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Analysis of Hospital Facility Growth: Are We Super-Sizing Healthcare?

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Abstract

A retrospective analysis of space planned for selected clinical areas in acute healthcare facilities between the years 1980–2008 was conducted. Findings revealed that, during the 28-year period, incremental growth occurred in both room size and departmental square feet in adult inpatient units as well as interventional services. This observed growth and—in many instances— super-sized or excessive growth may be attributed to various factors, depending on the year of construction, regional variability, or level of urbanization. However, at a macro level, growth may be attributed to changes in patient care and operational models; consumer-driven healthcare and market competition; demographics and patient acuity; technology; and regulations and building codes. In the future, forces including but not limited to capital availability, an increased desire for efficiency, and continued escalation in the cost of construction are likely to play an increasing role in offsetting the desire for sizing excess.

Key Words: *Supersize, facility sizing, patient care, patient acuity, consumerism, market competition, technology, minimum standards, room sizes, standardization, utilization, operations, capacity, grossing factors, nonessential services, volume basis, future trends, obsolescence*

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Introduction

The term "super-sizing" was first introduced by the fast-food restaurant McDonald's; it referred to the act of making something better by increasing its size. Over time the term has lost much of its positive connotation and has become popularly associated with an unappealing cultural desire for excess. The healthcare industry is not exempt from this phenomenon and has witnessed its own version of "size creep." This observation has critical implications within the healthcare field, given the desire and commitment of hospitals and health systems around the United States to expand or renovate their facilities. Current estimates suggest that the healthcare construction industry is engaged in $47 billion-worth of ongoing construction (Carpenter, 2008). In terms of the delivery of care, facility sizing affects not only the patient experience and the ability and ease with which caregivers work, but the technology requirements, operational costs, and ultimately the allocation of limited capital resources.

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Using 76 archived projects from nearly 30 years of client work, this analysis provides insight into the evolution of one management consultancy's sizing standards and illuminates specific sizing trends (KSA Space Programming Database, 2008). Conclusions are drawn about the observed growth and what can be considered justifiable versus unjustifiable, as well as some of the factors driving this expansion in programmed spaces. The paper concludes with a discussion of potential *anti*-super-sizing forces moving forward in the 21st century as well as the implications if this observed super-sizing phenomenon continues. Ultimately, this paper attempts to answer the question: "Have we gone too far?"

Projects Included in the Study

This study includes a national sample of 76 hospitals, programmed over a 28-year period from 1980–2008 (Table 1). The sample includes hospitals varying in size from small community hospitals to large quaternary academic medical centers. Specific department sample sizes include: adult critical and acute care services (n = 51 facilities), interventional services (n = 62 facilities), and imaging services (n = 27 facilities). Imaging services were narrowed to the 10-year range from 1997–2008. These three areas were selected for analysis because of their relative consistency across internal programs, in addition to the fact that they comprise the vast majority of "repetitive elements" in hospital planning projects. Other equally important areas were less consistent in occurrence and application, leading to difficulties in assembling a statistically significant sample for study.

Methodology

Data Collection

A retrospective analysis was conducted, which identified key clinical areas of interest within the adult inpatient setting; all children's hospitals were excluded. Space programs for adult inpatient, interventional, and imaging services were compiled and reviewed from the client database of programmed facilities of a national and international consultancy to healthcare organizations. Programmed values were manually transcribed and data analysis was conducted using Microsoft Excel. The following metrics were applied to all programs:

Net square feet (NSF) represents the physical floor space available within a room or area for a given function or use. It is measured from the inside, wall-to-wall or to the lines of functional separation. In some cases, the "net area" will be enclosed by partitions and a doorway, while in others, net area will be a portion of another room or space. Net area determinations are based on functional need, measurements of equipment, manufacturer recommendations, and experience.

Departmental gross square feet (DGSF) includes the sum of net square feet plus an allowance for walls and partition thickness, as well as corridors that are specific to the department. DGSF is measured from the inside face of exterior walls to the corridor side of corridor walls to the center line of common walls being shared with another department.

The DGSF includes all corridors that serve only a single department, but it does not include any corridors that serve more than one department.

Table 1. Hospitals Included in Study

N	YEAR	TYPE	STATE
1	1991	Community	NC
2	2006	Community	CA
3	1998	Community	IL
4	1982	Community	NY
5	1981	Community	FL
6	1985	Community	TX
7	2005	Teaching	MA
8	1996	Teaching	MA
9	2004	Community	NE
10	2001	Community	SC
11	2003	Community	MO
12	2003	Community	CO
13	2002	Community	CO
14	1980	Academic	OH
15	2002	Academic	NY
16	1982	Community	VI
17	2004	Community	CA
18	1988	Community	IL
19	1998	Community	CO
20	1983	Community	VA
21	1998	Community	MN
22	1987	Community	KY
23	1999	Teaching	VT
24	1988	Community	NC
25	1984	Community	GA
26	1982	Community	NC
27	2003	Community	CA
28	1989	Community	MN
29	1990	Community	NE
30	2003	Community	OK
31	2007	Community	OK
32	2004	Teaching	FL
33	2002	Academic	Quebec
34	2004	Academic	SC
35	1987	Community	FL
36	1985	Community	WY
37	1999	Teaching	NY
38	1986	Community	IA

