drugs acting on the gastrointestinal tract	.79
12342400	Vitamins and nutritional agents	.79
11735700	Manipulation	.79
11733530	Disorders of the autonomic nervous system	.77
12334000	Drug tolerance and physical dependence	.77
12341100	Antibacterial and antifungal chemotherapy	.77
12331000	Drug toxicity	.76
11731945	The ear (excluding balance function)	.76
12332000	Drug idiosyncrasy and allergy pharmacogenetics	.75
11731943	Eye and optic nerve	.74
11733520	Disorders of the peripheral nervous system	.74
11734800	Shock and trauma	.74
11732210	Endocrine glands and their hormone physiology	.73
11731810	Muscles	.73
11735000	Surgery	.72

Figure 7 . INTERRELATED VARIABLES DETERMINING FACTOR I (continued)
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Category Number	Category Name	Factor Loading
11732100	Immunologic system	.72
11731900	Nervous system	.71
11733510	Disorders of the central nervous system	.71
11731831	Skin and sweat glands	.69
11733700	Disorders of the digestive system	.69
11735600	Suture	.69
11733300	Endocrine, nutritional, and metabolic disorders	.68
11734200	Disorders of the musculoskeletal system and connective tissues	.68
11733800	Disorders of the respiratory system	.68
11737200	Hemorrhage and bleeding and their arrest	.68
11743000	Nutrition and dietetics	.68
11731300	Hematopoietic system	.67
11737600	Resuscitation	.67
11734100	Disorders of the skin and subcutaneous tissues	.67
11731600	Digestive system	.66
11735100	Operative procedures	.66
11731820	Bones and joints	.65
11731700	Urinary system and external genitalia	.65
11736000	Anesthesiology	.65
12300000	Pharmacology	.64
11731500	Respiratory system	.63
11732220	Reproduction	.63

Figure 7 . INTERRELATED VARIABLES DETERMINING FACTOR I (continued)
p. 4 of 5

Category Number	Category Name	Factor Loading
11733200	Neoplasms (cancerous growths)	.63
11733600	Disorders of the circulatory system	.62
11733900	Disorders of the uro-genital system	.61
11731400	Circulatory system	.60
11737000	First aid and care	.60
11737100	Bandages, dressings, tourniquets and splints	.60
11737700	Wounds and their healing	.60
5	Leadership	.59
11732223	Female reproductive system	.58
11733100	Infective and parasitic diseases	.56
13	Taxonomic Skills	.55
11735400	Introductory procedures	.55
12220000	Radiographic (X-ray) analysis	.55
11743400	Nutritional requirements and diets	.54
11731200	Topographic anatomy	.52
11745000	Growth and development	.50
11731100	Regional anatomy	.50
41696000	Psychosomatic disorders	.48
11731000	Normal structure and function	.47
11	Figural Skills	.47
11733000	Pathology	.46
11738000	Asepsis	.46

Figure 7 . INTERRELATED VARIABLES DETERMINING FACTOR I (continued)
p. 5 of 5

Category Number	Category Name	Factor Loading
14	Implicative Skills	.43
41697000	Transient situational disturbances	.43
65620000	Mechanics of writing English	.43
11745100	Embryology and prenatal period	.42
12	Symbolic Skills	.41

Note: Factor loadings represent the degree to which skill and knowledge variables partake of the factor. Loadings are standardized and range from ±.00 to ±.99. Loadings of .41 or higher are shown. These variables tend to rise in an interrelated manner.

Figure 8 . INTERRELATED VARIABLES DETERMINING FACTOR II
p. 1 of 3

Category Number	Category Name	Factor Loading
11733545	Disorders of the ear	.84
12341400	Local chemotherapy	.82
11733543	Disorders of the eye and optic nerve	.81
11745500	Adolescent growth	.80
41691000	Mental retardation	.78
41692000	Organic brain syndrome	.78
41697000	Transient situational disturbances	.78
11745400	Childhood growth	.77
11734700	Poisoning	.76
11742133	Special post-disease and chronic disease therapy	.76
11744100	Oral hygiene and care	.76
41660000	Development and growth of behavioral processes of the individual	.76
11733400	Disorders of blood and blood-forming organs	.75
11745600	Adulthood	.72
41690000	Psychopathology	.69
11734600	Burns	.68
41696000	Psychosomatic disorders	.68
11732222	Male reproductive system	.67
11742132	Corrective, preventive and compensatory adjustments	.66

Note: Factor loadings represent the degree to which skill and knowledge variables partake of the factor. Loadings are standardized and range from ±.00 to ±.99. Loadings of .41 or higher are shown. These variables tend to rise in an interrelated manner.

