

ABSTRACT

New Hospital on a New Site – Case Study for Universal Application: Arrowhead Regional Medical Center

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The intent of this article is to show how the effective application of the planning principles used in the development of the design for Arrowhead Regional Medical Facility can be applied to the future planning of hospitals in a regional and international context. We seek to demonstrate this thesis by showing how the concepts used in the planning of Arrowhead held up over the 10-year planning, design, and construction of the project, and how the lessons learned in that process were applied to the design of a hypothetical hospital in the Middle East.

Our goal is not to establish new benchmarks for the planning and sizing of hospitals, but to share some effective approaches and principles that can serve as useful tools for future planning of health-care facilities.

Design of the Arrowhead Regional Medical Center proceeded from key project concepts established early in the schematic design process. Particularly important key concepts include:

- Site planning for clear wayfinding
- Internal planning for operational efficiency
- Planning for growth and incremental expansion.

Lessons for universal application are derived from the design of Arrowhead Regional Medical Center. The application of these lessons is tested in the recent design by Bobrow/Thomas and Associates (BTA) of a hypothetical hospital in the Middle East.

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Before we can tell the story of the successful Arrowhead planning principles, we must take exception to a paper published by the Academy using Arrowhead Regional Medical Center to demonstrate the authors' point regarding potential waste in capital expenditures. That article unfortunately used out-of-date standards long abandoned by the industry (i.e., square feet/bed), and significant statistical inaccuracies as to the size and cost of the project, to demonstrate an approach that focused simply on first costs rather than on the true costs of operating a hospital over its lifetime. The appropriate approach, and the one used by

Bobrow/Thomas and Associates in the design and planning of the Arrowhead facility, is to look at capital investment as a tool to create the most efficiently operated, contemporary market-sensitive environment.

First, we would like to establish the context of the Arrowhead project historically. In California, the responsibility for providing health care to the indigent population falls completely upon the shoulders of the counties. Since the mid-1860s, the County of San Bernardino had been providing those services to the public in a campus of buildings located in the City of San Bernardino. Over time, the facility had grown to 286 licensed beds, 56 of which were licensed for behavioral health. The overall square footage for the campus was approximately 450,000 gross square feet.

Around 1985, the County of San Bernardino began to look at their long-range planning options for the medical center, evaluating (among other things) renovation and repair of the existing facility, partnerships with private institutions, and building a new hospital. Two key factors played into the decision, as well as the subsequent planning process:

- The County is located in one of the most seismically active regions in the country
- The volatile health-care market of the time and the uncertainty of health-care reform.

Analysis of the cost to renovate and upgrade the facility to conform to existing seismic codes proved cost prohibitive and virtually impossible to implement operationally. It is important to note that this evaluation was prior to the Northridge Earthquake and subsequent enactment by

the State of California of even higher standards of seismic performance for hospitals.

The responsibility for provision of health-care by the county to its uninsured population was at the time and still is a significant source of revenue for the county. However, the reimbursement received by the county, while substantial, was always susceptible to legislative and health-care market provider disruption. The county, therefore sought to establish a strategic plan that could--in the most cost effective manner--continue to provide the legislatively mandated health-care services and still retain appeal to the private sector. This would both attract business and provide a facility that would be attractive for acquisition and/or operation should the county decide to pursue private contracts to meet its obligation.

The county chose to proceed with the development of a new medical center on a new site, and began creating the functional program in 1989. In December, 1990, Bobrow/Thomas and Associates, in association with Perkins and Will, were awarded the design contract for the facility.

The program called for the design of a complete replacement of the existing medical center with 373 beds, a behavioral health center, complete outpatient clinics, and full emergency and trauma services. Additionally, the program mandated that the facility be capable of withstanding an earthquake of 8.3 magnitude and continue operation without outside assistance for 72 hours.



Because Arrowhead Regional Medical Center is an entirely new facility on a clear site, it offers the opportunity to use the design of this modern acute medical facility to illustrate broad concepts that can be applied to the design of new hospitals on similar virgin sites in any part of the world. It also illustrates the importance of establishing clear project goals that drive the design process. In the case of Arrowhead Regional Medical Center, the following key project concepts¹ were identified early in the schematic design process:

- Campus of buildings with clear and intuitive way-finding
- Environment respectful of the patients' dignity
- User-friendly facility
- Potential for growth and incremental expansion
- Building exterior that develops from the functional planning of the interior

