

meantime, work on allocation methodologies for dentistry, ancillary services, etc. could be conducted, under common guidance from DOD. Likewise, the problems of appropriation management could be addressed, with feedback from Congress concerning what funding resources would be included and Congressional action to modify the budgeting and appropriations mechanisms appropriately. Finally, the three service systems, having been jointly developed under common guidance from DOD, could be merged to a single resource allocation system, if so required. The key to ensuring successful implementation of any DRG system is careful analysis beforehand. As James Studnicki<sup>14</sup> observed:

Hospitals are sacred places where modern miracles occur and where the state of the art and science of medicine is advanced.

Hospitals are also crass economic entities where millions of dollars are exchanged for services rendered. There is yet a great deal to be learned about the interface of these two natures of hospital operations. Many of the important questions of quality assurance and cost containment hinge on our ability to understand the delicate balance of clinical and financial influence on the medical care process. Regulation based on the simplistic notion that the discipline of proprietary management can be transferred directly to medical care without thoughtful modification is merely a hoax.

Although federal hospitals are not quite the "crass economic entities" Mr. Studnicki describes, and DOD health care is not under "proprietary management" his point is well taken. Even the stairstep implementation approach discussed above requires careful analysis and thought at each turn, with modifications being made as necessary.

As previously noted, the House Armed Services Committee is looking to DRG uses for management functions other than budgeting. As early as 1983, the Research Department of the Naval School of Health Sciences (NSHS), Bethesda, Maryland, was examining DRG applications for the Navy. Two areas were addressed: 1) monitoring convalescent leave,<sup>4</sup> and 2) accounting for variations in length of stay in Navy hospitals.<sup>15</sup>

The results from both studies could easily be adapted for all three uniformed services' medical departments. Combined use of the resultant techniques could generate reductions of LOS and convalescent leave, with servicemen and -women returning to their units sooner. That would result in a higher readiness level for those units, which would help fulfill military medicine missions. The NSHS research also pointed to use of DRG methods as hospital performance-measuring devices. These facets of using DRGs are already fairly well developed and could be implemented without undue additional effort.

### Conclusion

In the 20 years since the pioneering work at Yale, DRGs have come a long way. Originally developed as a utilization review tool, they have been modified to serve prospective payment programs, and further modified to become resource allocation systems. DRGs and DRG-based systems are used by researchers, utilization review committees, the insurance industry, eight states for Medicaid, and the government for Medicare, VA health care, and, soon, DOD health care.

A review of current literature readily shows that DRGs, and

similar systems, are not perfect. For example, the Medicare system frequently comes under attack for such problems as DRG creep and inequitable reimbursement for case mixes with high levels of severity. The NSHS research also noted DRG shortcomings. Although DRGs were the best system examined in both research projects, they accounted for 40.9% of the variations in length of stay<sup>15</sup> and only 24.5% of the variations in convalescent leave.<sup>4</sup>

Despite their imperfectness, DRGs are the most advanced system of patient classification yet developed.<sup>16</sup> Because of their widespread, ingrained use they will be here for a long while. Continual refinements of the DRG categories (e.g., to account for new diseases such as AIDS and to more precisely measure case mix and severity level) and their applications (e.g., the VA's ongoing modifications) will help further improve their utility. Their adaptation in any setting must, however, be implemented with deliberate care and forethought. DRGs have the potential, for DOD health care, of improving budget allocation procedures and, through better work load measurement, permitting more effective planning.

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## Experience with a Pre-Basic Fitness Program at Fort Jackson, South Carolina

COL Margarete DiBenedetto, MC USA

One hundred seventy-five consecutive recruits entering the Fort Jackson Fitness Company were evaluated for Upper Body Strength, Flexibility, and Cardiovascular Fitness, and the results were compared with those of 60 soldiers entering Basic Training directly from the Reception Station. Injury rate and end-cycle performance were compared between Fitness Company graduates and their regular basic trainee cohort. The study showed that the Push-up repetition and two-mile run times were still below the standard for the Post. Sick call rate was also significantly higher among the less conditioned troops. Sit-up repetition and other basic soldiering skills, however, as well as EPTS (discharges for medical conditions existing prior to service) and ELS (entry level separation) rates, were equal. Increase of Fitness Company graduation requirements and dissemination of standards and requirements to potential recruits in high schools, colleges, and other public institutions are recommended.