Figure 8 . INTERRELATED VARIABLES DETERMINING FACTOR II (continued)
p. 2 of 3

Category Number	Category Name	Factor Loading
11742100	Physical therapy	.66
11742148	Exercise	.65
11737400	Sprains, strains, fractures and their healing	.64
11741000	Epidemiology	.64
11743300	Nutritional qualities of foods	.64
11745300	Infant growth (second month through second year)	.63
11737500	Foreign bodies not involving wounds	.57
11745700	Old age (geriatrics)	.57
11734300	Congenital abnormalities	.56
11739430	Sanitation	.55
11745200	Neo-natal period	.53
11737300	Handling and transportation of the sick or wounded	.50
41710000	Psychotherapy and counseling	.50
11732100	Immunologic system	.48
11800000	Microbiology	.48
11732221	Conception and contraception	.47
11731300	Hematopoietic system	.46
12342600	Drugs for allergy, cough, vomiting and the dermato-mucosal surfaces	.46
11200000	Genetics	.45
11743400	Nutritional requirements and diets	.45
12342700	Drugs acting on the gastrointestinal tract	.45
11731943	Eye and optic nerve	.44

Figure 8 . INTERRELATED VARIABLES DETERMINING FACTOR II (continued)
p. 3 of 3

Category Number	Category Name	Factor Loading
11734200	Disorders of the musculoskeletal system and connective tissues	.44
12334000	Drug tolerance and physical dependence	.44
12342400	Vitamins and nutritional agents	.44
11731945	The ear (excluding balance function)	.43
12341200	Antiprotozoal/antimetazoal chemotherapy	.43
11733520	Disorders of the peripheral nervous system	.42
12333000	Drug resistance (of a non-genetic nature)	.42
11733700	Disorders of the digestive system	.41

Note: Factor loadings represent the degree to which skill and knowledge variables partake of the factor. Loadings are standardized and range from ±.00 to ±.99. Loadings of .41 or higher are shown. These variables tend to rise in an interrelated manner.

The fact that no skills are involved in determining Factor II does not indicate that they are not needed; only that they are not associated with these categories in any regular way.

Again returning to Figure 6, the reader will observe that Factors III, IV, V and VI all explain about six percent of the variance and are determined by 9, 15, 14 and 18 variables, respectively. These factors are easier to understand than Factors I and II. Factors I and II are clearly professional-level factors. The other four factors more obviously reflect groupings from which specially related sequences can be developed.

Factor III quite clearly relates to radiology and radiologic technology. As can be seen from Figure 9, its two skills, Figural and Taxonomic, interrelate with seven knowledge categories that reflect the work with X-rays.

Factor IV is described by Figure 10. This is a factor reflecting Human Interaction, counseling, social service and other behavioral aspects of care. The factor reflects the emphasis at the Center on providing care in a social as well as a medical context. The interrelationship between Human Interaction, Oral Use of Language, Decision Making on Methods and Decision Making on Quality was noted in early tests of the skills. The fact that they are again related suggests a stable association of these skill variables to which the addition of the knowledge categories adds a deeper meaning.

Figure 9 . INTERRELATED VARIABLES DETERMINING FACTOR III

Category Number	Category Name	Factor Loading
15315000	Optical properties	-.91
15214200	Optics	-.89
12210000	Radiobiology	-.84
12200000	Radiology	-.78
15212100	Electric circuit theory	-.72
12220000	Radiographic (X-ray) analysis	-.67
11	Figural Skills	-.55
11731200	Topographic anatomy	-.41
13	Taxonomic Skills	-.41

Note: Factor loadings represent the degree to which skill and knowledge variables partake of the factor. Loadings are standardized and range from ±.00 to ±.99. Loadings of .41 or higher are shown. These variables tend to rise in an interrelated manner.

Figure 11 presents the variables which determine Factor V. They describe the interrelated knowledges and skills needed for direct physical care of the patient, including Object Manipulation, the two Anatomies, much of First Aid, and Asepsis. It is of interest that Consequences of Error to Humans loads high on this factor. The immediacy of physical treatment raises the immediacy of the dangers involved and emphasizes the need to teach the appropriate skills.