N	YEAR	TYPE	STATE
39	2002	Community	TX
40	2006	Community	TX
41	2002	Community	CA
42	1987	Community	NJ
43	1984	Community	NJ
44	1988	Community	FL
45	1988	Community	
46	2008	Community	CA
47	1990	Community	IL
48	2006	Academic	NY
49	2006	Academic	OH
50	2004	Community	CA
51	2004	Community	CA
52	2004	Community	CA
53	2002	Community	OR
54	2004	Community	GA
55	1988	Academic	NC
56	1983	Community	VA
57	1989	Community	NY
58	1985	Community	CA
59	2006	Teaching	IL
60	2005	Teaching	OR
61	1998	Community	MD
62	1979	Community	MI
63	1982	Community	KY
64	1987	Academic	MN
65	1988	Academic	MN
66	2001	Community	IN
67	2007	Academic	CA
68	1998	Academic	CA
69	1997	Academic	CA
70	2001	Academic	CA
71	2006	Academic	FL
72	1983	Community	TX
73	1989	Teaching	NC
74	2003	Community	TN
75	1982	Community	KS
76	2000	Community	AZ

The DGSF includes all structural elements within a department, but it excludes major mechanical and circulation shafts running through the department, unless the stair or shaft is dedicated to that department.

Toilets, housekeeping closets, and other support spaces dedicated to a department are included in the DGSF.

Net-to-gross multiplier is applied to the sum of all departmental NSF that calculates DGSF. These multipliers are empirical and based upon national norms as well as the experience of this healthcare consulting firm experienced in the programming of space requirements. They vary by department depending on the intensity of small rooms and the required widths of corridors.

Building gross square feet (BGSF) includes the sum of all DGSF plus allowances for stairs, elevator shafts, mechanical and electrical equipment rooms, building lobbies and public spaces, entry canopies, common toilets, and other nonprogrammed areas. BGSF is the sum of the floor areas included within the outside faces of exterior walls and pertains to all stories or areas that have walkable floor surfaces and a head-room height of at least 6' 0".

Note: When programming buildings with large public mall or lobby spaces, it is necessary to include these spaces as programmed (i.e., net) area and not as part of the building net-to-gross factor.

Departmental-to-building (DGSF to BGSF) *multiplier* is applied to the DGSF during the programming phase. This multiplier can vary widely based upon several factors but includes all major mechanical, electrical, and plumbing, as well as building vertical and horizontal circulation. For new buildings, it is most dependent on the actual design configuration, and the standard industry planning range is 1.3 to 1.4. However, for small high-tech projects or other equipment intensive situations, it may be higher. In the case of renovation projects, existing building configuration must also be considered.

…[T]he type, quantity, and optimal size of elements for a new space are all included within a space program.

Note: When programming hospitals, it is necessary to include the central energy plant in the programmed area and not as part of the building net-to-gross. All other mechanical/electrical/plumbing (MEP) is included.

Note: Historically, information technology (IT) rooms (i.e., network closets) have been captured in the DGSF-to-BGSF multiplier; however, these requirements have grown significantly in the past 15 years. The issue of where to count IT infrastructure rooms that are not dedicated to a department continues to be debated. However, because IT spaces have become a substantial element of modern healthcare facilities, they are most often programmed space (i.e., net) and not subsumed into the BGSF multiplier.

Ultimately, the type, quantity, and optimal size of elements for a new space are all included within a space program. The number of individual units is then multiplied by a unit of net square feet to reach a total square footage. An example of a space program is presented in Table 2.

Definitions

Programming terminology has varied greatly over the years, both within the industry and between institutions. Given the noticeable discrepancies in programming nomenclature by year, region, and hospital, the following definitions for room types and clinical departments were applied to all programming documents reviewed to determine their relevance and inclusion in this analysis.

Adult acute care unit (DGSF) includes specialized and general medical/surgical, telemetry/step-down/progressive, acuity-adaptable and/or universal adult inpatient units. It excludes subacute units (e.g., rehabilitation, psychiatry, and geriatrics), obstetrics, general or specialized pediatrics, research, and observation units. It includes direct patient care and unit-based support. It excludes clinical support satellites (respiratory therapy, biomedical engineering, rehabilitation services, pharmacy, social services, and clinical dieticians), unless dedicated within a specific unit.

*Adult acute patient care room (*NSF) includes patient room, toilet, and bath/showers. It excludes hallway documentation stations if they are listed as a separate line item. Semiprivate rooms were counted as multiple-occupancy rooms (i.e., four patients in a 400 NSF ward equals 100 NSF per bed). It excludes isolation anterooms.

Adult critical care unit (DGSF) includes general and specialized medical/surgical intensive care units. It may include acuity-adaptable or universal units, if they are designated as critical care. It includes direct patient care and unit-based support. It excludes clinical support satellites (respiratory therapy, biomedical engineering, rehab services, pharmacy, social services, and clinical dieticians) unless they are dedicated within a specific unit.

Adult critical patient care room (NSF) includes patient room and toilet. It excludes isolation anterooms.

Interventional services (DGSF) includes the surgery department and all direct support. It *may* include interventional or image-guided suites, clean or minor procedure rooms, perioperative services, and clinical support (e.g., anesthesia workroom, biomedical engineering satellite, as well as pharmacy and frozen section/surgical pathology), direct administration, and staff support. Spaces excluded in the majority of cases include preadmission testing clinic, faculty/physician offices, central sterile, and satellite clinical laboratories.

