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The Service Complexities of General Tertiary Hospitals in Metropolitan Manila

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A scalogram analysis performed on twenty-three general tertiary hospitals in Metro Manila graphically illustrates the increasing complexity of the service departments (structure) and the medical equipment acquired (materiel) as they undergo sequential progression (evolution). The two scalogram scales concurrently reflect the hospital level of specialization structurally and materially in order to meet a wide range of health-related problems. Levels of specialization are not predictable by the length of existence; correlations are mostly low and insignificant. Hospitals found to be structurally specialized are also better equipped. The coefficient of synchronization between structural and materiel specialization is strong.

Introduction

How do hospitals evolve? Do hospitals develop their services and acquire diagnostic and treatment equipment in a cumulative pattern? What factors affect such development? The hospitals of today are conceivably not as complex nor as well-equipped as they were when they first started.

This paper will attempt to show the evolution of (1) hospital services/departments (structure) and (2) hospital diagnostic and treatment equipment (materiel) which they acquired through time, using the analytical procedure called the Guttman scale of the scalogram technique.

Objectives

The first objective of this study is to discover the pattern of evolution of general tertiary hospitals' services in Metro Manila. This development of increasing services is the indicator of specialization and structural complexity, the fulfillment of the expectation that general tertiary hospitals can accommodate a greater variety of ailments compared to other tertiary hospitals which are less complex. The second objective is again to discover the evolving pattern of equipment

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acquisition which we expect will go hand in hand with service complexity, i.e. that complexity of materiel is synchronous with complexity of services. The third and last objective is to test whether the evolutionary process is correlated with length of existence.

Methodology

Sampling

The hospitals included in this study are the 55 hospitals in Metro Manila classified as general tertiary hospitals by the Department of Health as of December 1987. Out of the 55 hospitals listed, 27 were chosen for a 50 percent sample size by interval sampling. The actual sample size was only 23 instead of 27, because some hospital administrators refused to be part of the study or made it very difficult to collect data. (Please see Appendix I.)

Procedure

Data on the various departments/services offered and equipment in services were collected from hospitals. Nonfunctioning equipment was scored as zero or not present. With the collected data, two separate batteries were constructed, the first one indicating the service complexity of hospitals using the scalogram technique. In the process, the original battery of 30 items was reduced in order to reach an acceptable coefficient of reproducibility (CR) of at least .90 and a coefficient of scalability (CS) of at least .65.

An identical procedure was used to produce a scale for equipment in service. The original battery of 40 items in service was reduced to a final battery of 13, producing a CR and a CS within acceptable limits.

The limitation of this study is that the scalogram scales are not stable and probably lose validity over time, therefore there is a need to adjust the scales from time to time.

Findings

A perusal of these scales shows the complexity of the services and equipment of hospitals from the least to the most complex. The diagonal cutting line represents the cumulative cutoff points which theoretically separate more complex hospitals from the less complex. The value of the scalogram analysis in both batteries is that it

Scalogram Analysis 1: Hierarchy of Functions Hospital Service Complexity (Final Battery).

	FREQUENCY	PATHOLOGY	PEDIATRICS	RADIOLOGY	OB-GYNE	CARDIOLOGY	EENT	PULMONAR-CHEST	RHEUMATOLOGY	REHAB & P.T.	NEUROLOGY	DENTAL	UROLOGY	GASTROENTEROLOGY	PLASTIC SURGERY	OPHTHALMOLOGY	ONCOLOGY	PSYCHIATRY	THORACIC	NEPHROLOGY	ENDOCRINOLOGY	INDUSTRIAL MED.	NUCLEAR MED.	ALLERGOLOGY	INFECTIOUS DISEASES	FAMILY MEDICINE	SCORE
PGH	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	25
WGG	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	25
ST. LUKE	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	24
MMC	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	24
CMC	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	24
CGH	24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	24
UST	23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	24
MDH	22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	23
CSMM	23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	22
POLYMED	21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0	20
dl SCH	21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0	20
UDMC	19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	0	0	0	19
MCM	21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	0	1	17
MCP	18	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	0	0	1	0	1	0	16
QCMC	14	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	15
PNR	13	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	12
UERM	13	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	11
CCSH	10	1	1	1	1	1	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	9
MEDCITY	10	1	1	1	1	1	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	7
FEU	10	1	1	1	1	1	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	7
MMGH	9	1	1	1	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	4
OCAMPO	4	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
MSH	3	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
ERRORS		0	1	0	0	0	0	1	0	2	1	4	1	4	2	0	1	2	1	3	1	4	4	3	2	2	