Figure 10. INTERRELATED VARIABLES DETERMINING FACTOR IV

Category Number	Category Name	Factor Loading
41884000	Social service administration and policy	-.74
41885100	Social agencies (public and private) administration and policy	-.58
9	Decision Making on Methods	-.58
41884200	Health services administration and policy	-.56
41710000	Psychotherapy and counseling	-.56
4	Human Interaction	-.55
6	Oral Use of a Relevant Language	-.55
41690000	Psychopathology	-.50
14	Implicative Skills	-.51
10	Decision Making on Quality	-.48
7	Reading Use of a Relevant Language	-.48
8	Written Use of a Relevant Language	-.47
65620000	Mechanics of writing English	-.46
11733000	Pathology	-.43
11739430	Sanitation	-.42

Note: Factor loadings represent the degree to which skill and knowledge variables partake of the factor. Loadings are standardized and range from ±.00 to ±.99. Loadings of .41 or higher are shown. These variables tend to rise in an interrelated manner.

Figure 11. INTERRELATED VARIABLES DETERMINING FACTOR V

Category Number	Category Name	Factor Loading
11731200	Topographic anatomy	-.58
11738000	Asepsis	-.58
2	Object Manipulation	-.57
16	Consequences of Error To Humans	-.56
11737300	Handling and transportation of the sick or wounded	-.53
11731100	Regional anatomy	-.52
11737200	Hemmorrhage and bleeding and their arrest	-.52
11737100	Bandages, dressings, tourniquets and splints	-.52
11731400	Circulatory system	-.48
11745300	Infant growth (second month through second year)	-.45
11735400	Introductory procedures	-.44
11	Figural Skills	-.44
11745200	Neo-natal period	-.42
11731500	Respiratory system	-.41

Note: Factor loadings represent the degree to which skill and knowledge variables partake of the factor. Loadings are standardized and range from ±00 to ±99. Loadings of .41 or higher are shown. These variables tend to rise in an interrelated manner.

Figure 12 presents Factor VI. This factor is extremely easy to interpret and provides one of the more intellectually satisfying results of the factoring. This is a female care factor, covering sex, conception, contraception, pregnancy, childbirth and gynecological disorders. It is of interest to note that the surgical aspects of obstetrics and gynecology are largely represented in Factors I and V. The absence of skills from the factor suggests that the skill variables do not interrelate systematically with the knowledge variables.

FACTOR STRUCTURE OF TASKS

The "two-mode" factor program was applied to a full set of task data for the first time during the pilot test. The results were extremely gratifying. The six task factors are based on the loadings of the tasks on each of the six factors. Each factor is the expression of its counterpart variable factor. A task's loading on a factor is determined by the degree to which it partakes of the skill and knowledge variables that determined its corresponding variable factor. The interrelationship of the variable factors and the task factors is achieved through the use of the two-mode program.

The two mode solution permits the rank ordering of each task on each factor by its loading on the factor. A task's loading reflects its scale values on the variables involved in the factor and also reflects the number of those variables determining the factor on which the task scales above zero. Thus, the more categories and skills involved in the factor and the higher the task's scale value for these, the higher

Figure 12. INTERRELATED VARIABLES DETERMINING FACTOR VI

Category Number	Category Name	Factor Loading
11735800	Delivery methods for childbirth	-.80
11745100	Embryology and prenatal period	-.70
11734400	Disorders and complications of pregnancy, childbirth, puerperium	-.67
11734500	Perinatal morbidity and mortality	-.63
11732223	Female reproductive system	-.52
11732221	Conception and contraception	-.51
11732222	Male reproductive system	-.48
11733900	Disorders of the uro-genital system	-.48
11800000	Microbiology	-.48
11734300	Congenital abnormalities	-.47
11200000	Genetics	-.47
11732220	Reproduction	-.46
11731700	Urinary system and external genitalia	-.46
11741000	Epidemiology	-.45
11732210	Endocrine glands and their hormone physiology	-.44
11735100	Operative procedures	-.44
11733100	Infective and parasitic diseases	-.43
11733300	Endocrine, nutritional, and metabolic disorders	-.41

