CALCULATION OF RELATIVE WEIGHTS FOR NUCLEAR MEDICINE PROCEDURES

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Relative weights for nuclear medicine procedures have been assigned previously on the basis of subjective estimates of resources expended. Thus, ultimate values frequently have not reflected time and cost of personnel and equipment accurately. Based on computerized data collected on over 8,000 patients, we have attempted to calculate relative weights more objectively by analyzing the following parameters: (A) physician time; (B) technologist time; (C) nurse (or aide) time; (D) equipment time and depreciation; and (E) radiopharmaceutical cost, or cost equivalent. Most major organ scans were found to have quite similar values whereas procedures with low ratings on previous value schedules were found to have high relative values when analyzed objectively.

Several analyses of the economics and operation of nuclear medicine departments have appeared recently (*1,2*). Using information gathered for over 1 year in our department for the purpose of analysis, we have been able to calculate relative weights for most nuclear medicine procedures. For the purpose of this study, relative weights are defined as the total relative amount of technical resources and effort devoted to a given type of procedure under the specific operational conditions of this nuclear medicine department. While these relative weights may eventually contribute a data base for the assignment of relative values for billing purposes, they are not meant to be in any way restrictive or comprehensive for fee evaluation.

METHODS

Data on each procedure done in our department were processed as previously described (*2*). A monthly report containing information relative to the type and number of procedures done and machine and technologist time, as well as isotope used, was compiled. Data on 8,400 patients were then used to calculate relative weights as follows.

Parameters for analysis including physician time and effort, technologist and/or nurse contribution, machine time and type, as well as radiopharmaceutical cost or preparation effort or both, were included on a rating scale of 0–9 for each category (Table 1). Thus, a maximum score of 9 for each category was possible while a minimum amount was 0. The aggregate score was a sum of all five categories. The maximum possible score for a given procedure was therefore 45.

The physician component quantitated in this manner includes only what could be called the "technical input" of the physician, namely the actual time and effort spent on such activities as reviewing images, comparing them with other studies, and examining patients. They do not reflect his "professional input," namely the degree of knowledge, skill, and special expertise required. These parameters, by definition, cannot be quantitated.

We then selected a common simple procedure that continuously had the lowest score on this scale. This was the single determination Schilling test. A thyroid uptake was also considered since the aggregated score was close to that of the Schilling test; however, in general the Schilling test consistently rated slightly lower. A relative weight of 1.00 was assigned to the Schilling test by normalizing the data. The aggregated score on the Schilling study for the five parameters was 7 points; thus, the aggregate for each procedure was divided by 7 to obtain a relative value, when 1.00 represents the score for a Schilling test and all other studies carry a numerical value relative to this procedure. For example, a four-view

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TABLE 1. PARAMETERS USED IN THE CALCULATION OF RELATIVE WEIGHTS

Parameter	Points
Physicians	
Number of films	1–4
Five views or flow	5
Correlation with other studies, i.e., x-ray, ultrasound	2
Special, i.e., palpation, auscultation	2
Technologists	
Time (min)	
0–9	1
10–19	2
20–29	3
30–39	4
Over 40	5
Flow	3
Special, i.e., computer, videotape	1
Nurse	
Time (min)	
0–9	1
10–19	2
20–29	3
30–39	4
Over 40	5
Special, i.e., skin tests for TSH allergy, stool collection	2
Machine	
Time (min)	
0–9	1
10–19	2
20–29	3
30–39	4
Over 40	5
Probe or well counter	1
Scanner (single head)	2
Scanner (dual head), camera	3
Camera-computer	4
Radiopharmaceuticals—based on cost (dollars) or cost equivalent	
0–9	1
10–19	2
20–29	3
30–39	4
40–49	5
50–59	6
60–69	7
70–79	8
Over 80	9

TABLE 2. EXAMPLES OF AGGREGATE SCORES FOR RELATIVE WEIGHTS

Parameter	Four-view static brain scan	Schilling test
Physician time	6	1
Technologist time	5	3
Machine time and depreciation	8	2
Radiopharmaceutical cost	1	1
Total	20	7

static brain scan with an aggregated score of 20 points had a relative weight of $20 \div 7 = 2.86$. The calculations underlying the aggregated score are shown in Table 2.