Operating room, major and interventional (image-guided) *suite* (NSF) includes operating room and interventional procedure room, control room and/or computer room. It may include cardiac catheterization, electrophysiology, and interventional radiology. It excludes minor procedure rooms, gastrointestinal/endoscopy, bronchoscopy, cystoscopy (unless sized as an operating room), and C-section operating rooms. It excludes sterile

Table 2: Example 32-bed Adult Acute Care Unit Space Program

Key Rooms	32
Net to Gross Factor	1.60
DGSF	23,900
DGSF / Key Room	747

Adult Acute Care Unit

ROOM / SPACE	NO. OF UNITS	NSF/ UNIT	TOTAL NSF	COMMENTS
Patient Care				
Patient Room, Private	30	300	9,000	Includes toilet and shower
Patient Room, Private, Isolation/Bariatric	2	325	650	Includes toilet and shower
Alcove, Isolation	2	80	160	
Alcove, Charting/Documentation	16	20	320	
Subtotal			***10,130***	
Central Station / Unit Support (per 32 beds)				
Workstation, Standard	1	60	60	Unit Clerk
Office Equipment, Medium	1	60	60	
Report Room/ Team Workroom	1	300	300	Accommodate 4 workstations and conference table
Workstation, Hoteling	4	40	160	Pharmacist, Nutritionist
Pneumatic Tube Station	1	15	15	
Alcove, Crash Cart	1	20	20	
Alcove, Wheelchair	1	20	20	
Holding, Food Carts	1	20	20	Soiled food carts
Storage, Equipment, Large	1	320	320	
Subtotal			***975***	
Decentralized Support				Arrange support into 2 clusters, 1:16 beds
Workstation, Medium	8	40	320	Clinical workstations, unassigned
Report Room/ Team Workroom	2	240	480	Can accommodate 4 workstations and conference table
Clean Supply Room, Large	2	180	360	Immediate and Patient Chargeable supplies
Soiled Holding Room	2	150	300	
Medication Supply Room	2	100	200	Pyxis, Counter, Sink, Storage including Refrigerator
Nourishment Room / Pantry	2	60	120	
Alcove, Linen, Clean	4	20	80	Enclosed cabinet
Alcove, Equipment	4	40	160	Portable equipment
Closet, EVS	1	60	60	
Subtotal			***2,080***	
Staff Support				
Lounge, Staff, Small	1	180	180	Full size refrigerator and kitchenette
Lockers, Box/Purse	100	2	200	Provide adjacent to staff toilets
Toilet, Staff	2	55	110	
OnCall Room	1	100	100	
OnCall Toilet/Shower	1	80	80	
Subtotal			***670***	
Public / Family Area				
Lounge, Family	15	20	300	May be divisible into small lounges or consult rooms
Consult Room, Standard	1	120	120	
Toilet, Public	2	55	110	
Subtotal			***530***	
Offices and Workstations				
Office, Private	1	100	100	Unit Director
Office, Shared (2 people)	1	120	120	Hospitalists, includes 2 workstations
Office, Shared (2 people)	1	120	120	Asst. Nurse Manager
Office, Shared (2 people)	1	120	120	Social worker, case manager
Office, Shared (2 people)	1	120	120	RN Educator, Unassigned office
Subtotal			***580***	
Total NSF			**14,965**	
Grossing Factor			1.6	
Total DGSF			**23,900**	Rounded to nearest hundred

Table 3. Hospital Sizing Summary

	2007 AVERAGE (MEAN)	20-YR INCREASE
Patient Rooms	320 NSF	77%
Total Adult Acute Bed Space	720 DGSF per Bed	118%
Total Adult Critical Bed Space	900 DGSF per Bed	N/A
Operating Room/Image-Guided	704 NSF	53%
Total Interventional Space	3,700 DGSF per Suite	45%
Magnetic Resonance Imaging Room	810 NSF	(13%)
Computed Tomography Room	620 NSF	22%
Positron Emission Tomography Room	718 NSF	69%
Radiography/Fluoroscopy Room	370 NSF	28%
Nuclear Medicine Room	385 NSF	49%
Ultrasound Room	150 NSF	4%
Total Imaging Space	1,750 DGSF per Key Room	33%

core, substerile areas, scrub sinks, and preparation/recovery stations.

Imaging services (DGSF) includes various modalities (general radiography, fluoroscopy, ultrasound, interventional radiology, magnetic resonance imaging (MRI), computed tomography (CT), positron emission tomography (PET), nuclear medicine, mammography, bone densitometry, cardiodiagnostics, neuro diagnostics), direct clinical support, administration, and staff support. Older programs may include significant film storage. It typically excludes faculty/physician offices.

Imaging room (NSF) includes procedure room, control and/or computer rooms.

A Retrospective Study: Hospital Sizing 1980–2007

Findings: Summary

Table 3 and Figures 1–6 highlight summarized findings. Table 3 displays the 2007 average programmed size and 20-year total percentage increase of various key room elements. Figures 1–6 highlight trend lines for either NSF per room or DGSF per room.

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Findings: Adult Acute and Critical Care Services

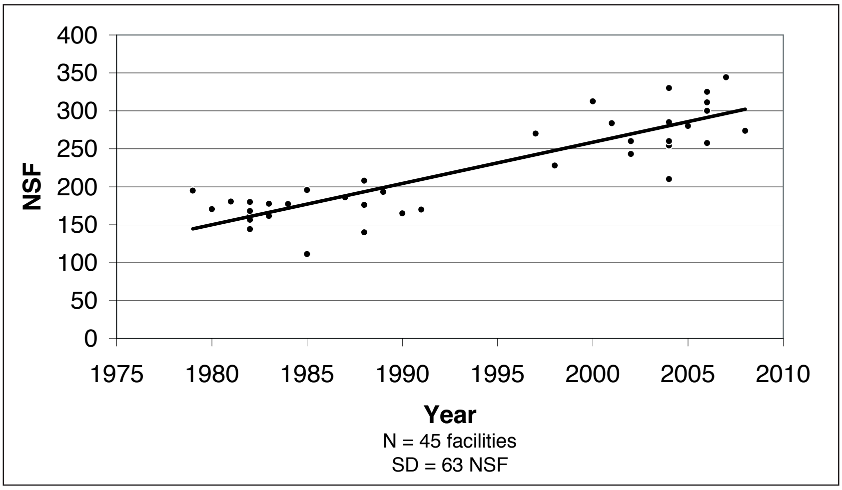

Figure 1. NSF per adult acute care bed.