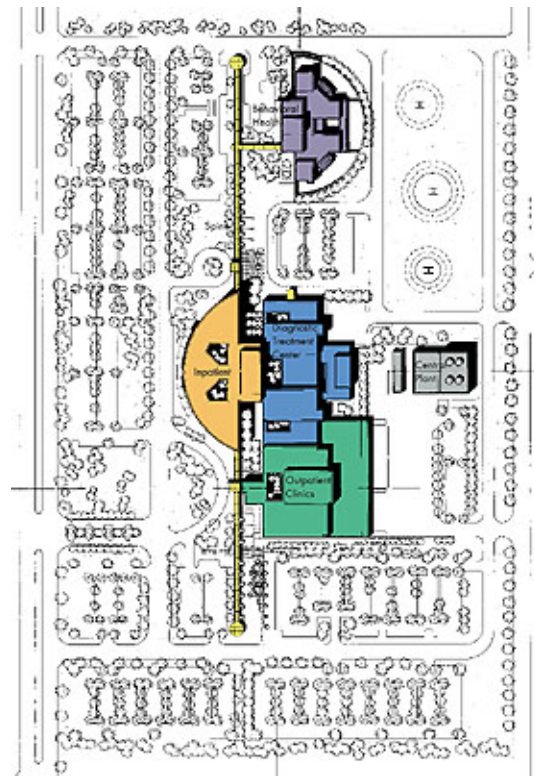
¹ BTA/P&W, San Bernardino County Replacement Medical Center, Schematic Design Report, July 16, 1991. P.3

- Operational and functional efficiency, i.e., single-bed patient rooms, a nursing pattern that allowed for a range of staff ratios from 1:1 to 1:2 on each nursing floor
- Floor-by-floor mechanical systems freeing up all the nursing units from vertical shafts
- Situation of the building as if it were in a park
- Discrete location of surface parking
- Separation of the public and service zones by planned circulation and landscaping
- Clear site vehicular circulation

The application of these key project concepts to the design of Arrowhead Regional Medical Center will be discussed in some detail. In this discussion, it should be kept in mind that these concepts, far from being unique to San Bernardino County, apply to the design of a major medical facility anywhere. Of course, local conditions and site constraints, plus the necessity to live with existing buildings when a new addition is considered will make compromises necessary. Arrowhead Medical Center represents as close to ideal site conditions as any project will probably ever have.

Site planning for clear way-finding

Site planning responds to the need for clear organization of the campus and allows for simple progression from the entry points to a variety of services offered at Arrowhead Regional Medical Center. Vehicles enter the campus from two major access points along Pepper Avenue, the main road leading from the Interstate 10 freeway exit. The outpatient clinic, which accounts for approximately 80% of patient volume, is located closest to the first entry point for maximum visibility and ease of access.

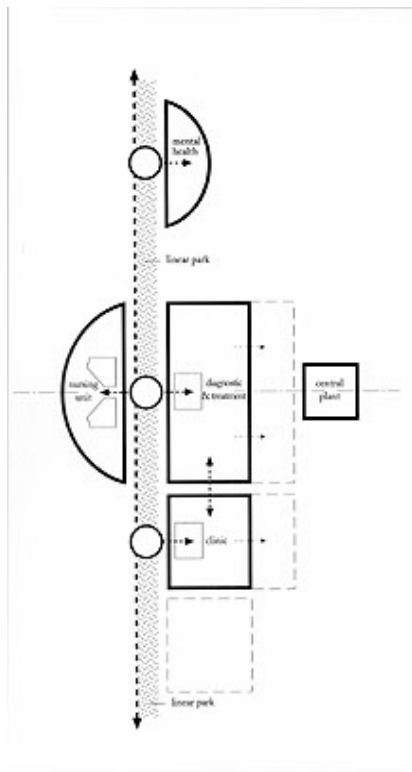


The behavioral health facility is located at the other end of the campus, farthest from the first entry point, to allow for discrete patient drop-off and dedicated visitor parking. In between is the inpatient nursing tower, which is located at the center of the site, and is easily visible because it is the tallest of the campus buildings. These most important campus elements are arranged along a major vehicular spine that connects all entries and parking at the front of the campus.

Parking is broken up into landscaped courts that relate directly to each of the major buildings. Employee parking is dispersed to the corners of the site. Landscaped parking areas and two landscaped zones along the vehicular spine create the situation of the buildings as if they were in a park.

Paralleling the major vehicular spine is a landscaped pedestrian spine that penetrates the center of the campus and serves as the

major organizational element on the site. This site element creates courtyards and outdoor waiting areas within the Arrowhead Regional Medical Center. It accesses the main public circulation within the buildings, including the main lobby and all vertical transportation systems. Courtyards along this spine allow natural light into interior spaces, facilitating way finding by creating memorable spaces along the major path of travel.