Fitness and its impact on physical and mental health and human performance has been a main theme in the civilian and military media and literature for nearly a decade. This emphasis on health in our society would suggest that military training would be easier than ever to accomplish in a relatively short time without significant ill effects. Unfortunately, the fitness boom caught on mainly with the more mature population who have already experienced some of the negative effects of inactivity. The younger generation, however, is in general poor physical condition. Since there is a direct relationship between fitness level and training injuries, it is not surprising that the injury rate has risen to unacceptably high levels in some basic training posts. It is physiologically detrimental to apply the same standards of training to the very unfit recruit as to one who is well conditioned. To bridge the gap, Pre-Basic Training Fitness Companies were developed. Since 1985, re-

cruits who do not pass a push-up test at the Reception Station (female, 1 push-up, male, 13 push-ups) are placed into a three-week program of athletic training. The major emphasis is on strength and general fitness training. When female recruits are able to perform six correct "male" push-ups and male recruits 20 push-ups, or when four weeks at the Fitness Company have been completed, they are transferred to Basic Training. Experience seems to support the value of this preparation in reducing injury and medical discharge risk, but it has not been subjected to disciplined investigation. Therefore, we developed a study that would compare the strength and fitness of the soldiers entering Basic Training directly with those needing the fitness program. The objectives were:

1. To determine to what degree (a) lack of skill, (b) lack of upper body strength, and (c) lack of self-confidence contribute to the inability to perform the qualifying push-ups.
2. To determine the effectiveness of the three-week athletic training program in improving physical and psychological condition.
3. To determine to what degree the fitness level impacts on sick call, injury, EPTS (discharges for medical conditions existing prior to service) and ELS (entry level separation) rates.
4. To determine the discharge rate of soldiers who, based on physical performance inadequacies, should have been admitted to the fitness program, but were not, and to compare that rate with the discharge rate of soldiers with Pre-Basic Fitness Training.
5. To establish comparisons between Fitness Company graduates and their basic trainee cohort in end-of-cycle performance of basic soldiering skills and the Army Physical Readiness Test.

### Materials and Methods

One hundred seventy-five consecutive subjects entering the Fitness Company (100 females and 75 males) were evaluated as to their strength, flexibility, and cardiovascular fitness.

From Fort Monroe, Virginia.

Work Site: Fort Jackson, South Carolina.

The opinions or assertions contained herein are the private views of the author and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

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Nautilus equipment was utilized and the one-time maximal performance was recorded (after familiarization with the event) for the following machines: Bench Press, Military Press, Latissimus Pull, Biceps Curl, Triceps Extension, Abdominal Nautilus, 10° Chest Nautilus, Female Chest Nautilus, 70° Shoulder Nautilus, Seated Rows, and Leg Press.

Since height and weight are significant factors in the ability to utilize available strength, we developed the following index by multiplying height by weight and then dividing the calculated value by the sum of pounds lifted during the Nautilus events (except for Seated Rows, Leg Press, and Pull-down Nautilus). To predict Push-up capabilities, we added one more factor by dividing the result by the triceps extension value (even though it was already included in the sum). Since the triceps is a major muscle utilized in push-ups, we thought that it would add an even better predictor for performance:  $(\text{Height} \times \text{weight}) / (\text{Sum of lbs lifted} : \text{Triceps value} = \text{Index})$ .