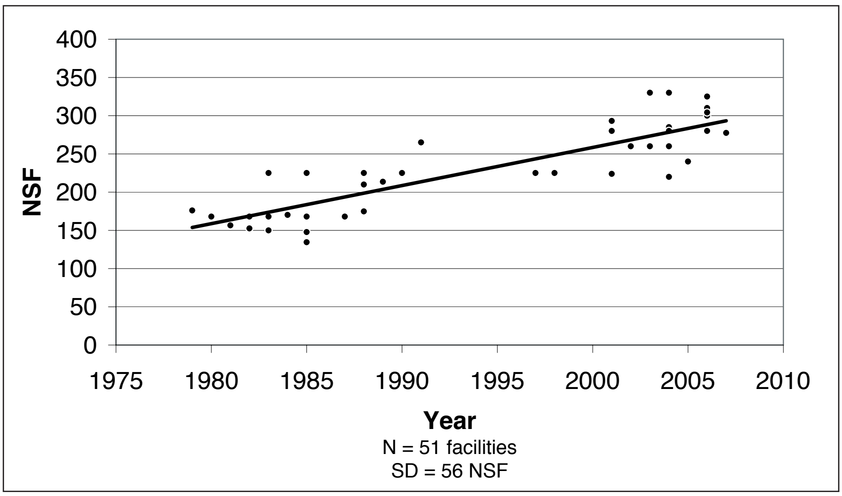

Figure 2. NSF per adult critical care bed.

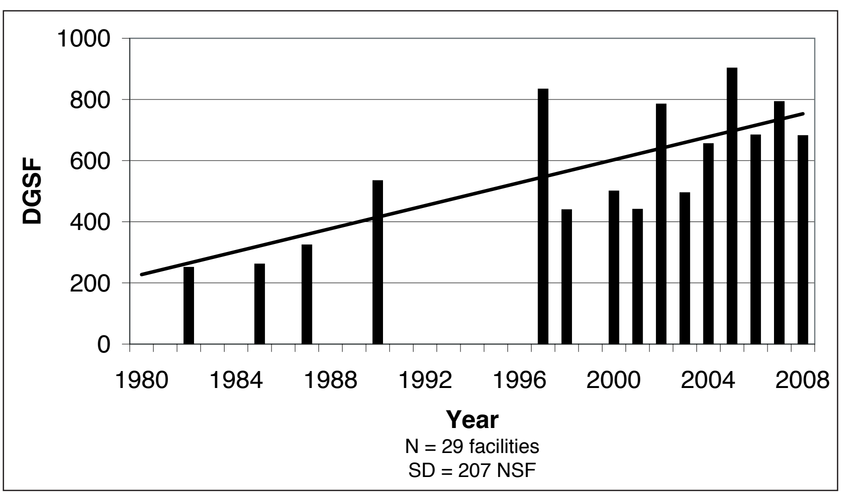

Figure 3. DGSF per acute care bed.

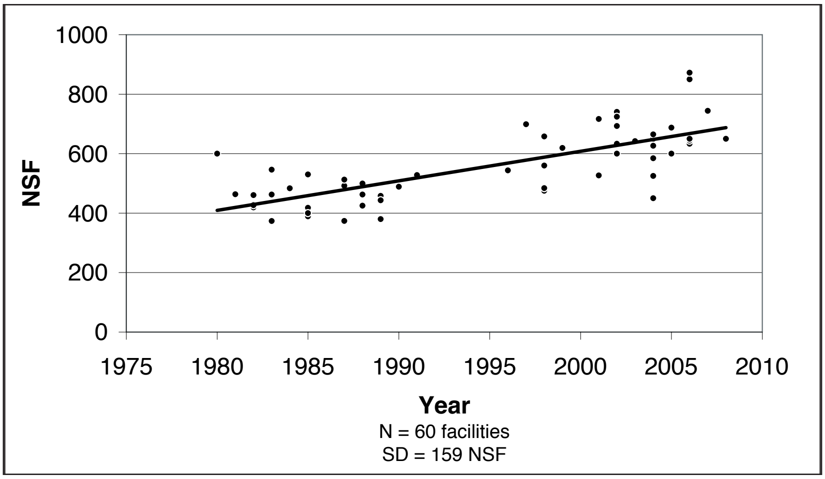

Figure 4. NSF per OR/interventional suite.

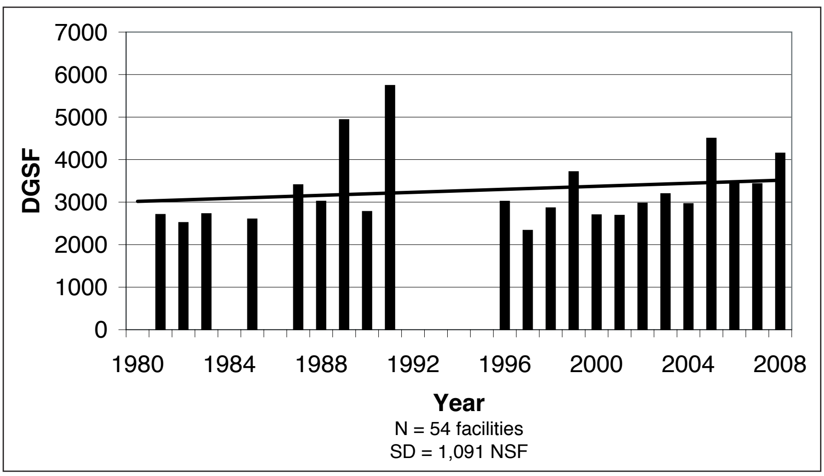

Figure 5. DGSF per OR/interventional suite.

