Developments in Business Simulation & Experiential Exercises, Volume 16, 1989

THE CANADIAN HOSPITAL EXECUTIVE SIMULATION SYSTEM (CHESS)

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ABSTRACT

This paper discusses the development of the Canadian Hospital Executive Simulation System (CHESS), a computer-based management decision-making game designed specifically for Canadian hospital administrators. It begins with a brief introduction regarding the development of health care industry-specific simulation games. Next, it examines the need for, and the steps in the development of CHESS; finally, it concludes with a description of the CHESS model and plans for a field test of the model.

HOSPITAL MANAGEMENT GAMES

Simulation games have been in use in business schools and by various organizations since the 1950s. The use of these models by health care educators, however, developed somewhat later. A model entitled The Hospital Game, developed by Jack Meredith, has been available since 1977. The state of the art in health care management simulation games in the United States was described by Suver, et al, in 1983.' Five models of varying complexity were discussed by Suver, and though idiosyncrasies were noted in each, they all share one obvious common characteristic, i.e. they attempt to simulate a health-care environment.

No major changes have been made in the state of the art of health-care models since 1983, other than to take greater advantage of microcomputer power and availability. One model discussed by Suver, The Hospital Simulator (HOSPSIM),2 was developed by two of the authors of this article.' HOSPSIM focuses on the management of an individual hospital in the United States and the functional decisions that must be made, by participants using the model, to meet management and community objectives. The CHESS model described in this paper has several of the characteristics of HOSPSIM, although there are considerable differences due to variations in the simulated environments.

THE NEED FOR CHESS

The need for a model oriented to the Canadian health care delivery system was described in 1984 by Charles A. Shields, the Vice-President for professional Development for the Canadian College of Health Services Executives (CCHSE). The HOSPSIM model, with its U.S. health care environment, was used in a two-day workshop during the Alberta Hospital Association's Annual Institute on Hospital Administration in late 1986. Although the simulation/game technique was well received by the Canadian hospital administrators who participated in the HOSPSIM workshop, they noted that a model reflecting the Canadian health-care environment would have been more effective. Further discussions with Shields during 1986-87 regarding the development of such a model resulted in a meeting of interested parties in Ottawa, Canada to resolve this issue.

OTTAWA FOCUS GROUP

A focus group convened by CCHSE consisting of practioners and educators from the Canadian health care field, plus the authors of HOSPSIM, met in Ottawa in September 1987. The purpose of this meeting was to determine the feasibility of developing a Canadian health-care model, and to determine what factors should be considered in such a model. The group concluded that while there are many differences between Canada and the United States in the delivery of health care, there are also many similarities; thus a model with a variation on the approach used by HOSPSIM would expedite the development of a Canadian version.

The group also decided that the first step in developing such a model would be to begin with a hospital based system, and concluded that the model to be developed should simulate a "typical" 200-250 bed active treatment hospital. A hospital in this sense is defined as an institution where patients are accommodated on the basis of medical need and are provided with continuing medical care and supporting diagnostic and therapeutic services at a classification level of secondary. Secondary health care is one of three levels of health-care classification; this mid-level of care consists of specialized care requiring more sophisticated and complicated diagnosis and treatment than is provided at the primary (or lowest level) health care level.

MODEL DEVELOPMENT PROCESS

A survey was conducted in late 1987 to determine the characteristics of a "typical" 250 bed active treatment hospital. The survey instrument consisted of two parts. Part one of the survey was completed by the Chief Executive Officer of each participating institution and sought the CEO's opinion regarding those variables which should be included in the proposed model, and their views regarding many aspects of their organization's planning and decision-making environment and process.

Part two of the survey instrument asked for more specific and detailed information relating to factors in each institution such as the number of each medical specialty on staff, the number of patient days per year, patient types, resource use per patient types etc. The Canadian College of Health Service Executives solicited responses from twenty hospitals throughout the ten Canadian provinces, and responses were received from 17 hospitals reflecting input from eight of the ten provinces. Following initial analysis of the data received from the

survey, on-site interviews were conducted with a number of the survey respondents.

A number of individuals representing provincial and national health ministries and other health-professional agencies were also interviewed. The interviews were completed in January 1988, and the information obtained from the surveys and interviews was used to develop a conceptual model of CHESS which was presented in Calgary at the Canadian College's annual Congress in February 1988. The response to the conceptual model was positive; thus the decision was made to proceed with development of CHESS and to field test the model in the fall of 1988.

THE MODEL

CHESS simulates the operation of two to twelve urban active treatment hospitals. In this simulation/game, participants are organized into management teams; each team represents an individual hospital. Decision-making emphasis is placed on key management decisions, where Participants represent the top management team of a hospital and make decisions in each of the functional areas of the hospital's operation. The evaluation of performance of each management team is accomplished by comparison of the results achieved by each team to the results achieved by other management groups participating in the simulation.