SCORING 1 = exist or present
0 = absent

ERRORS = 39
RESPONSES = 575
COEFFICIENT OF REPRODUCIBILITY = 1 - (39/575) = .93
COEFFICIENT OF SCALABILITY = 1 - (39/118) = .66

Scalogram Analysis II: Hierarchy of Functions Hospital Requirement in Services (Final Battery)

	FREQUENCY	ECG	DEFIBRILLATORS	NEBULIZERS	ULTRASOUND	TREADMILL	WHIRLPOOL BATH	P.T. ULTRASOUND	EEG	TENS	GAMMACAMERA	M-MODE ECHOCARDIOGRAM	AUTOTECHNICON	EMG	SCORE
ST LUKE	12	1	1	1	1	1	1	1	1	1	0	1	1	1	13
PGH	12	1	1	0	1	1	1	1	1	1	1	1	1	1	13
MCM	10	1	1	0	1	1	1	1	1	1	1	1	0	0	11
UST	11	0	1	1	1	1	1	1	1	1	1	1	0	1	11
MMC	10	1	1	1	1	1	1	0	1	1	1	0	0	1	10
MDH	10	1	1	0	1	1	1	1	1	1	1	0	1	0	10
WGH	9	1	1	1	1	1	1	1	0	1	1	0	0	0	18
dl SGH	10	1	1	1	1	1	1	1	1	1	0	0	1	0	9
MED CITY	9	1	1	1	0	1	1	1	1	1	0	0	0	1	9
CSMH	8	1	1	1	1	1	1	0	1	1	0	0	0	0	9
CMC	8	1	1	0	1	1	1	1	1	1	0	0	0	0	9
UERM	7	1	1	1	1	0	1	1	1	0	0	0	0	0	0
CHG	8	1	1	0	1	1	1	1	0	0	1	0	1	0	7
MCP	6	1	1	1	1	1	0	1	0	0	0	0	0	0	7
POLYMED	8	1	1	1	1	1	1	0	1	0	0	1	0	0	5
FEU	5	1	1	1	1	1	0	0	0	0	0	0	0	0	5
UDMC	4	1	1	1	1	0	0	0	0	0	0	0	0	0	4
QCMC	4	1	1	1	1	0	0	0	0	0	0	0	0	0	4
PNR	3	1	1	1	0	0	0	0	0	0	0	0	0	0	3
MGH	2	1	1	0	0	0	0	0	0	0	0	0	0	0	2
OCAMPO	2	1	1	0	0	0	0	0	0	0	0	0	0	0	2
CCSH	2	1	1	0	0	0	0	0	0	0	0	0	0	0	2
MMGH	2	1	0	1	0	0	0	0	0	0	0	0	0	0	1
ERRORS		1	0	6	1	1	1	2	2	0	2	1	3	3	

SCORING
1 = present or in current use.
0 = present or not in use

ERRORS = 23
RESPONSES = 299
COEFFICIENT OF REPRODUCIBILITY = 1 - (23/299) = .92
COEFFICIENT OF SCALBILITY = 1 - (23/80) = .71

predicts what less complex hospitals would develop into. For instance, the Medical City, which does not have a distinct section for rheumatology, will probably have one since it is the next step in the scalogram scale. This is a forward prediction, if one follows the scalogram direction. Another example would be the backward prediction value of the scalogram. Using the same hospital as an example, which possesses a TENS Machine (for physical therapy), and which is approximately 2/3 of the way through the equipment scale, it follows that it should also have all the other medical equipment below that scale step (or the equipment preceding the TENS machine on the scale). The backward and forward errors in prediction have a built-in error depending on the coefficient of reproducibility. A CR of .93 means that both backward and forward prediction have an inherent error of 7 percent. For concurrent predictions, the scalogram presents the ranking of hospitals in a list from top to bottom indicating how able a certain hospital can meet a diverse range of ailments. These scale scores could be correlated against other variables in order to seek out concurrent coefficients of association.