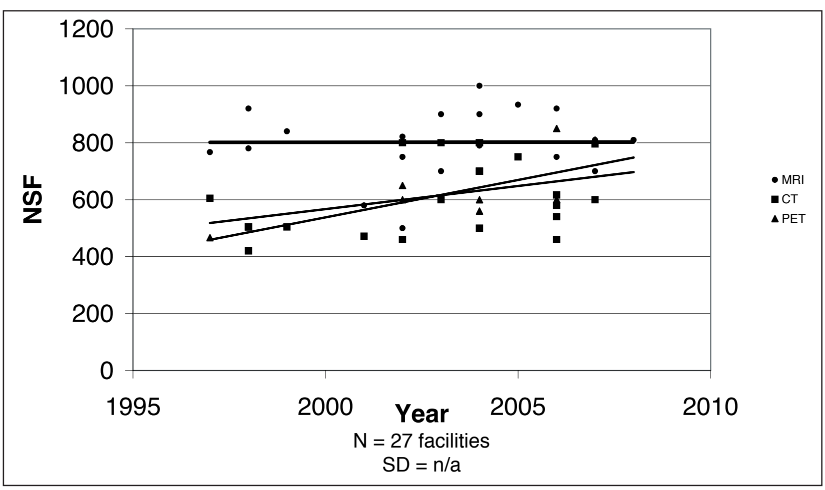

Figure 6. NSF per PET/MR/CT. (1997-2007)

Findings: Interventional Services

Findings: Imaging Services

Findings: Grossing Factors

Department size has increased because of the need for more circulation space; this is, in part, responsible for growing NSF to DGSF multipliers (Table 4).

Table 4. Average Grossing Factors

	1987	2007
Inpatient Units	1.35 – 1.5	1.5 – 1.6
Interventional Services	1.45 – 1.5	1.6 – 1.7
Non-Invasive Diagnostic	1.3 – 1.5	1.55 – 1.65
Emergency	1.35 – 1.5	1.55 – 1.6
Administration	1.2 – 1.3	1.25 – 1.4
Support Services	1.2 – 1.35	1.2 – 1.4

Total facility size has increased because of growing DGSF to BGSF multipliers, accommodating growing requirements for public space, mechanical systems, and information technology (Table 5).

Table 5. Average Grossing Factors

	1987	2007
DGSF to BGSF	1.25	1.31

Limitations of the Study

One Data Source

Only projects programmed by this international and national healthcare consultancy were used, thereby introducing bias from sample selection, which ultimately may influence the validity of the findings as well as their applicability to other firms' and institutions' work. All interpretations of this study's external validity should be used with this caveat in mind.

Absence of Built Data

This analysis reflects a review of the mathematical sum of programmed departments; however, the physical, geometrical, and built size of these departments (and institutions) was not investigated. Ultimately, the space recommendations listed in the programming documents may differ from the final built environment. Anecdotally, budgetary issues and the like sometimes result in the program experiencing a "reduction of all rooms by 10%," an approach which this healthcare consulting firm does not recommend. Likewise, in the case of specialized architectural design or configuration, the building could grow by 10% or more beyond the program.

Small Sample Size and Incomplete Data

Similarly, the small sample size (N = 76) introduces a certain degree of bias. Moreover, the incompleteness of the data resulting from non-standard documentation in the archived space programs (e.g., NSF was provided but DGSF was not and/or data were not available from the years 1992–1995) rendered a portion of the sample unusable.

Variability of Programs

Data included two major program types: full replacement facilities and major additions. Select programs included renovations within an existing facility. A number of other institution types were also incorporated in the analysis, including community and teaching hospitals as well as academic medical centers; however, the study excluded all children's hospitals. Given the variability in both the types of projects and facilities included in this analysis, it is impossible to state categorically that the trend observed (and its strength) can be generally and universally applied to all inpatient settings.

Variability Between Programmers

Intraprogrammer variability was also observed. However, whether this effect is the result of the individual programmer's style/preference, the result of a client request, or a combination of the two is indeterminable. Additionally, the magnitude of this phenomenon is unknown, which underscores the importance of understanding the historical context associated with the respective programs. Similarly, the grossing factors used have changed over time and in many cases reflect the programmer's best guess.

Absence of Context for Confounding Factors

Rationale (e.g., programs may have been influenced to a considerable degree by a particular institution's financial situation or footprint limitations) for the programmed spaces was not explicitly stated in many of the programs, especially those completed before the mid-1980s. Consequently, the rationale was inferred or collected informally from colleagues and project staff; however, there was no standardized investigation into these factors.

Primary Driving Forces of the Super-Sizing Phenomenon

Historical growth in programmed space may be attributed to various factors depending on the year of construction, regional variability, or even the level of urbanization in a particular community. Some of the strongest contributors to the observed super-sizing phenomenon within the programming recommendations of this healthcare consulting firm (and perhaps within the broader field) can be attributed to the following:

- changes occurring in both operational and patient care models;
- greater consumer demand and increasing market competition;
- increases in average patient acuity and disease prevalence;
- the dramatic evolution and impact of technology; and
- the modification of regulations and building codes.