Unpaired *t* tests were performed to determine the statistical significance of strength difference between the recruits referred to the Fitness Company and those entering basic training directly from the Reception Station. Flexibility was assessed by measuring the distance hands can reach in the sitting position beyond the feet dorsiflexed 90°. Early morning heart rates and the results of a modified step test were used as indicators of cardiovascular fitness. The stress test utilized a 15 1/4-inch step for men and a 13-inch step for women. The test rate of 90 steps per minute was performed for a total of five minutes. The pulse rate was taken before the exercise and five seconds after. Then, after 10 minutes rest, the pulse rate was again counted and, after an additional five minutes, was counted one more time. A score chart, taking into consideration weight and age, as reported in FM 21-20<sup>1</sup> was used to calculate a fitness rating. In addition, 60 Privates (30 females and 30 males) who were accepted into Basic Training directly from the Reception Station were tested using the same parameters. Twenty of the Fitness Company soldiers were retested at the end of Basic Training. After completion of the Fitness Company Program, 50 soldiers were followed throughout the Basic Training cycle and compared with the soldiers directly assessed in the same Platoon. Five Companies were thus studied for their sick call rate, injury rate, ELS, and EPTS, and final performance data were compared between the groups.

## Results

Table 1 shows mean age, height, and weight of the four groups. The mean values obtained from the different groups

TABLE 1  
PERSONAL DATA OF THE FOUR GROUPS

	Mean Age years	Mean Height inches	Mean Weight pounds	N
Males, FTC	20 ± 3.5	71 ± 2.7	185 ± 30	74
Males, BT	21 ± 3.5	68 ± 3.0	155 ± 27	30
Females, FTC	21 ± 4.3	65 ± 2.8	132 ± 14	99
Females, BT	22 ± 4.3	64 ± 2.7	125 ± 17	30

in pounds lifted during the Nautilus events are demonstrated in Table 2. Also reported is the Upper Body Strength Index. The "% columns represent the difference in strength related to that of recruits entering the fitness training program. The most significant observation was that, indeed, the group of Privates entering directly into Basic Training from the Reception Station were considerably stronger than the candidates for the Fitness Company (females 30% and males 52%). The statistical significance for both is  $p < 0.001$ . Strength gain during the whole training period for the group tested was 42% (20 females), when height and weight were considered, using the index. The comparison of flexibility and cardiovascular fitness can be seen in Tables 3, 4, and 5. According to the values obtained by the step test and resting heart rates, the fitness level calculated (Table 5) is considered a readiness index for sustained hard work, where 5 represents the highest level and 1 the lowest. As can be noted, there is a slightly higher level in cardiovascular fitness among the straight accession basic trainees also. While the better conditioned group seemed to have slightly more flexibility, no statistically significant difference in outcome or injury rate could be demonstrated. As expected, female soldiers were more flexible than their male counterparts.

EPTS and ELS rates as well as sick call rates can be seen in Table 6. As expected, graduates from the Fitness Company still had a higher sick call rate. The EPTS and ELS rates were not significantly different between the two groups (mean 8.9%). However, EPTS and ELS rates of soldiers who did not meet the Basic Training requirements but entered training without the Fitness Program was 20%. The performance data show absolutely no difference in basic soldiering skills ("Superbowl"—compass reading, first aid, rifle disassembly and assembly, gas mask donning (timed), battlefield surviving skills, etc.), basic marksmanship, hand grenade throw, and sit-ups. There still was a slightly lower group value on push-ups and the two-mile run (Table 7). The number of individual poor performers was also higher among former Fitness Company soldiers.

## Discussion

Wherever there is training, injuries will occur. The more intense the exercises the greater the possibilities for tissue breakdown. The same relationship, however, also exists with an increased fitness level as a result of physical activities. The ideal situation is a balance of good fitness improvement with the least possible injuries. Another factor of concern is time. If it were possible to conduct training at a slower progression rate, better results could be achieved, but budget constraints render this solution impractical. In order to reduce injuries, it does, however, seem cost effective to extend training for those most at risk, i.e., the unconditioned and unfit soldier. Teves et al.<sup>2</sup> assessed the strength gain of basic trainees in a study at Fort Jackson in 1978. They found a strength increase of 4% for males and 14% for females by using an incremental dynamic lift testing technique. This required recruits to lift to a height of 152 and 183 cm on a machine with a weight carriage assembly. Much of the musculature utilized in such a lift is the same as that which we tested in our Nautilus events. Teves