As described above, the campus is zoned in a longitudinal direction for access based on frequency of visits/vehicular traffic. In the transverse direction, the campus is zoned to separate patient and visitor circulation from emergency and service circulation. The zone facing Pepper Avenue is dedicated to public uses. The back side of the site (eastern portion), facing Meridian, is zoned for both emergency and support uses, with entry points dedicated to each function. It is important, however, that access to the emergency department be provided from

any campus entry point: although ambulance drivers and EMT personnel will use the specific entrance provided, members of the general public may not be familiar with the most direct access. At Arrowhead Regional Medical Center, an internal loop road and clear signage secondary access to emergency services possible.

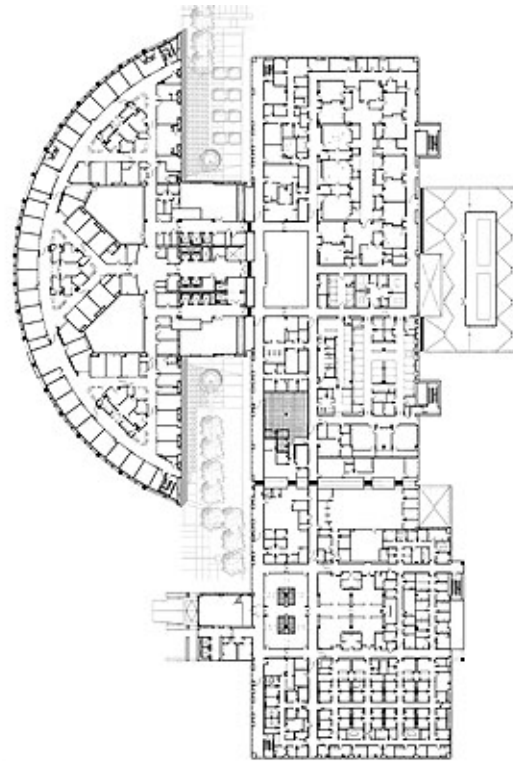
Also located in the support zone is the heli-stop, which allows for direct access to the emergency department keeping helicopter operations noise away from the nursing tower. In addition, the central plant for campus mechanical systems and the truck service dock for supply delivery and waste products removal is located in this zone. The service dock takes advantage of the natural slope of the site, allowing service entry at the basement level of the center. (However, on another project, if the site were large enough-- even if the natural slope does not allow--there still would be an opportunity to excavate a truck ramp.)

At the one end of the site, along Valley Boulevard, there remains an undeveloped triangular portion of the site. This is the only aspect of the Arrowhead Regional Medical Center site that is less than ideal. During the environmental review process for the project, it was discovered that the site was one of the last remaining habitats for a rare form of sand flea. As a condition for construction of the project, a portion of the site was left undeveloped to allow the sand flea habitat to remain undisturbed. Because of the overall organization of the site, this is not a great hardship; however, it makes provision of an internal loop road within the campus itself all the more important, because no access whatsoever can be made from Valley Boulevard.

Internal planning for operational and functional efficiency

Internal planning of the Arrowhead Regional Medical Center carries forward the emphasis on clear circulation, ease of way-finding, and logical zoning of services that are evident in the site plan. Optimal operational design seeks to co-locate key services, reduce both vertical and horizontal travel distances for patients and staff, maximize visibility and control of patient and visitor areas, and accommodate changes in staffing and modes of operation.

All major functions of the medical center are zoned into four architecturally defined elements: inpatient, diagnostic and treatment, clinic/outpatient and behavioral health. Of these elements, only behavioral health is a freestanding building. The other three elements are linked together along the major circulation axis, with the diagnostic and treatment element located between and serving both the inpatient and clinic/outpatient elements. Because each of the elements reads as a separate building, the overall scale of Arrowhead Regional Medical Center is broken down into four separate pieces. The design of each piece, while respecting the vocabulary of the whole, seeks to differentiate each element, providing visual images that enable patients and visitors to recognize them from both the exterior and interior.



Within the individual elements, functional efficiency is achieved by locating key functions adjacent to one another, such as ICUs and the surgical suite. Because the overall width of the diagnostic and treatment and clinic/outpatient elements allow sufficient space, the individual departments can also be organized for efficient internal layouts, including, for example, creation of staff work areas in the center of ORs and imaging rooms to minimize staff travel distances.