Patient Care and Operational Models

Patient care standards, technology, and operational models have evolved over the past 30 years, requiring additional space for the delivery of care and support in direct proximity to hospital inpatients. The adoption of a multidisciplinary team approach, especially at academic and teaching institutions, and the distribution of care team support closer to the bedside have created an increased demand for consultation/conferencing rooms and computer documentation stations. Ancillary staff (e.g., social workers, utilization/case managers, and dieticians) in particular, have an increasing role in the care team and spend substantial time either dedicated to particular units or floating between units—a trend unlikely to reverse anytime soon. The convergence of surgery and imaging technologies also has driven the desire for larger floor-plates as practitioners seek horizontal adjacency among various mo-

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dalities. The shift toward more ambulatory or short-stay procedures has propelled growth in the size and quantity of periprocedural (prep and recovery) care stations. Perhaps most significantly, the transition from shared to single-bed patient rooms has increased the space requirement to accommodate the same number of beds for clinical and nonclinical amenities alike (e.g., rooming-in space for families, private patient toilets/showers, monitoring equipment, workspace for caregivers).

…[T]he transition from shared to single-bed patient rooms has increased the space requirement to accommodate the same number of beds for clinical and nonclinical amenities alike…

Consumerism and Market Competition

Consumer-driven healthcare has elevated patient expectations relative to levels of service, amenities, and ambiance. Fueled by consumer demand, hospitals have had to become increasingly competitive, seeking to differentiate themselves from their competition based on service and thereby capture an increased share of the market. Some of the byproducts of this competition include increased patient room size and the provision of an extensive array of in-house services (e.g., business centers, family lounges with full-size kitchens). With respect to patient rooms, not only has the trend accelerated toward providing single-bed rooms for their health and safety benefits, but private toilets and showers have become standard, as well as additional space to accommodate specific populations (e.g., bariatric patients). More spacious rooms also permit the introduction and gradual adoption of care models that encourage family participation in the care of patients, including rooming-in and other requirements that have affected the layout and size of inpatient units.

Furthermore, consumerism is not limited only to patients. The recruitment of renowned clinicians has become a competition, where the promise of large, state-of-the-art facilities (e.g., large operating room suites, clinic space, faculty offices) is used to attract a coveted recruit.

Patient Acuity and Disease Prevalence

Many patients who historically were treated within the hospital are now seen in ambulatory environments. Traditionally these patients were those with lower relative acuity; therefore, the overall health of the population seen within the hospital has decreased. Higher-acuity patients require more support, additional technology, and higher levels of staffing. In addition, the advancing age demographic in the United States has led to a demand for more capacity (beds, procedural areas, technology) within the acute care environment. Changing rates of incidence and prevalence of disease have also contributed to the need for different types of space (e.g, more, larger, and different diagnostic and treatment areas, bariatric-sized rooms).

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Technology

Infrastructure requirements for both MEP systems and IT have significantly increased, requiring greater floor-to-floor heights, interstitial spaces, and spaces to accommodate increasingly sophisticated heating ventilating, and air conditioning (HVAC), communications, and transport systems, thus affecting total building size. The availability and proliferation of clinical technologies (e.g., MRI, interventional radiology, surgery robotics, and lasers) has changed the standard of care and played a role in the super-sizing of diagnostic and treatment departments. The number of biomedical devices has similarly increased, supporting the cause for larger patient rooms. Patient-centered care models have also had a tangible effect on moving procedures and equipment to the bedside, including monitors, automated pumps, and portable imaging equipment. As the range of equipment and number of portable devices increases, space is needed for storage and maintenance (i.e., the amount of storage per operating room). The use of robotics and automation for logistics and clinical support functions has proven to be space intensive. The use of automated lab systems, pharmacy robots, and robotic distribution systems that require their own internal transport routes have all contributed to the super-sized environment.

The movement toward point of care IT has required additional space within patient rooms, in corridors, and at nursing and clinician workstations. Similar increases have occurred in administrative areas. Supporting this increased use of technology has led to a growth in technology support spaces for network infrastructure, cabling, and data center spaces, as well as increased capacity requirements for HVAC and electrical infrastructures. The fuller adoption of point-of-care technologies reduces the space needed for record storage (e.g., medical charts, radiology films) space; however the net effect is the need for more space.

Regulations and Building Codes

International, national, state, and local regulations have mandated minimum requirements for many functions within hospitals. For example, the American Institute of Architects' (AIA) guidelines have changed significantly in the last 30 years and now recommend private patient-centered care rooms at 250 NSF plus 30 NSF for each additional person (i.e., family member) (AIA, 2006). Similarly, the Americans with Disabilities Act (ADA) requires a percentage of wheelchair-accessible rooms and toilets (ADA, 2008). Building codes also have evolved, an example being the introduction of USP 797 regulations for preparation of sterile intravenous solutions in clean rooms in inpatient pharmacies (U.S. Pharmacopeia, 2008). Corridors have become wider, fire safety and seismic requirements have increased, and public health requirements (e.g., more quarantine/isolation rooms to accommodate mass casualties) are of greater concern. Each of these changes has contributed to the requirement for additional space.

Looking Back: Is the Growth Justified?

This large consulting firm, with an international practice that includes the programming of health-

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care capital projects, views growth as *justified* when it is warranted or seems likely to improve a space's capabilities or functionality, whereas *unjustified* growth does not contribute directly to functionality or adds an element of flexibility that is not likely to be used. *Excessive* elements are those exceeding a customary limit or demonstrating an unnecessary amount of what is being measured (e.g., square feet, money, time, resources). An element may be considered excessive (i.e., larger than anticipated) while still being justified (e.g., improves functionality). That said, correct sizing depends on the operational model of the department; the aggregate size of the medical center; the degree of teaching, research, or other nonclinical uses anticipated; the level of automation; internal political agreements; local regulations; and numerous other variables. For example, on-site materials stores must meet regulations for emergency storage at a minimum, but the threshold into excessive onsite storage varies drastically across comparable campuses and may be more a matter of interpretation.