TABLE 2  
STRENGTH: WEIGHT LIFTING (NAUTILUS)  
(ONE-TIME MAXIMUM LIFT SCORES)

	FEMALES			MALES				
	FTC N 100	Post BT FTC N 20	%	BT N 30	%	FTC N 75	BT N 30	%
Bench press	58 ± 9	70 ± 9	17%	79 ± 12	27%	108 ± 23	165 ± 37	35%
Military press	58 ± 9	68 ± 8	15%	73 ± 10	21%	101 ± 19	130 ± 28	22%
Latiss. pull.	58 ± 11	68 ± 11	15%	60 ± 12	3%	110 ± 24	130 ± 27	15%
Biceps curl	37 ± 10	50 ± 8	26%	34 ± 9		76 ± 17	83 ± 22	8%
Triceps ext.	29 ± 7	36 ± 6	19%	32 ± 5	9%	60 ± 15	78 ± 19	23%
Abdom. naut.	85 ± 16	105 ± 20	19%	94 ± 17	10%	125 ± 28	135 ± 30	7%
10 chest naut.	56 ± 9	79 ± 16	29%	67 ± 20	16%	112 ± 24	163 ± 42	31%
Chest naut.	48 ± 11	66 ± 14	18%	64 ± 15	25%	78 ± 21	107 ± 31	27%
70 shoulder naut.	56 ± 10	68 ± 9	18%	59 ± 9	5%	109 ± 28	145 ± 34	24%
Total (sub):	486 ± 65	604 ± 72	20%	562 ± 71	14%	872 ± 172	1175 ± 317	26%
Index:	5.3	3.1 ± 0.6	42%	3.7	30%	1.9 ± 0.6 (N73)	1.0 ± 0.4 (N30)	52%

TABLE 3  
FLEXIBILITY

Males, FTC	14.3 cm ± 3.2
Females, FTC	15.5 cm ± 2.9
Females, BT	17.6 cm ± 2.1

TABLE 4  
MODIFIED STEP TEST

	Post exercise increase beats/min	After 10 min rest decrease beats/min	% returned to resting rate at 10 min
Males, FTC	62 ± 27	52 ± 23	84%
Males, BT	66 ± 19	57 ± 21	86%
Females, FTC	63 ± 24	47 ± 20	75%
Females, BT	52 ± 15	40 ± 15	77%

TABLE 5  
CARDIOVASCULAR FITNESS INDEX

Males, FTC	1.7 ± 1.1
Males, BT	2.0 ± 1.1
Females, FTC	1.3 ± 0.7
Females, BT	1.9 ± 1.0

et al.<sup>2</sup> found an Upper Body Strength difference between males and females of about 56%. We found the female soldiers to have 56% of male lifting capacities, and in the Basic Training group the male Privates were 53% stronger than the females. The female Privates of the Fitness Company whom we retested after completion of Basic Training showed an overall gain of upper body strength of 42%. Since the Basic Training female cohort tested was already 30% stronger, it can be understood that there still was a difference of capabilities in the two groups at the end of the eight-week cycle. While the push-ups in

themselves did not indicate future performance, they nevertheless reflected quite accurately upper body strength and, thereby, at least indirectly, showed qualification for heavy MOS categories.