RESULTS

A comprehensive list of relative weights and aggregate scores is shown in Table 3.

DISCUSSION

The use of a multiparameter system to obtain relative weights is complex and at times arbitrary relative to the selection of values for a specific parameter. Different institutions will perform procedures differently; thus, scores will be different. However, when multiple parameters are used the differences are minimized since the energies expended will influence all of the parameters. This results in a rather constant aggregate score even though a specific parameter may vary from laboratory to laboratory.

To calculate the relative weight for two given procedures, one need only divide the relative weights of both. Thus, a brain scan relative to a plasma volume with multiple sampling would be $2.86 \div 1.72 = 1.66$. Since some institutions have a rather critically ill population when compared with others, the relative values may change for a few procedures. Another variable between institutions is the radiopharmaceutical cost per procedure, which tends to be significantly lower at larger institutions with heavy workloads since they buy their radiopharmaceuticals in bulk. However, most relative weights will remain the same since the extra effort involved for a particular study will be nearly constant from patient to patient in a given institution. Thus, an aggregate score may be higher on the average in certain institutions than others but the relative weights within these institutions would remain the same.

Of interest is the closeness of many procedures in terms of relative weights. The liver scan nearly equals the brain scan in this system whereas a complete ferrokinetic workup including plasma iron disappearance, red cell iron utilization, and body distribution exceeds the values for most major organ procedures.

The use of sophisticated equipment such as computers, videotape, histogram devices, etc. also adds to the time and complexity of the studies. The additional weights these procedures contribute are generally arbitrary and involve additional physician, technologist, and machine time as well as requiring certain expertise not generally available. Thus, incremental points are necessary for all parameters. Generally, we added three aggregate points when

TABLE 3. LIST OF RELATIVE WEIGHTS AND AGGREGATE SCORES

System	Relative weight	Aggregate score
Endocrine		
Thyroid uptake		
Single determination	1.14	8
Multiple determinations (as in 6 and 24 hr, etc.)	1.72	12
Thyroid stimulation, suppression or discharge not including initial uptake studies	1.57	11
Thyroid, imaging, with uptake		
Single determination	2.42	17
Multiple determination	2.56	18
Thyroid, imaging only	2.00	14
Thyroid carcinoma metastases imaging, neck and chest only	2.72	19
With additional studies (e.g., imaging other body areas, urinary recovery, etc.)	3.72	26
Adrenal, imaging	4.56	32
Parathyroid, imaging	4.41	31
Hematopoietic, reticuloendothelial, and lymphatic		
Bone marrow, imaging		
Limited area	2.42	17
Multiple areas	3.14	22
Whole body	3.14	22
Extramedullary hematopoiesis, imaging (e.g., ^{52}Fe)	2.58	18
Blood or plasma volume		
Single sampling	1.14	8
Multiple sampling	1.72	12
Red cell mass determination		
Single sampling	2.00	14
Multiple sampling	2.29	16
Red blood cell sequestration	2.86	20
Red cell survival (e.g., ^{51}Cr)	2.29	16
Plasma radioiron disappearance (turnover) rate	2.72	19
Radioiron red cell utilization and body distribution	2.29	16
Radioiron red cell utilization, body distribution and storage pools	2.42	17
Lymphatics and lymph glands, imaging	2.42	17
Gastrointestinal		
Liver, imaging		
Static	2.72	19
Including vascular flow	3.56	25
Liver and spleen, imaging		
Static	3.00	21
Spleen scan with multiple views	3.00	21
Including vascular flow of liver and/or spleen	3.42	24
Liver function (e.g., with radioiodinated rose bengal)		
With serial images	3.00	21
With probe technique	2.14	15
Liver-lung study, imaging (e.g., for subphrenic abscess)	3.42	24
Salivary glands, imaging		
Static	2.29	16
Including serial views	3.00	21
Pancreas, imaging		
Static	4.00	28
Including serial views	4.30	30