Total building size is highly variable and as a result BGSF per inpatient bed is not a valid comparator at the macro level. Traditionally this value has ranged from 1,500–2,500 BGSF per inpatient bed; however, the value can range considerably higher and is contingent on the functions included within the building (i.e., degree of ambulatory services, support/logistics, research, and education) as well as circulation patterns and the level and sophistication of MEP and technology infrastructure within the building.

Guessing at an unknown future, programmers often err on the side of too much flexibility.

Unjustified: Excessive Room Sizes

Although private patient rooms are most often justified for reasons of operational efficiency, patient safety, and comfort, rooms larger than 320 NSF may be deemed excessive (includes handicap-accessible toilet and shower, caregiver work space, family space). Similarly, major operating rooms larger than 750 NSF may not improve the room's functionality, but instead use excess floor area for equipment storage. Imaging room sizes have been directly influenced by equipment size, but "big box rooms" (i.e., MRI, CT, PET) of more than 860 net square feet (includes procedure room of 560 NSF [28' x 20'] and 250 NSF control/computer room) may be considered excessive. It is notable that the functionality of the square footage is highly dependent on layout and configuration.

Unjustified: Greatest Common-Denominator Planning (Excessive Standardization)

In the quest to make space as flexible as possible for the future (based on lessons of the past), programmers are increasingly sizing to the greatest common denominator. Guessing at an unknown future, programmers often err on the side of too much flexibility. For example, it is not uncommon to use a standard big box room size for major imaging modalities, even though CT requires less space than MRI or PET. This anticipation of future modality shifts and "fusion technologies" not yet on the horizon may provide a questionable return on investment. Although standardization has been the golden rule for many years, planners must acknowledge the premium for excessive or unnecessary flexibility.

Unjustified: Under-Utilization of Space

Highly specialized rooms, spaces poorly located or otherwise planned with the wrong department, dedicated spaces for functions that will become obsolete, and dedicated spaces that could be shared across multiple departments are red flags for potentially super-sized departments. Similarly, excessive shelled or non-built out spaces (i.e., not functional without additional construction) included to enhance future flexibility (if financially feasible) may be allocated at some future date to non-revenue–generating functions, which can unnecessarily oversize buildings. In general, poor design or an inefficient configuration is that which necessitates greater levels of staffing or increased fixed cost per unit (e.g., fewer beds per acute care unit, multiple entries, and under-utilization of space, such as large lobbies with no programmed purpose).

Unjustified: Inefficient Operations

Often spaces are planned to accommodate duplication of services or staff, non-value-added spaces, and poor patient or materials flow. Personal preferences for desirable hours of operation may adversely impact the efficiency of an area (e.g., physician preference for early slots on the operating room schedule may drive a preference for more operating rooms). Planning and building too many rooms (too much capacity) or the wrong rooms for future needs result directly in size creep.

Unjustified: Excessive Capacity Based on the Scale of a Department

The scale of a department should determine its capacity. Unnecessary features may include, for example, multiple private conference rooms, too many waiting chairs per exam room, private offices for nonsupervisory staff, or too many single-function information desks. Often these spaces go unused or unstaffed and create wayfinding and flow problems in addition to increasing project size and cost.

Unjustified: Excessive Grossing Factors

Excessive NSF to DGSF grossing factors may allow for architectural flexibility of a department's configuration, but it can result in travel distances for staff or patients that are too great and that increase building size without a commensurate increase in throughput (Table 6).

Table 6. Average Grossing Factors

	1987	2007	Unjustified
Inpatient Units	1.35 – 1.5	1.5 – 1.6	> 1.8
Interventional Services	1.45 – 1.5	1.6 – 1.7	> 1.9
Non-Invasive Diagnostic	1.3 – 1.5	1.55 – 1.65	> 1.8
Emergency	1.35 – 1.5	1.55 – 1.6	> 1.7
Administration	1.2 – 1.3	1.25 – 1.4	> 1.5
Support Services	1.2 – 1.35	1.2 – 1.4	> 1.5

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Unjustified: Location of Nonessential Services Within the Inpatient Setting

Essential services are those that *must* be located within an inpatient medical center. Many organizations employ the tactic of moving nonessential services or functions not directly involved in direct patient care to adjacent, nonhospital buildings. These buildings may be built to less than an inpatient code and are therefore somewhat smaller and include functions that need not be inside a hospital (e.g., ambulatory clinics, faculty offices, non-unit-based administrative offices, logistics support [laundry, materials warehousing, workshops], large group education rooms, and basic research facilities). However, there is often a need for "stub" or duplicate space in the main hospital building to handle the interface with these off-site services (e.g., laundry staging area, physician workrooms). Telephony, computerization, and multimedia communications have also enhanced the ability to move back-office functions out of the main hospital building.

Unjustified: Unrealistic Volume Basis

Building capacity may be planned to meet unrealistic projected volumes of care. For example, if a hospital will be open in 2008, it may be considered excessive to build for volumes projected for 2025 (as opposed to developing a master plan that accommodates future expansion to this capacity and deferring the capital investment).

Looking Forward: Future Trends

The future direction of the healthcare industry is a matter of some debate. Within broad boundaries, however, and tied to specific political cycles, one may speculate about several phases in our immediate future when forces will be set in motion that will exert pressure to slow the increase in project size or begin to reduce size in absolute terms.