The sick call rate was higher for the Fitness Company graduates. One must realize that even three weeks of intensive athletic training cannot elevate fitness to the level of those having had a more active lifestyle. Nevertheless, we did observe a very definite beneficial effect. Not only were physical performance levels much improved, but there was a significant change in general attitude and stamina. After having failed the basic entry test, the addition of physical discomfort in the first week of "fitness training" was a source of considerable stress. Positive group bonding quickly occurred, fostering a natural "growing" process. The achievement climate rose with its goal expectations and, slowly, beginning successes which finally culminated in the ability to perform the required exercises for entry to Basic Training. The excitement was sincere and the newly gained confidence and pride took the group a long way toward enduring the more rigorous requirements in the next training phase. Observing the transformation of an insecure, weak, adolescent into a confident soldier is surely a great part of the success story of the Fitness Companies. Having a company commander with physical therapy (PT) skills strongly enhances the mission by direct supervision of physical training activities and first line injury evaluation and treatment.

The cost effectiveness of the program is shown by the 10% difference in discharge rate. Taking into account the money spent on each soldier from recruitment to discharge, a loss of \$3.7 million annually can be estimated if no Pre-Basic Fitness Program is offered.

The recommendations derived from this study are:

1. To increase the Fitness Company graduation requirements to a higher achievement level, to allow for a greater degree of integration with the cohort.
2. To prepare information material describing acceptable cardiovascular and strength standards, with suggestions for effective pre-entry training, for use by recruiters to

TABLE 6  
INJURY AND SICK CALL RATE/TRAINING DAY

	Injury a.c. rate per train. day	Sick call rate per train. day	% of Pvs BT seen in MTF	% of Pvs FTC seen in MTF
<b>Company A, Females</b>	<b>Strength: 203</b>	<b>ELS 11 EPTS 12</b>		
1st Platoon	2.5	3.4	70	
2nd Platoon	2.7	4.1	68	95
3rd Platoon	2.0	3.1	70	
4th Platoon	4.2	4.9	75	100
<b>Company B, Females</b>	<b>Strength: 220</b>	<b>ELS 10 EPTS 12</b>		
1st Platoon	1.5	2.3	74	90
2nd Platoon	1.5	2.3	70	
3rd Platoon	1.3	2.2	55	
4th Platoon	2.2	3.3	71	
<b>Company C, Males</b>	<b>Strength: 261</b>	<b>ELS 8 EPTS 12</b>		
1st Platoon		1.8		
2nd Platoon		3.5		
3rd Platoon		2.2		
4th Platoon		2.0		
<b>Company D, Males</b>	<b>Strength: 251</b>	<b>ELS 4 EPTS 16</b>		
1st Platoon	1.2	1.5	34	
2nd Platoon	1.2	1.7	50	
3rd Platoon	1.2	1.6	48	
4th Platoon	1.2	1.9	49	60
<b>Company E, Males</b>	<b>Strength: 220</b>	<b>ELS 3 EPTS 6</b>	89	90
1st Platoon		2.0		
2nd Platoon		2.3		
3rd Platoon		1.9		
4th Platoon		2.7		

Comparison between straight accession basic trainees and basic trainees who are fitness training company graduates as to percent seen in medical treatment facilities.

TABLE 7  
END OF CYCLE TEST SCORES

	PU	SU	RUN	BRM	HANDGRENADE
BT Males	45 ± 11	55 ± 9	871 ± 70 sc	31 ± 4	51.6 ± 6
FTC Males	29 ± 9	51 ± 8	918 ± 99 sc	31 ± 5	51. ± 6
BT Females	22 ± 8	56 ± 9	1044 ± 87 sc	28 ± 4	50.9 ± 7
FTC Females	19 ± 8	55 ± 9	1104 ± 80 sc	30 ± 6	48.5 ± 4

distribute to high schools, colleges, ROTC groups, and other interested parties.