Since one of the objectives is to determine if service complexity is a function of the length of existence of the hospital, we correlated length of existence with the service complexity scale score and the hospital equipment scale score using Spearman's rank correlation. The only statistically significant coefficient is length of existence vs. equipment scale score on the final battery. As a general rule, length of existence is not a good determinant of evolution since the correlations are low and mostly insignificant.

Length of Existence vs. Evolution

length of existence vs. service complexity (final battery), rho =.02
not significant at 5%

length of existence vs. service complexity (original battery), rho =.07
not significant at 5%

length of existence vs. equipment scale (final battery), rho =.40
significant at 5%

length of existence vs. equipment scale (original battery), rho = -.02
not significant at 5%

It is possible that hospitals have services or departments which are not properly equipped—that is, there is a lag between the services and the equipment. Therefore, we can rank correlations between service complexity and equipment final battery scale

scores producing a rho=0.4 significant at the 5 percent level. A rank correlation between service complexity and equipment scale score in the original battery produced a rho=0.83 significant at the 1 percent level. This could be viewed as a coefficient of synchronization between service and equipment. This last correlation illustrates that hospitals with the most complex services are also the best equipped, although it does not mean that they are the most able.

Coefficients of Synchronization

service complexity vs. equipment scale (final battery)
rho = .40 significant at 5%

service complexity vs. equipment scale (original battery)
rho = .83 significant at 1%

Summary

This exercise shows the evolution of hospitals in the Philippine setting using a purely objective methodology. It also shows that the length of existence of the hospitals does not predict their level of specialization; the computed correlations were mostly low and insignificant. Hospitals which were found to have a high level of structural specialization are also those which are better equipped. There is a strong correlation between structural and materiel specialization.

Glossary of Terms

Coefficient of Reproducibility (CR)—obtained by dividing the number of errors by the total number of responses, and subtracting the resulting fraction from 1.

$$1 - \frac{\text{Errors}}{\text{Total Responses}}$$

This coefficient represents the proportion of actual responses which could be accurately reproduced if only the item order and the scale scores for each case were known.

Coefficient of Scalability (CS)—found by dividing the number of errors by the lowest number of nonmodals and subtracting the resulting fraction from 1.

$$1 - \frac{\text{Errors}}{\text{Nonmodals}}$$

Since the CR for the scale is the simple average for all the item reproducibilities, there is the danger of inflating the CR artificially merely by the inclusion of items with extreme distributions.

Cutting Point—the 1:0 pair that produces the lowest number of errors. The cutting points arranged determine the theoretical division of the items and the position of the scale steps.

Errors—the number of (1) responses to the right of the cutting point plus the number of (0) responses to the left of the cutting point.

Frequency—the number of (1) responses in the battery for a particular row or column. This represents the number of items in the battery the hospital actually possesses.

Materiel Specialization—refers to the kinds or types of equipment in possession and service in the hospital.

Nonmodals—the lowest number of responses in a row or column, either in (1)'s or (0)'s.

Responses—the total number of responses found by multiplying the number of rows with the number of columns.

Scale Score—this gives a theoretical number of items the hospitals should have. This is found by counting the number of positions to the left of the cutting point.

Service Complexity—refers to the level of structural specialization of a hospital with regards to service sections or departments.