Note: Factor loadings represent the degree to which skill and knowledge variables partake of the factor. Loadings are standardized and range from $\pm.00$ to $\pm.99$. Loadings of .41 or higher are shown. These variables tend to rise in an interrelated manner.

the task's loading on the factor. Tasks with no knowledge categories and few skills do not load high on any factor.[2]

Assignment of Tasks to Factors

Rank ordering the tasks for each factor is not enough for assignment of tasks to factors. A task may load high on many factors. The nature of the variable data in health care tasks is such that most higher level tasks include most knowledge categories and most skills, while many variables are represented in more than one factor. Thus, it must be emphasized that the assignment of a task to a factor must primarily reflect its relation to lower-level tasks in terms of the variables which determine the factors.

The method used was to assign a task to the factor on which it loaded highest, with assignment to other factor(s) on which it loaded high if the manifest content of the task and the factor warranted this. At the initial stage of analysis this practice permitted detailed inspection of alternatives. Tasks which loaded low on all factors because they require little or no knowledge or skills were not assigned to factors unless there was a clear association of the context of the task with the

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[2] By way of contrast, the use of a "factor score" program for rating tasks on the basis of the factor structure of variables proved to result in distortions. Those aspects of the factor structure resulting from chance statistical quirks are greatly magnified, and the procedure leads to bizarre results, especially with tasks having few knowledge categories. The "two-mode" method proved to be far superior.

content of the factor. For example, preparing for suture was put into the same factor with suturing by virtue of its context.

Since the concept of graduated educational steps lies behind the reason for arranging tasks in hierarchies by factor, it was decided to examine the tasks in each rank order grouping to see if some tasks should not be on one or another factor by virtue of requiring too many skills or knowledge categories unrelated to those required by the other tasks in the factor. The reader will remember that the task's loading on a factor determines its rank order on the factor; but the task can require a good many other skills and knowledge categories beyond those determining the factor.

As a result of this latter inspection, the number of tasks assigned to more than one factor was somewhat reduced, but no major reshuffling was required. The factor structure of tasks has proven to be surprisingly sensitive to the general direction of educational content and level, and produces robust results.

As Figure 13 indicates, the two professional-level factors (Factors One and Two), which account for the largest number of skill and knowledge variables, account for (or are the highest factor for) the fewest number of tasks. Most of the tasks' loadings fall away sharply from these two factors, expressing the vast educational gap between surgery, diagnosis, and prescription tasks, and most other tasks. There were 61 tasks unassigned to factors, and 17 tasks represented on two factors each.

Figure 13. DISTRIBUTION OF TASKS TO FACTORS

	Number	Percent of Total
Total	273	
Factor One	15	5
Factor Two	11	4
Factor Three	26	10
Factor Four	60	22
Factor Five	90	33
Factor Six	27	10
Unassigned	61	22
On More Than One Factor	17	6

The factor with the largest number of tasks was Factor Five, the Physical Treatment and Care Factor, followed by Factor Four, the Human Interaction, Social Service and Counseling Factor.

Assignment of Tasks to Levels by Factor

Although the factor loadings for the tasks permitted easy assignment of tasks to factors, the meaning of a difference of loading of, for example, .83 and .44 was hard to judge in educational terms. A task's loading at .83, when contrasted with a task loading of .44, means more categories related to the factor for the task, or higher scale values for the categories, or a combination of these. In addition, the weight of a variable on the factor (the variables own loading on the variable factor) also influences a task's factor loadings.

Since the objective was to identify rungs on a ladder, stages in a sequence, or comparable levels for tasks -- all of these being interchangable concepts -- it was necessary to do one further type of analysis. The tasks of a factor were laid out in rank order of their load-

ings on the factor, and the skills and knowledges were laid out in the order of their appearance in tasks, from low to high on the factor. This permitted identification of the major cut-off points when marked increases in scale level occurred or when large blocks of new knowledge categories were needed. This information was used to determine which tasks within a factor were at relatively the same level. Finally, by using the tasks which appear in more than one factor as an added guide, it was possible to relate the task level groupings across factors.

Seven levels were identified; but each factor did not necessarily have tasks at each level. (Within Factor Four, the third level is divided into two parts on the basis of the content of the tasks involved.) Figure 14 indicates the distribution of tasks by level.