### Summary

One hundred seventy-five consecutive Privates entering the Fort Jackson Fitness Company were evaluated as to their Upper Body Strength, Flexibility, and Cardiovascular Fitness, and the results were compared with those of 60 soldiers entering Basic Training directly from the Reception Station. Performance of soldiers within the Fitness Company and then within their Basic Training was assessed, and sick call and injury rate as well as final evaluations were compared with those of their cohorts in five Basic Training Companies. While considerable improvement was observed after three weeks of athletic training for the less fit soldiers, their final Physical Training scores for the push-up and two-mile run still lagged behind those of the other trainees. On the other hand, there

were equal accomplishments in sit-up repetitions and performance of basic soldiering skills by both the Fitness Company and the regular basic trainees. No significant difference could be demonstrated in EPTS and ELS rates between the two groups, but the injury sick call rate was considerably higher in Fitness Company graduates. This does not disprove the effectiveness of the Pre-Basic Training effort; rather, it points to the need to increase the graduation requirements of the Fitness Company. Dissemination of standards and requirements to potential recruits in high schools, colleges, and other public institutions is recommended.

### Acknowledgment

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## Catecholamines in Heat Stroke

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In order to find out whether the sympatho-adrenal system is activated in relation to heat stroke, plasma levels of norepinephrine (NE) and epinephrine (E) were measured using high pressure liquid chromatography in seven patients with heat stroke. The mean NE ± SD levels on admission and six hours afterwards were 1397 ± 317 and 717 ± 239 pg/ml, respectively. The corresponding values for E were 257 ± 55 and 32 ± 15 pg/ml. The levels of both NE and E on admission were considerably higher than those of the controls: 328 ± 62 and 88 ± 16 pg/ml (12 normal subjects). This increase in both NE and E indicates activation of the sympatho-adrenal system in patients with heat stroke. The α-mediated effect of catecholamines may be important in impairing heat dissipation and thus may contribute to the pathogenesis of heat stroke.

from a venous catheter on admission and six hours afterward. Patients were cooled in the Makkah Body Cooling Unit, designed by Weiner and Khogali,<sup>10</sup> and received an infusion of 0.9% saline and 5% dextrose. All of them received i.v. Valium to control convulsions. Cooling was stopped when rectal temperature was around 39°C.

### Blood Collection and Analysis

Five milliliters of blood were collected in heparinized glass tubes containing EGTA and glutathione, with final concentration of 5 mM. Plasma was separated immediately and frozen until analysis. High performance liquid chromatography (HPLC) was used to measure plasma catecholamines according to the procedure of Davies and Molyneux<sup>11</sup> with minor modification as reported previously.<sup>12</sup>

### Introduction

Heat stroke (HS) is a medical emergency with numerous complications and metabolic manifestations,<sup>1-6</sup> but the actual cause of failure of thermoregulation leading to this syndrome is not yet clear.

In spite of the lack of information about catecholamine response in humans with HS, this may be predicted from data on exercise,<sup>7</sup> heat exposure,<sup>8</sup> and animal studies.<sup>9</sup>

In this study, the plasma epinephrine (E) and norepinephrine (NE) levels were measured in HS patients to assess the changes in their levels and correlate them to the manifestations and pathogenesis of HS.

### Methods

#### Subjects

Seven patients admitted to the Heat Stroke Treatment Unit at the King Abdulaziz Hospital in Makkah during one working shift were investigated. They fulfilled all the criteria for HS.<sup>6</sup> Blood samples for catecholamine determination were drawn

### Results

The seven patients investigated (four males, three females) regained consciousness and were discharged from the Unit within two to eight days. Their age range was 50 to 80 years (mean 66.4). The rectal temperature in all patients was 41°C or more with a maximum of 42.5°C. All of the patients had sinus tachycardia on admission, with a systolic blood pressure ranging between 100 and 130 mm Hg.

The levels of plasma NE and E on admission and six hours afterward are shown in Table 1. The mean ± SD values for NE and E in 12 normal subjects were 328 ± 62 and 88 ± 16 pg/ml, respectively.

### Discussion

Exercise and external heat can stimulate catecholamine release,<sup>8,13,14</sup> and our patients had been subject to both factors in performing their rituals. Another stimulus for catecholamine release is volume repletion.<sup>15</sup> As patients with HS are dehydrated,<sup>3</sup> NE and E are expected to rise in those with significant intravascular fluid loss.

The levels of E and NE in our patients on admission were