National War Over Resources: 2008–2012

In this time frame, the major sources of healthcare revenue (taxes, premiums, deductibles) are not expected to keep pace with spending, leading to an extended period of belt-tightening. As a result, healthcare systems will begin to face *anti*-super-sizing pushbacks that will discourage excess, such as:

- Restricted capital availability (due to increased cost of debt, poor ratings, excessive leverage, or other factors) will increase scrutiny and require more extensive justification of space requirements. A growing imperative for cost/benefit and return-on-investment analysis will be seen because additional space and capital investments will need to offset future operating costs and improve clinical outcomes.

- Competing needs and priorities will require more robust business cases for new medical center construction. Without these, capital will be siphoned toward technology solutions, research, education, or ambulatory construction. In all cases, strategic priorities (i.e., those related to incremental growth) will be viewed more favorably than those related to replacement (i.e., increased capital for no incremental revenue) without significant external justification (e.g., seismic requirements or other risk-related justifications).

- Rapidly rising construction costs will focus development on incremental capacity, deferring replacement of non-revenue–generating services and extending the life of existing facilities.

- Rising operational costs, primarily caused by workforce availability and other resource shortages (e.g., energy), will begin to push down building size as inefficient operations become intolerable.

- Site and zoning restrictions and neighborhood alliances will begin to play a more active role in restricting the healthcare built environment, based on increased activism regarding neighborhood rights and the ability to contest rezoning.

- National healthcare policy will continue to affect reimbursement and incentives for construction of facilities to accommodate more profitable services. Payers' cost awareness will be heightened, and they will resist blatant excesses.

In addition to these *anti*-super-sizing pushbacks, future clinical trends likewise will play an important role in defining the degree of facility growth. Whether it be the next wave of medicine (e.g., genomics, molecular imaging), home monitoring and diagnostic tools, telemedicine, or other clinical advances, these trends will continue to expand the definitions of inpatient vs. outpatient care and will place increasing demands on IT infrastructure.

A final factor that will have an impact on facility size in this period is an increased focus on sustainability. Some attributes such as configuration requirements for natural light, building orientation, and selection of mechanical systems may not fundamentally cause additional super-sizing, but the trend may affect the length of useful building life and favor anti-super-sizing forces (i.e., operational costs).

Resolution and Legislation: 2012–2020

While the healthcare industry experiences increasing economic pressure leading to legislation, society will begin to question expensive facilities. The clinical enterprise will be under increasing pressure from consumers and payers to demonstrate the value it provides in facility excesses (e.g., extreme size, expensive finishes). By means of increased consumer advocacy, patients will develop a better understanding of healthcare costs; payers will develop more sophisticated processes to measure quality, cost, and the overall value of healthcare services. Medical centers will be forced to validate, through clinical and outcomes research, that new facilities enhance patient safety, comfort, and length of stay as well as staff satisfaction, recruitment, retention, and productivity. Demonstrating a positive effect on an institution's viability—particularly its financial health and community image—will be increasingly valued.

Consequently, organizations will no longer be able to plan for all eventualities or the greatest

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common denominator; they will have to specify how capital and space are deployed.

While the marginal benefit of including unjustified or excess space in a project currently may outweigh operational and related construction costs, super-sized facilities will begin to experience decreasing (and eventually negative) marginal benefit in the future. In short, sizing facilities in excess of what may be considered functional or reasonable, especially in terms of committed capital and staff resources, will produce undesirable effects fiscally, socially, and politically for the sponsoring organization.

Balancing these pushbacks, the majority of the Baby Boomer generation (born 1946–1964) will be crossing into retirement (and Medicare) in this period. This will drive two eventualities. First, there will be a huge increase in inpatient demand, which means hospitals will want to keep open every bed possible (even in inefficient facilities). Second, this is the most politically active age cohort in the history of the country, and there will be an expectation that they be treated (free of cost, because they will have paid into Medicare all their adult lives) in roomy, state-of-the-art facilities.

Obsolescence Catches Up: 2020–2025

Building life spans in healthcare are roughly 50–70 years, and within 20 years we will reach a point where hospitals built before 1980 will be considered nonfunctional in many parts of the United States. Significant demographic shifts (e.g., northeast to southwest), deferred investment in health facility infrastructure, and operational cost pressures will lead to a point of crisis for society when the cost of new acute healthcare capacity and upgrading old capacity will outrun the resources of a largely not-for-profit industry.

Countervailing forces such as limited capital availability and the continued escalation of construction costs will likely accelerate the downward pressure on sizing excess.

Conclusions

During the last 30 years, hospital rooms, departments, and overall buildings that the health consulting firm has programmed for the healthcare industry have grown in size, as evidenced by this analysis. In some cases these spaces have been excessive or super-sized; however, the existence of unjustified space in facilities programmed by other firms suggests that the firm under consideration is not alone. The verdict on the benefits versus costs of additional programmed space is anything but clear cut, and opinions vary by user and institution. This observed creep in size is the result of multiple contributing factors that have varied by time and place; they include changing patient care models, consumerism, and technology trends. Although it is likely that these trends will continue in the short term, the consulting firm examined believes that increased size will require increased justification. Eventually the industry will reach a "super-sizing plateau," the point at which growth per unit of capacity slows and then ceases. Countervailing forces such as limited capital availability and the continued escalation of construction costs will likely accelerate the downward pressure on sizing excess. Inevitably the basic "bigger is better" mentality will fundamentally shift to one of "more is just more."

As space programmers, we hold out hope for resolution, noting that other industries have managed to improve processes and quality, reduce cost, and quantify outcomes. We must take the quantum leap to do the same. Instead of looking back in regret over failed building plans or forward in fear, believing that we must program and build to the worst-case scenario, we must focus on the present—opting to build that which is operationally efficient, financially feasible, and clinically appropriate.

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