Figure 14. DISTRIBUTION OF TASKS BY LEVEL

	Number	Percent of Total
Total	273	
Level 7	4	1
Level 6	22	8
Level 5	23	8
Level 4	28	10
Level 3	55	20
Level 2	74	27
Level 1	72	26
On More Than One Level	7	3

A task could be on one level for one factor and on another level for another by virtue of what it had in common with the other tasks in a level.

Tasks which appear in Factors Five and Six appear at the same level in each. Tasks which appear in Factors Four and Five tend to be at a lower level in Four. This reflects the fact that Factor Four is determined more by skill interrelationships than by knowledge interrelationships.

As can be expected, the tasks decrease in number as the levels rise. The shape of the distribution is not unlike the distribution of jobs in the industry as a whole. (The major difference is that the levels of the jobs do not necessarily correspond to the levels of the tasks.)

The reader who wishes to identify the levels in academic or occupational terms might consider the following possible characterizations for the seven levels:

Level 1	Aide; entry; unskilled; on-the-job-training.
Level 2	Assistant; semi skilled; on-the-job-training with credit.
Level 3	Technician; some special training; about one year.
Level 4	Semi-Professional; two or more years of training.
Level 5	Professional I; professional training.
Level 6	Professional II; highly rigorous and/or specialized professional training.
Level 7	Surgery or its equivalent in post professional training.

The Task Sequences

Figure 15 presents the tasks by code number within levels and by factor. It is a visual portrayal of the results of the factor analysis. The six factors are represented as task sequences rather than job ladders because the nature of the factors are such that, ideally, whole jobs would

Figure 15. TASK SEQUENCES BY FACTOR ASSIGNMENT AND TASK GROUPINGS

Task Sequence Level	ONE Surgery, Diagnosis and Prescription	TWO Pediatric Diagnosis and Prescription	FOUR Social Service and Counseling	SIX Female Care	FIVE Physical Care and Treatment	THREE Machine Related Care and Radiology	
(7)	47 49 48 44						
(6)	21 46 43* 9 39 10	55 63 64 56 27	25	54 52 43* 42*	28* 37 60 62 22	6 8	
(5)	45 40 53 28*	29 123 120		86 85 89 50* 41*	50* 30 32 41* 61 91 31 87	1 3 4 7 20	
(4)	42*	88 83 24	90 125 121 114 101* 102 115 110	248 101* 84 5* 11 202* 226* 250*	12 17 19 34 59 33 250* 13 5* 105 171		
(3)	Administrative and Supply Tasks 165		236 26 239 127 23 111 241 219 122 252 148 154 249* 203 158 237 245 226* 100	258* 249* 103 51 16 143* 15 117* 118* 107*	38 18 112 156 192 167 133 251 57 117* 143* 92 119 243 232 118* 58 104 109 218 191	68 67 65 66 81	Lab Re-la-ted 36 14 35
(2)	186 76 242 128 157 129 134		246 159 238 202* 124 197 228 221 255 258* 240 131 261 253 94 77	179 229 152 185 210 215* 206 163 224 173 244 199 93 200 201 162 142 95 96 205 190 194 233 177 188 209 212 195 187 189 256 161 170 198		73 74 262 270 257 99 82 79 132 271	139 207 172 141 98 108 140
(1)	235 164 150 220 264 160 136 75 130 151 176 266 80 230 137 168 169 231 265 184		234 259 107* 116 138 247 204 211 254 215* 126 113 216 106 225 208	217 213 166 260 180 181 153 193 183 182 214	Machine Related and Household 135 147 175 178 149 174 70 2 268 72 269 267 223 69 222 144 146 273	71 73 263 272	155 97 147 196

Numbers are task code number. See Table A.1.
* Asterisk indicates that task also appears on another factor.

probably be made up of combinations of one or more sequences rather than a single factor or the task contents would be edited or expanded.

The reader will note that tasks appearing on more than one factor appear with asterisks. (They later become the basis for lattice relationships.) Tasks which were not assigned to factors have been grouped in terms of their skill and knowledge requirements and function. They provide entry level sources for the sequences and/or the rudiments for other factors to be expected when the data base is expanded to include more job titles, such as in the laboratory or in administration.