CHESS is a short-run game/model in that decisions are made quarterly and the results of these decisions are available after each quarter's simulation. The simulator is also a long-run game/model because as many quarterly decisions as desired may be made by participants to reflect the passage of time of several years. Management teams operate each hospital by means of decision variables such as the service offered, the medical and hospital staff available, bed mix, ancillary capacity/staff, etc. Decisions are made by each team by entering values for the decision variables in a decision form on a quarterly basis.

Specific decisions are made quarterly and relate to such factors as:

Medical Staff size/mix
Nursing Service hours available
Bed capacity/mix
ancillary procedure capacity
Ancillary staff available
Maintenance expenditure
Housekeeping expenditure
Education/Training expenditure
Capacity expansion/contraction

These values and others are entered by a Game Director into a computer as variables in a mathematical model. The results, as computer printouts, are returned to each hospital "management team" for analysis of their quarterly performance. Output results available to each team consist of healthcare-related statistics for their service area plus operational and financial data relating to each hospital's past quarterly performance.

The computer program used in CHESS is a mathematical modes based on relationships abstracted from the results of the above mentioned survey and on-site interviews. The model, as expected, does not include all possible relationships but does include many general concepts related to the actual workings of active treatment hospitals.

The Hospital simulated in CHESS is a non-profit corporation that owns and operates a 250-bed, active treatment hospital. The Hospital is supported by a medical staff of 59 physicians. It is one of 2 to 12 regional active treatment hospitals that serve urban service areas in Anyprovince, Canada. Patients from each hospital's service area also have access to a tertiary hospital and to several primary hospitals in the region. The regional hospitals are the only ones that reflect the patient demand generated in the simulation. Unsatisfied patient demand automatically flows to the tertiary and primary hospitals. The service-area population generally has the same characteristics as the overall population of Canada.

Each hospital participating in the simulation/game starts from essentially the same position. Each hospital has been operating for approximately the same length of time before a management group begins to operate the Hospital. Thus, the history of each hospital is very much like the history of all competing hospitals.

Each hospital management team receives four reports each quarter.

1. A Peer Report - This report contains very general information about the operations of all hospitals involved in the simulation exercise. In addition, this report contains general information relating to the state of the economy and other items of interest to the health-care community in Anyprovince.

2. A report of the general operational data unique to the hospital each team manages.

3. Financial statements for the hospital the team manages.

4. Management Information System Trumpet (MIST) A detailed report of operational and financial indicators for the hospital the team manages. The report also contains averages of comparable data items for other hospitals in the exercise.

The first three of these reports are provided automatically each quarter. The fourth report, MIST, is provided only if a hospital management team elects to purchase it. A MIST report is shown in Table 1 to indicate the kind of information available to the simulation/game participants.

TABLE 1

Each quarter a management team must consider several individual decisions. Some of these decisions must be repeated every quarter while others may be necessary only on occasion or not at all. Table 2 gives an example of a decision form which must be completed each quarter.

TABLE 2

Area demand for active treatment hospital care is basically a function of the service area population. The expected annual patient days of care for each hospital are approximately 430 per 1,000 population.