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Appendix I

List of Hospitals Included in the Study

1 - Medical Center Parañaque (MCP)
2 - Chinese General Hospital (CGH)
3 - St. Luke's Medical Center (STLUKE)
4 - Polymedic General Hospital (POLYMED)
5 - Quezon City Medical Center (QCMC)
6 - de los Santos General Hospital (dlSGH)
7 - Far Eastern University Hospital (FEU)
8 - U.E.R.M. General Hospital (UERM)
9 - Col. Salvador T. Villa General Hospital (formerly PNR)
10 - Manila Doctor's Hospital (MDH)
11 - Camp Crame Station Hospital (CCSH)
12 - The Medical City (MEDCITY)
13 - Cardinal Santos Medical Hospital (CSMH)
14 - De Ocampo General Hospital (OCAMPO)
15 - Waterous General Hospital (WGH)
16 - Marine Station Hospital (MSH)
17 - Medical Center Manila (MCM)
18 - Makati Medical Center (MMC)
19 - Miraculous Medal General Hospital (MMGH)
20 - United Doctors Medical Center (UDMC)
21 - Philippine General Hospital (PGH)
22 - Capitol Medical Center (CMC)
23 - Santo Tomas University Hospital (UST)

Appendix II

Original Department Scale Battery Items

			Frequency
1	-	Anesthesiology	19
2	-	Allergology and Immunology	11
3	-	Cardiology	21
4	-	Dermatology	20
5	-	Dental	18
6	-	Endocrinology	12
7	-	E.E.N.T.	20
8	-	Family Medicine	4
9	-	Gastroentorology	17
10	-	Hematology	18
11	-	Industrial Medicine	11
12	-	Infectious Diseases (Communicable)	9
13	-	Nephrology	13
14	-	Neurology	18
15	-	Nuclear Medicine	11
16	-	Obstetrics and Gynecology	22
17	-	Oncology	13
18	-	Orthopedics	18
19	-	Out-Patient Department	9
20	-	Opthalmology	15
21	-	Psychiatry	15
22	-	Pulmonary and Chest Diseases	19
23	-	Pathology (Laboratories)	23
24	-	Pediatrics	22
25	-	Plastic Surgery (Reconstructive\Cosmetic)	15
26	-	Rehabilitation Medicine and Physical Therapy	18
27	-	Radiology (X-ray)	23
28	-	Rheumatology	4
29	-	Thoracic	13
30	-	Urology	17

Appendix III

Original Equipment Scale Battery Items

			Frequency
1	-	Anesthesia Machine	12
2	-	ABA 100 (blood chemistry analyzer)	7
3	-	ABG Machine (arterial blood gas analyzer)	14
4	-	Autotechnician	5
5	-	Centrifuge	20
6	-	Cardiac Monitor	9
7	-	C.T. Scan (computer tomography)	3
8	-	Calibrator (for nuclear medicine)	8
9	-	Defribrillators	19
10	-	EEG Machine (electroencepalograph)	12
11	-	Electrical Stimulators (for PT)	13

12	-	EMG Machine (electromyograph)	5
13	-	ECG Machine (Electrocardiograph)	22
14	-	Electrocautery	11
15	-	Flame Photometer	10
16	-	Hydrocollator (for PT)	9
17	-	Hematology Analyzer	8
18	-	Hemodialysis Machine	16
19	-	IPPB Machine (Intermittent positive pressure breathing apparatus)	8
20	-	M-mode Echocardiogram	5
21	-	Magnascanner (for nuclear med)	8
22	-	Microtome	4
23	-	Nebulizers	15
24	-	Negatoscope	7
25	-	Opthalmoloscope	6
26	-	Pulmonary Function Test Machine	6
27	-	Respirators and Ventilators	17
28	-	Resuscitators	11
29	-	Short Wave Diathermy (for PT)	10
30	-	Spectrophometer	19
31	-	Suction Apparatus	16
32	-	Spectroscaler	2
33	-	Traction (cervical/pelvic)	14
34	-	Treadmill	16
35	-	TENS (transcutaneous electrical nerve stimulator for PT)	10
36	-	P.T. Ultrasound	11
37	-	Ultrasound	17
38	-	Volume Respirator	4
39	-	Whirlpool Bath	13
40	-	Gamma Camera (for nuclear med.)	6

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