The task content of the sequences are presented in Figures 16 through 22,which follow. Each Figure presents the tasks of one of the task factors. On the left is the task's code number and the task's abbreviated name. (The full name can be found in Appendix Table A.1.) Next to the name appears the title in which the task is located. If it is an overlap task, more than one title appears. Next to each title is the scale value on the Task Frequency Scale which indicates how often the performer does the task. Appendix B.3 presents the Task Frequency Scale. The last column on the right presents the task's loading on the factor. The reader will note that the tasks are listed in descending order of their loadings. At various intervals within the Figure there is a horizontal line. These lines separate task levels, so that all the tasks between such lines are grouped into the same level.

Figure 16 is the Factor One Task Hierarchy. At the top of the Figure are the Obstetrician-Gynecologist's surgical tasks. Included in

Figure 16. FACTOR ONE TASK HIERARCHY: SURGERY, DIAGNOSIS AND PRESCRIPTION SPECIALTY

Task Code No.	Abbreviated Name of Task	Current Titles[a]	Frequency[b]	Loading on Factor[c]
47	Surgical excision of uterus, ovaries: hysterectomy through abdomen or vagina.	OB-GYN	4	1.78
49	Ligation of fallopian tubes.	OB-GYN	4	1.78
48	Vaginal plastic surgery or correction of vaginal hernia.	OB-GYN	3	1.78
44	Cesarean section delivery.	OB-GYN	3	1.67
21	Informally instructing interns, residents in patient care.	INT	4	1.62
46	Saline abortion.	OB-GYN	2	1.59
43	Delivery of baby through vagina.	OB-GYN	3	1.54
9	Diagnosing medical condition and deciding care for non-child patient.	INT	7	1.53
39	Diagnosing obs-gyn condition and deciding care for female patient.	OB-GYN	8	1.51
10	Deciding whether to proceed with care and administer medication to non-child patient.	INT	7	1.44
45	Currettage abortion.	OB-GYN	4	1.39
40	Deciding whether to administer or change medication for female patient.	OB-GYN	6	1.35
53	Instructing nurses in obs-gyn patient care.	OB-GYN	7	1.05
28	Emergency life support care.	INT PED	1 2	.79
42	Providing fertility assistance for female pt.	OB-GYN	4	.77

[a] Radiologist = RAD; Internist = INT; Obstetrician-Gynecologist = OB-GYN; Pediatrician = PED; Lead X-ray Tech. and X-ray Tech. = X-ray; Nurse Practitioner = NP; LPN-Unit = LPN-U; LPN-Emergency = LPN-E; Family Health Worker = FHW; Medical Assistant-Unit = MA-U; EKG Tech. = EKG; Dark Room Aide = DRA.

[b] Numbers refer to scale values of the Task Frequency Scale. (B.3).

[c] Loadings represent the degree to which task partakes of factor. Loadings are not standardized, and sign has no intrinsic meaning except for change from high on one, passing through zero, to opposite sign, as continuous hierarchy.

this factor are the diagnosis and prescription tasks for Obs-Gyn and for the Internist, and the reconsidering and administration of medication for both physicians. Teaching tasks which draw on similar knowledge are also included. The bottom of the sequence is a fertility assistance task. Its appearance here is better understood if it is remembered that the task includes andrometric biopsy (part of surgical procedures) and pharmacological prescription when either is appropriate.

With the identity of the tasks known, the reason for the large number of variables for this factor is apparent. These tasks represent a sequence of professional level tasks, all of which draw on a vast quantity of knowledge at fairly high levels. The reason that none of the other factors lead into this one is due to the sheer magnitude of the increase in knowledge categories and the rise in scale levels.

Figure 17 presents the Factor Two tasks. At the top of this sequence is the diagnostic task in pediatrics and related teaching. The entry to this factor is through the Nurse Practitioner's junior version of diagnosis (for adults as well as for juveniles). It is apparent that the variable factor drew on the need for subjects in Growth and Development for these tasks. The factor differs from Factor One in this respect; it also differs because it does not involve subjects directly related to surgery or obstetrics.