TABLE 1

C H E S S 09-01-1988 10:10:47
M I S T

HOSPITAL# 2
QUARTER 3, 1988

ANCILLARY SERVICES SECTION*	YOUR INSTITUTION	PEER GROUP
ROUTINE PROCEDURES/PATDAY	10.64	10.64
DIR EX/PROCEDURE	5.18	5.18
PD HRS/PROCEDURE	0.23	0.23
CRITICAL PROCEDURES/PATDAY	2.17	2.17
DIR EX/PROCEDURE	6.04	6.04
PD HRS/PROCEDURE	0.25	0.25
SUPPORT:EDUCATION AND TRAINING EXPENSE	5000.00	5000.00
MAINTENANCE EXPENSE	230000	230000
UTILITIES	529723	529723
HOUSEKEEPING EXPENSE	90000	90000
SQ FT COVERED BY HOUSEKEEPING	220000	220000
PERSONNEL:PAID NURSING HRS/PAT DAY	5.43	5.43
PAID PROFESSIONAL HRS/PAT DAY	2.96	2.96
OVERALL AVG HOURLY WAGE	13.00	13.00
EMPLOYEE BENEFITS % WAGE	15.00	15.00
FINANCIAL:REVENUE/PAT DAY	141.67	141.59
EXPENSE/PAT DAY	149.37	149.37
REVENUE/DISCHARGE	3712.92	3711.96
EXPENSE/DISCHARGE	1623.18	1623.18
DEPRECIATION	329792	329792
INTEREST EXPENSE/BED	0.00	0.00
INSURANCE EXPENSE	237780	237780
NURSING SERVICES		
PAT DAYS % MED PATS	29.02	29.02
ALOS	10.84	10.84
REVENUE/PAT DAY	11.25	11.25
DIRECT EXPENSE/PAT DAY	77.51	77.51
PAT DAYS % SURG PATS	27.25	27.25
ALOS	6.58	6.58
REVENUE/PAT DAY	16.07	16.07
DIR EXPENSE/PAT DAY	81.59	81.59
PAT DAYS % OB PATS	6.06	6.06
ALOS	4.84	4.84
REVENUE/PAT DAY	18.75	18.75
DIR EXPENSE/PAT DAY	84.86	84.86
PAT DAYS % PSY PATS	6.59	6.59
ALOS	17.81	17.81
REVENUE/PAT DAY	16.55	16.55
DIR EXPENSE PAT DAY	90.08	90.08
PAT DAYS % PED PATS	3.53	3.53
ALOS	5.42	5.42
REVENUE/PAT DAY	0.00	0.00
DIR EXPENSE/PAT DAY	90.08	90.08
PAT DAYS % LT PATS	27.55	27.55
ALOS	242.98	242.98
REVENUE/PAT DAY	12.70	12.70
DIR EXPENSE/PAT DAY	80.29	80.29
PAT DAYS % OPSCASES	0.00	0.00
ALOS	1.00	1.00
DIR EXPENSE/CASE	0.00	0.00

HOSP	PATDAYS	DISCHS	REV/PD	REV/DISCH	COST/PD	COST/DISCH
1	19815	1823	341	3710	328	3568
2	19815	1823	342	3713	328	3568
3	19815	1823	342	3713	328	3568

TABLE 2

CHESS

DECISION FORM

HOSPITAL # ___, ___ QUARTER FY___

CHANGE TO BEDS IN SERVICE (+/- and NUMBER)

Med Pfd	Med Std	Surg Pfd	Surg Std	OBS Pfd	OBS Std	Psyc Pfd	Psyc Std	Ped Pfd	Ped Std	Extd Care Pfd	Extd Care Std
(01)	(02)	(03)	(04)	(05)	(06)	(07)	(08)	(09)	(10)	(11)	(12)

ADD ANCILLARY CAPACITY (<$25,000)

Critical	Routine
$_____ (13)	$_____ (14)

RECRUITING

Nursing Service	Professional Staff Critical	Professional Staff Routine
$_____ (15)	$_____ (16)	$_____ (17)

MEDICAL STAFF INCENTIVES

Med	Surg	Obs	Psyc	Ped
$_____ (18)	$_____ (19)	$_____ (20)	$_____ (21)	$_____ (22)

HOUSE-KEEPING	IE and R&D STUDIES	EDUCATION & TRAINING	PUBLIC RELATIONS	FUND RAISING	MIST (Y or N)
$_____ (23)	$_____ (24)	$_____ (25)	$_____ (26)	$_____ (27)	_____ (28)

MAINTENANCE

Beds	Procedures Critical	Procedures Routine
$_____ (29)	$_____ (30)	$_____ (31)

FINANCIAL

Short-Term Loan	Long-Term Loan	Invest Funds
$_____ (32)	$_____ (33)	$_____ (34)

MOH APPROVAL REQUIRED--USE FORM 22?

Change Ped Service	Change Day Sugery	Change Licensed Beds	Add Ancillary Proc Cacity (>=$25,000) Critical	Add Ancillary Proc Cacity (>=$25,000) Routine
_____ (35)	_____ (36)	_____ (37)	$_____ (38)	$_____ (39)

ANNUAL (3rd Q) Budget Requests

Operating	Capital
$_____ (40)	$_____ (41)

Other factors influencing area demand are economic conditions and seasonal effects. During expanding economic conditions, a slight decrease in patient days for private pay patients in the 15-44 age group in most services is expected. Slight seasonal patterns in demand are observed from reports of the last two-years operation of the hospital.

The model considers patient-day demand for six patient service types: medical, surgical, obstetrical, pediatric, psychiatric, and extended care/chronic. Participants are provided with information related to the annual patient days per 1,000 population expected for each of the six service types by selected age groups, the average length of stay by age group and patient service type, and the expected source of payment for these same age groups. Demand for patient days of care at each individual hospital is influenced by that hospital's medical staff size and composition.