Of particular interest in design for overall efficiency is the creation of a nursing unit that can be operated in any nursing plan model with variable size nursing units. During schematic design several nursing unit configurations were studied. The configuration selected is based upon 24-bed, all private room, triangular nursing units. Three nursing units are joined on one floor to create a 72-bed floor. This allows some support services and patient care management staff to be shared by an entire

floor. Each individual nursing unit, however, is small enough to allow all patients to be served from a central nursing station within each unit, or for higher acuity patients to be served from sub-stations within the unit. Linking the triangular units along the curved façade of the Nursing Tower also allows the 24-bed unit to expand if necessary into an adjacent unit, by taking responsibility for one or two additional patient rooms along the curved corridor. A key consideration in the design of the unit is the lack of any architectural element that would prevent assignment of patients according to the level of acuity (versus any preconceived grouping of rooms or “pod”).

Using all private rooms in a public hospital at first seems inefficient. However, when looked at in terms of maximizing bed use, all private rooms allows for a smaller overall number of beds, because patients do not need to be shifted to avoid a man and a woman sharing a semi-private room. In addition, the private rooms at Arrowhead Regional Medical Center are sized to allow for some treatment modalities (e.g. ultra sound, portable x-ray) to be performed within patient rooms, enhancing patient satisfaction and staff efficiency. The rooms are also large enough to allow for conversion of medical surgical nursing units to intensive care units, if more ICUs are needed at some time in the future.

When the Arrowhead Regional Medical Center was being designed, the layout of the nursing unit was extensively studied and discussed with the hospital’s planning team. The architects decided that the best way to test the unit was to prepare a field simulation. To accomplish this, a full-scale floor plan of an entire nursing unit was painted on an existing parking lot in San Bernardino. The nursing staff was invited to participate in a day of testing that included navigating the plan with hospital beds and

checking travel distances. Many plan refinements came out of this session.

Planning for growth and incremental expansion

The planning and design of a medical center requires accommodating the need for the facility to grow and replace itself over time. With the continuing changes in health care-- both with new technology and in the organization of service delivery--the pace of redevelopment of existing facilities can only increase. For Arrowhead Regional Medical Center, future growth and expansion are anticipated in the current facility in several ways, both externally and internally.

The external organization of the site plan, with appropriate zoning of activities and clear vehicular and pedestrian circulation, allows for the addition of buildings in several areas that are currently either landscaped open space or parking. The original buildings are sited so that open space exists to the south (between the Outpatient Clinics and the loop road) and to the north (between the Diagnostic and Treatment element and the Behavioral Health building).

The allowance of appropriate space between buildings for a site this large is deliberate, and points up the potential mistake of beginning all development at one end of a site with future expansion then possible in one direction only. In addition, setting the buildings way back from the frontage along Pepper Avenue allows for a zone of future expansion along the entire north/south axis. Should this expansion occur, some of the surface parking lots would be replaced with parking structures. There is also a future expansion zone at the far end of the site, north of behavioral health, for either future medical center buildings or other San Bernardino County facilities.

Building internal expansion is also a major consideration in the planning of Arrowhead Regional Medical Center. The major north-south circulation spine carries through the entire complex, uniting the major building elements at each floor level. This spine is open-ended at the north and south edges of the building, and, by extension, creates a “street” along which future building elements can be placed, each tying into the existing circulation. The existing building faces can also move out, extending along the circulation spine. In addition to the public circulation, a similar north-south continuous corridor on the basement level serves as a service spine within the hospital, and by extension via a tunnel, as a connector to the behavioral health building.

Future flexibility is enhanced by creating a service zone along the main circulation spine and in the elevator core, which accommodates all the mechanical, electrical and plumbing vertically and horizontally, leaving the remainder of the building area free of obstructions.

In addition, placing “soft space” of offices and non-clinical/technical spaces between the major growth functions ensures short-term flexibility. An example of this is the placement of fiscal services between the OR/cath lab and the clinics. The soft-function spaces can be easily relocated elsewhere, allowing the clinical departments to grow.



Lessons for universal application

In reviewing the development of Arrowhead Regional Medical Center, there are a few key lessons that have universal application to the development of a major medical center. First and foremost is the importance of selecting the appropriate site. The site ideally needs to be at least 40 acres and to have good roadway access for patients and visitors. A site sized at 40 acres or more will allow enough room for future expansion. Of course, if the medical center includes other related buildings, for example, laboratories or teaching facilities, it should be even bigger. The Arrowhead Regional Medical Center site, at 64 acres, is ample.

However, even with a large site, the medical center should keep an eye on the development of surrounding properties and try to influence the future of its neighborhood so that other land uses are compatible. For example, the large open area immediately to the east of Arrowhead Regional Medical Center is a cemetery. This provides a buffer zone between the hospital and residential housing, which might be adversely affected by helicopter operations.