The Factor Three task hierarchy (Figure 18) provides the first interesting surprise. It seems that there are tasks outside the usual scope of X-ray that are related to the factor. These tasks include those

Figure 17. FACTOR TWO TASK HIERARCHY: PEDIATRIC SPECIALTY IN DIAGNOSIS AND PRESCRIPTION

Task Code No.	Abbreviated Name of Task	Current Titles[a]	Frequency[b]	Loading on Factor[c]
55	Diagnosing health and development and deciding care for pediatric patient.	PED	8	1.65
63	Lectures, tests for Nurse Practitioners; delegation of duties considered.	PED	3	1.60
64	Informally training Nurse Practioners; delegation of duties considered.	PED	4	1.49
56	Deciding whether to go ahead with pediatric care and administer medication.	PED	6	1.43
27	Lectures to staff and students on health and medical subjects.	INT OB-GYN	2 2	1.22
29	Informally instructing subordinates in patient care.	INT PED	4 3	1.16
123	Instructing Family Health Workers or Nurse-interns in patient care.	NP	44	.90
120	Preparing, presenting classes for Family Health Workers; evaluating students.	NP	2	.84
88	Identifying juvenile's health condition.	NP	7	.59
83	Identifying obvious medical condition of adult and follow-up on care.	NP	4	.44
24	Assessing urgency of follow up for no-show patients.	INT OB-GYN PED	6 6 7	.34

[a] Radiologist = RAD; Internist = INT; Obstetrician-Gynecologist = OB-GYN: Pediatrician = PED; Lead X-ray Tech. and X-ray Tech. = X-ray; Nurse Practitioner = NP; LPN-Unit = LPN-U; LPN-Emergency = LPN-E; Family Health Worker = FHW; Medical Assistant-Unit = MA-U; EKG Tech. = EKG; Dark Room Aide = DRA.

[b] Numbers refer to scale values of the Task Frequency Scale. (B.3).

[c] Loadings represent the degree to which task partakes of factor. Loadings are not standardized,and sign has no intrinsic meaning except for change from high on one, passing through zero, to opposite sign,as continuous hierarchy.

Figure 18.

FACTOR THREE TASK HIERARCHY:
SPECIALTY IN MACHINE RELATED CARE AND RADIOLOGY
p. 1 of 2

Task Code No.	Abbreviated Name of Task	Current Titles[a]	Frequency[b]	Loading on Factor[c]
6	Reading, assessing X-rays and making recommendations.	RAD	8	-1.12
8	Answering MD questions about radiographs.	RAD	3	-1.06
1	Fluoroscopy of lower intestinal tract.	RAD	6	-.86
3	Fluoroscopy of upper GI tract.	RAD	6	-.86
4	Fluoroscopy portion of hysterosalpyngography.	RAD	3	-.85
7	Assessing performance and output of X-ray workers.	RAD	4	-.76
20	Reading and interpreting "stat" X-rays on request.	INT PED	4 6	-.42
68	Preparing patient and barium drink for fluoroscopy and taking upper GI X-rays.	X-ray	6	-.38
67	Taking lower GI series X-rays and scout film.	X-ray	6	-.38
65	Taking X-rays with vertical or table X-ray machine.	X-ray	8	-.37
66	Taking IVP X-rays after allergy test.	X-ray	4	-.36

[a] Radiologist = RAD; Internist = INT; Obstetrician-Gynecologist = OB-GYN; Pediatrician = PED; Lead X-ray Tech. and X-ray Tech. = X-ray; Nurse Practitioner = NP; LPN-Unit = LPN-U; LPN-Emergency = LPN-E; Family Health Worker = FHW; Medical Assistant-Unit = MA-U; EKG Tech. = EKG; Dark Room Aide = DRA.

[b] Numbers refer to scale values of the Task Frequency Scale. (B.3).

[c] Loadings represent the degree to which task partakes of factor. Loadings are not standardized, and sign has no intrinsic meaning except for change from high on one, passing through zero, to opposite sign, as continuous hierarchy.

Figure 18. FACTOR THREE TASK HIERARCHY (continued)
p. 2 of 2

Task Code No.	Abbreviated Name of Task	Current Titles[a]	Frequency[b]	Loading on Factor[c]
81	Assessing quality of radiographs.	X-ray	8	-.28
73	Reassuring patient about X-ray procedures.	X-ray	9	.02
74	Re-explaining pre-X-ray home procedures to pt.	X-ray	6	.02
262	Preparing patient and taking electrocardiogram.	EKG	8	.05
270	Demonstrating and instructing on taking EKG.	EKG	2	.05
257	Giving vision screening tests (Keystone and Snellin).	MA-U	6	.05
99	Administering Snellin eye test.	NP	2	.07
82	Calling repair company re X-ray equipment.	X-ray	6	.07
79	Preparing barium enema.	X-ray	6	.07
132	Checking and caring for equipment.	LPN-U LPN-E	4 4	.07
271	Deciding if EKG reading looks suspicious.	EKG	6	.07
71	Developing radiographs using hand developer.	X-ray DRA	3	.08
78	Preparing radiograph packet for interpretation.	X-ray	9	.08
263	Cutting and mounting an EKG strip.	EKG	8	.09
272	Checking level of developer and fixer solution.	DRA	6	.09