Population in the service area is the primary determinant for area gross patient demand. Adjustments to this gross area demand, caused by changing economic conditions, seasonal factors and area image, generate net demand. Each regional hospitaPs share of this net area demand thus is primarily a function of these factors but may be adjusted downward if the appropriate medical staff is not available to serve its potential demand for patient days of care. This physician-adjusted hospital demand may be further adjusted downward as a result of poor hospital image.

Incentives and retention are key elements in determining the effective number and mix of physicians on the Hospital's staff. If the medical staff believes that their need for providing proper health care is being satisfied, their turnover will be minimal and their loyalty to the institution will remain high. Conversely, the model assumes that the members of a medical staff can become disenchanted in short order and shift their allegiances to other hospitals if such things as nurse adequacy and their perceptions of the hospital change, or if the hospital is unable to provide for the needs of the staff members' patients.

If a team chooses to recruit a physician for their staff, the cost varies from approximately $5,000 to $25,000 for each FTE physician. Approximately
$5,000 each is required for the specialties of Medicine, Obstetrics, and Pediatrics. The scenario in the model assumes a current shortage of certain surgical specialties and psychiatrists in the area; thus it is necessary to provide larger incentives to these two specialties. These figures may vary considerably based on the amount spent on recruiting by competing hospitals, the hospital's image, and patient days per full time equivalent (ETE) physician in each hospital versus this same factor in other hospitals.

The model permits a hospital to provide seven services, i.e., medical, surgical, obstetrical, pediatrics, psychiatric, extended care/chronic, and day surgery. The hospital does not currently have an established pediatric service nor a day-care surgical unit. Patients less than fifteen years old are currently admitted either as medical, surgical, psychiatric, or obstetrical patients.

Anciallary Procedure Capacity is one of three major constraints of CHESS, the other two being Beds and Professional Staff Hours. The term procedure as used describes in generaI terms the therapeutic and diagnostic procedures of the various medical specialties. The term also includes supplementary and/or related services. It encompasses all direct professional (excluding nursing) services that are identifiable for a specific patient type's stay in the hospital.

PROGRAMMING THE MODEL

Considerable time was saved in programming CHESS by modification of the HOSPSIM code rather than writing an entirely new program. Several interesting observations are appropriate relative to the modification of HOSPSIM. A brief description of the program changes provides another perspective on some key differences between U.S. and Canadian health-care models.

CHESS has fewer decision variables but more history variables than HOSPSIM. This results from a far greater reliance on operating and capital budgets under the government funded Canadian system and less concern with charges for room and care. The Canadian budgets depend heavily upon weighted patient days of care provided in the previous year and this dependence requires maintenance within the history files of more past year data.

k second major difference involves establishment of wage rates and benefits for professional staff. In Canada these are effectively "givens" for hospital administrators. That is, wages and fringe benefits are determined for entire provinces rather than hospital by hospital. Thus, in CHESS, wages and fringe benefits are the same for all peer group hospitals.

CHESS includes more nursing services than HOSPSIM, including day surgery, psychiatric, and extended care. GYN is, however, included as a part of "surgery" in CHESS, but as a separate service in HOSPSIM. Most operational management decisions are very similar in both CHESS and HOSPSIM. That portion of the model required minimal changes.

This brief summary of several key differences and similarities suggests some of the challenges in modifying HOSPSIM to become CHESS. Variable arrays required re-sizing. Mathematical expressions had to be modified. Report formats were changed and decision and history files had to have new structures.

HOSPSIM was programmed originally in interpretive BASIC and ran (slowly) on microcomputers with only 64K of core. Fortunately, HOSPSIM had been updated to a TURBOBASIC-compiled version which ran on IBM PC-compatible computers. The editing and debugging capabilities of TURBOBASIC made modification of the simulator much more manageable. Furthermore, faster microprocessors with more care, together with much faster printers, make the compiled version of both models (HOSPSIM and CHESS) considerably more user friendly.

FIELD TEST

The Canadian College of Health Service Executives has

scheduled in November a management workshop utilizing CRESS, which will be conducted in Ottawa. Plans are to conduct a three-day seminar with six teams of 3 to 5 participants each. Participants will include hospital administrators and staff, government officials, other health care professionals, and graduate students.

The primary objectives of the field test are to insure that the computer program is free of bugs, to get professionals to evaluate CHESS as to its realism and value as an educational tool, and to identify changes needed prior to finalizing the system. If CHESS performs as expected, a number of training seminars/workshops will be conducted at various locations across Canada beginning in April, 1989.

CONCLUSION

This paper has described a process by which HOSPSIM, a hospital simulation designed for the U.S. health-care delivery system, has been modified to become CHESS, a similar system for the Canadian health-care environment. Such systems have proven value as vehicles for training, team building, and for further research. The authors welcome comments and questions, and, together with the Canadian College of Health Service Executives, inquiries concerning utilization of the final model.

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