Another important lesson is the need to zone the site for potential expansion in the master plan, so that buildings are not placed in way that could block future buildings. It is also important that this aspect of the master plan become internalized by the hospital administration. In today's healthcare environment, there will always be a need to do short-term projects to meet immediate needs. It is important, when these projects come up, that the long-term master plan implications be considered.

Building in internal flexibility is as important as site flexibility. One of the key decisions at Arrowhead Regional Medical Center was the organization of the diagnostic & treatment and clinic outpatient building elements along two major corridors, with enough space for individual departments to be laid out efficiently. Had the building been too narrow, the internal planning would have suffered and there would not have been the opportunity to provide the “soft space” that allows critical patient treatment areas to expand. Of course, creation of a wide building makes the use of mechanical heating, ventilation, and air conditioning vital. It also increases the importance of internal courtyards along the major corridors to bring in natural light and for way-finding. For a medical center in a climate or culture where more natural ventilation is desired, it would be possible to provide more courtyards with the opportunity to fill in courtyards for internal expansion rather than, as at Arrowhead Regional Medical Center, by occupying soft space.

Hypothetical hospital in the Middle East

Recently BTA had the opportunity to apply experience gained from Arrowhead Regional Medical Center to the design of a 200-bed (expandable to 300-bed), approximately 500,000-square-foot medical center for a client in the Middle East. This project did not go forward, however, the site development and internal planning for this hypothetical project illustrate the lessons for universal application discussed above.



The site for the hypothetical hospital is a roughly trapezoidal tract of land of approximately 200 acres. Like the site for Arrowhead Regional Medical Center, it is undeveloped, but with good road access at the edge of the built-up area in its community. There is a slight slope, allowing development of a depressed service yard for access to a service level one floor below the medical center's main level. The entire medical center is circled by two ring roads. The outer ring road allows traffic entering the site to circle around to the main entrance. Emergency vehicles have a grade-separated short cut directly to the emergency entrance.

The site is planned for clear way-finding. The inner ring road allows access to parking lots and transit between the inpatient main entrance and the outpatient entrance. Because both roads are circular, patients/visitors can access any part of the complex without getting lost. In addition, future expansion may include facilities between the inner and outer ring roads without compromising the coherence of the site concept.

The hypothetical hospital complex is organized into acute hospital, shared diagnostic and treatment, and outpatient clinic blocks. Special landscaping and the creation of a sheltered forecourt are used to denote the main entrance to the medical

center. Entrances from the forecourt are provided for both the acute hospital and the outpatient clinics. In addition, a separate outpatient entrance is provided on the opposite side of the clinic block to allow direct access from parking. A separate entrance with direct access to the emergency department is also provided at the back of the diagnostic and treatment block.



In addition to site organization for way-finding and future expansion, the hypothetical medical center is planned for operational and functional efficiency. Nursing units are entered from a central core that contains shared services. The design of each nursing unit core also allows for variation in patient/nurse ratios, depending upon acuity. Because of the cultural differences associated with design of a hospital for the middle east, The building is also zoned vertically, with one floor devoted to women's and children's nursing units (including women's services) and nursing units for men located on a different floor. The diagnostic and treatment block, which includes surgery, imaging, pharmacy, laboratory, emergency department and the perinatal unit, is located between the inpatient block and the outpatient clinics block. Both the diagnostic and treatment block and the outpatient clinic block are designed to be wide enough to allow the efficient internal organization

of each department. In addition, mechanical services are fed from the perimeter of these areas, allowing maximum internal flexibility.

The hypothetical medical center is also planned for growth and incremental expansion. Site zoning allows space for expansion for each of the initial buildings in each zone. Expansion will occur outward from the center of the site. Internal expansion in the acute nursing block is planned for with the inclusion of administrative "soft space" that can be displaced by future nursing units. Similarly, the diagnostic and treatment block includes internal room for expansion of key functions. The outpatient clinic block would expand with the addition of new building area at either end of the existing structure.

Conclusions

Examining both Arrowhead Regional Medical Center and our hypothetical hospital in the Middle East reinforces the need to consider the basics of hospital planning in any context, either in the U.S. or internationally. The importance of appropriate site selection, site planning for clear way-finding, internal planning for operational and functional efficiency, and planning the entire site and the medical center itself for growth and internal expansion are evident.

If there is one overarching need, it is that architects create flexible facilities that will assist the institutions they house in meeting the challenge of constant changes. These are changes in technology, the acuity of patients, census, and mission and role, all of which will only increase as time goes forward.

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