[a] Radiologist = RAD; Internist = INT; Obstetrician-Gynecologist = OB-GYN; Pediatrician = PED; Lead X-ray Tech. and X-ray Tech. = X-ray; Nurse Practitioner = NP; LPN-Unit = LPN-U; LPN-Emergency = LPN-E; Family Health Worker = FHW; Medical Assistant-Unit = MA-U; EKG Tech. = EKG; Dark Room Aide = DRA.

[b] Numbers refer to scale values of the Task Frequency Scale. (B.3).

[c] Loadings represent the degree to which task partakes of factor. Loadings are not standardized, and sign has no intrinsic meaning except for change from high on one, passing through zero, to opposite sign, as continuous hierarchy.

involved in EKG and eye tests. What is involved are the Figural Skills, Object Manipulation and knowledge such as Topographic Anatomy and Handling and Transporation of the Sick or Wounded. Moreover, these tasks are on the factor because the variables which determine the factor are required in a manner more compatible with the interrelationships among variables on this factor than on others.

An additional point of interest about this factor is that there are obvious gaps in the sequences. The tasks in X-ray performed at the Center do not warrant placement above Level 3. The Radiologist's tasks first appear at Level 5. Thus, there is the suggestion that the task sequence must carry the performer out of the Center and into the hospital for any real upgrading to be possible. The curriculum implication of this is discussed later in this document.

Figure 19 presents the tasks of the Social Service and Counseling Factor. This factor is loaded down by the institutional tasks of attending conferences and participating on committees because of the Human Interaction and related skills involved. Discounting these tasks, one has a factor which addresses itself to counseling and teaching the patient, providing social services, dealing with social problems and, in a rudimentary way, giving some psychological services. The factor is probably truncated. The functions of the social worker, psychologist or psychiatrist were not covered in the pilot test. However, the factor does emphasize the counseling aspects of some of the patient care tasks of the Nurse Practitioner and the Family Health Worker in cases where the abbre-

Figure 19. FACTOR FOUR TASK HIERARCHY: SOCIAL SERVICE AND COUNSELING SPECIALTY

Task Code No.	Abbreviated Name of Task	Current Titles[a]	Frequency[b]	Loading on Factor[c]
25	Participating in Family Health conference as internist.	INT	4	-.51
90	Post-hospital visit to chronic schizophrenic patient.	NP	4	-.47
125	RN committee work on health procedures.	NP	3	-.46
121	Participating in Family Health Team conference as Nurse Practitioner.	NP	4	-.45
114	Pragmatic counseling for patient on personal problems.	NP	4	-.43
101	Counseling in sex, contracept., VD, abortion.	NP	6	-.41
102	Chronic or special care procedures for daily living reinforced or explained to patient.	NP	4	-.41
115	Deciding on and arranging referral of patient to agency.	NP FHW	6 9	-.32
110	Answering patient's questions on care at RN level.	NP	8	-.31
236	Discussing personal, social, health problems with patient.	FHW	4	-.30

[a] Radiologist = RAD; Internist = INT; Obstetrician-Gynecologist = OB-GYN; Pediatrician = PED; Lead X-ray Tech. and X-ray Tech. = S-ray; Nurse Practitioner = NP; LPN-Unit = LPN-U; LPN-Emergency = LPN-E; Family Health Worker = FHW; Medical Assistant-Unit = MA-U; EKG Tech. = EKG; Dark Room Aide = DRA.

[b] Numbers refer to scale values of the Task Frequency Scale. (B.3).

[c] Loadings represent the degree to which task partakes of factor. Loadings are not standardized, and sign has no intrinsic meaning except for change from high on one, passing through zero, to opposite sign, as continuous hierarchy.

[d] Task actually loads higher on another factor. Consider variables determining factor for placement here.