Continued in column 2

System	Relative weight	Aggregate score
Vitamin B_{12} absorption studies (e.g., Schilling test)		
Without intrinsic factor	1.00	7
With intrinsic factor	1.14	8
Gastrointestinal blood loss study	1.43	10
Gastrointestinal protein loss (e.g., ^{51}Cr-albumin	1.86	13
Gastrointestinal fat absorption study (e.g., radioiodinated triolein)	2.00	14
Gastrointestinal fatty acid absorption study (e.g., radioiodinated oleic acid)	2.00	14
Musculoskeletal		
Bone imaging		
Limited area (e.g., pelvis, skull, etc.)	2.56	18
Multiple areas	3.29	23
Whole body	3.29	23
Joints, imaging		
Limited area	2.56	18
Multiple areas	3.29	23
Whole body	3.29	23
Cardiovascular		
Cardiac blood pool, imaging		
Static (e.g., as for pericardial effusion)	2.29	16
With vascular flow	4.15	19
Myocardium, imaging	3.86	27
Cardiac flow study, imaging (i.e., angiocardiography)	3.14	22
Vascular flow study, imaging (i.e., angiography)	3.14	22
Venous thrombosis study	3.42	24
Cardiac output	3.56	25
Circulation time	2.72	19
Tissue clearance studies	2.72	19
Respiratory		
Pulmonary perfusion imaging		
Particulate	3.29	23
Gaseous	3.29	23
With ventilation, rebreathing, and washout	4.00	31
Pulmonary ventilation imaging		
Aerosol	3.29	23
Gaseous, single breath		
Single projection	1.73	12
Multiple projection	3.29	23
Gaseous, with rebreathing and washout with or without single breath		
Single projection	4.00	28
Nervous		
Brain, imaging		
Limited procedure static	1.28	9
Including vascular flow	2.42	17
Complete static	3.29	23
Including vascular flow	4.00	28
Vascular flow study only	2.29	16
Cerebrospinal fluid flow, imaging (not including introduction of material)		
Cisternogram	4.00	28
Ventricolography	3.29	23
Myelography	3.29	23
Shunt evaluation	3.29	23

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TABLE 3. (*Continued*)

System	Relative weight	Aggregate score
CSF leakage	3.42	24
Cerebrospinal fluid leakage study, other technique	4.00	25
Genitourinary		
Kidney, imaging		
Static	1.57	11
Including vascular flow	3.00	21
Including function study (i.e., ranging renogram)	3.00	21
Including vascular flow and function study	4.15	29
Kidney, vascular flow	2.42	17
Kidney, function study (i.e., renogram)	1.86	13
With serial images	3.00	21
Kidney function, clearance	3.42	24
Urinary bladder residual study	2.86	20
Ureteral reflux study	3.29	23
Placenta, imaging	2.29	16
Miscellaneous studies		
Tumor localization (e.g., gallium, indium, bleomycin, selenomethionine, etc.)*		
Limited area	4.15	29
Multiple areas	4.41	31
Whole body	4.41	31
Body spaces (e.g., sodium, potassium, etc.)	4.15	29
Transmission scan (lungs, head, etc.)	1.86	13

* For specific organ, see individual listing.

a given procedure truly required a computer evaluation or sophisticated processing. This averages out to an increase of slightly better than 10% of the total weight per procedure.

Continuing operational analysis of a department as it was used here and described previously (*2*) or by similar methods permits periodic reassessment and updating of relative weights as the state of the art changes. It ought to be re-emphasized that we offer only one of a number of possible ways to analyze objectively the operation of a nuclear medicine department and to translate the accrued data for time and effort into relative weights for different common procedures. By using objective computerized data it is hoped that the arbitrariness of assigned relative weights and values will be reduced although it is fully understood that subjective and qualitative factors cannot be completely eliminated. Eventually, if a sufficient number of nuclear medicine departments of different size and character base their relative weight schedules on such objective data, a regional or national economic relative value schedule may be derived in this manner.

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