

## **Face-to-Face Interaction among Clinicians and Hospital Design: A Theoretical Model**

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## **Abstract**

A growing body of literature suggests that face-to-face interaction among clinicians in hospitals affects patient outcomes. How can we positively affect face-to-face interaction among clinicians to improve patient outcomes in hospitals? Most strategies for improving face-to-face interaction in hospitals so far have focused on changing organizational culture. In contrast, this paper proposes a theoretical model that shows how spatial program and structure can help face-to-face interaction to fulfill its purposes in hospitals through controlling the interfaces among different communities of clinicians providing care to hospitalized patients.

**Key words or short phrases:** *Face-to-face interaction; Hospital communities; Communities of practice; Communities of interests; Hospital design; Space; Spatial structure and program*

## **Introduction**

Face-to-face interaction is a system of communication behaviors that may fall anywhere between unplanned, serendipitous interaction (e.g., chance encounters in the corridor) to planned, collaborative interaction (e.g., highly ‘formalized’ interactions that may last for hours). For such a system of communication behaviors to work, all participants must be sufficiently close to each other; they must also have unmediated visual and/or verbal access to each other; additionally, they must engage in synchronous communication actions; and, whether serendipitous or collaborative, their communicative actions must have a limited time span. Unlike long-term collaboration or collaborative work that may go on for years, collaborative interaction must be viewed as a discrete event.

Face-to-face interaction can be interruptive, because it involves synchronous communication actions of its participants. In hospitals, such interruptive behaviors may increase the potential for clinical errors (Parker & Coira, 2000). In an observational study of communication behaviors in a hospital setting, Coiera and Tombs found that synchronous communication behaviors are often individually inefficient or unsuccessful. That is because all parties to a communication may be unable to participate, or they may be overloaded with information to provide any positive response or feedback. When taken as a whole, Coiera and

Tombs suggest, the synchronous communication behaviors may result in interrupt-driven environment in a hospital (Coiera & Tombs, 1998).

Despite their interruptive and inefficient nature, face-to-face interaction remains as an important medium of communication in hospitals. For example, in the review of information transactions in a hospital with a mature computer-based record system, it was found that about 50 percent of all transactions happened face-to-face between colleagues (Safran, Sands, & Rind, 1999). This dependence on face-to-face interaction is likely to persist despite the availability of high-end wired and wireless computerized communication technology. People, in general, prefer face-to-face interaction over other forms of communication for quality, cost and frequency (Kraut, Egidio, & Galegher, 1990). Face-to-face interaction is a high-quality communication behavior, because it involves more than one sensory channel. It is also cheap when its participants are co-located co-workers. Since face-to-face interaction among co-located co-workers involves little or no cost, they are also able to do it more frequently. For years now, face-to-face interaction, particularly the informal kind, has held special interests in the research community. It has been posited to have at least three benefits for collaborative work: First, informal face-to-face interaction can help identify common interests and goals, leading to new collaborations (e.g., Allen, 1977). Second, informal interaction can help current collaborators maintain awareness of their tasks and coordinate their activities (Kraut, Egidio, & Galegher, 1990; Cannon-Bowers, Salas, & Converse, 1993; Hutchins, 1994). Finally, informal communication can help develop and maintain social bonds between coworkers (Kiesler, & Cummings, 2002; Kraut, Fish, Root, & Chalfonte, 1990).

The benefits of face-to-face interaction, as reported in the literature, are so remarkable that any effort to reduce or eliminate it from a workplace in favor of any other kinds of mediated communication needs to be considered carefully. As a communication behavior among care givers, face-to-face interaction can be extremely relevant to patient safety in hospitals. It is in this context, we must find ways to improve face-to-face interaction in hospitals and, at the same time, try to reduce the threat any ineffective face-to-face interaction poses to patient safety. Most strategies for improving the quality of face-to-face interaction in hospitals so far have focused on changing organizational culture (Boyle, & Kochinda, 2004; Firth-Cozens, 2001). In contrast, the focus here is on developing a theoretical framework that uses space as a strategic tool for improving face-to-face interaction among various practice communities in hospitals. The

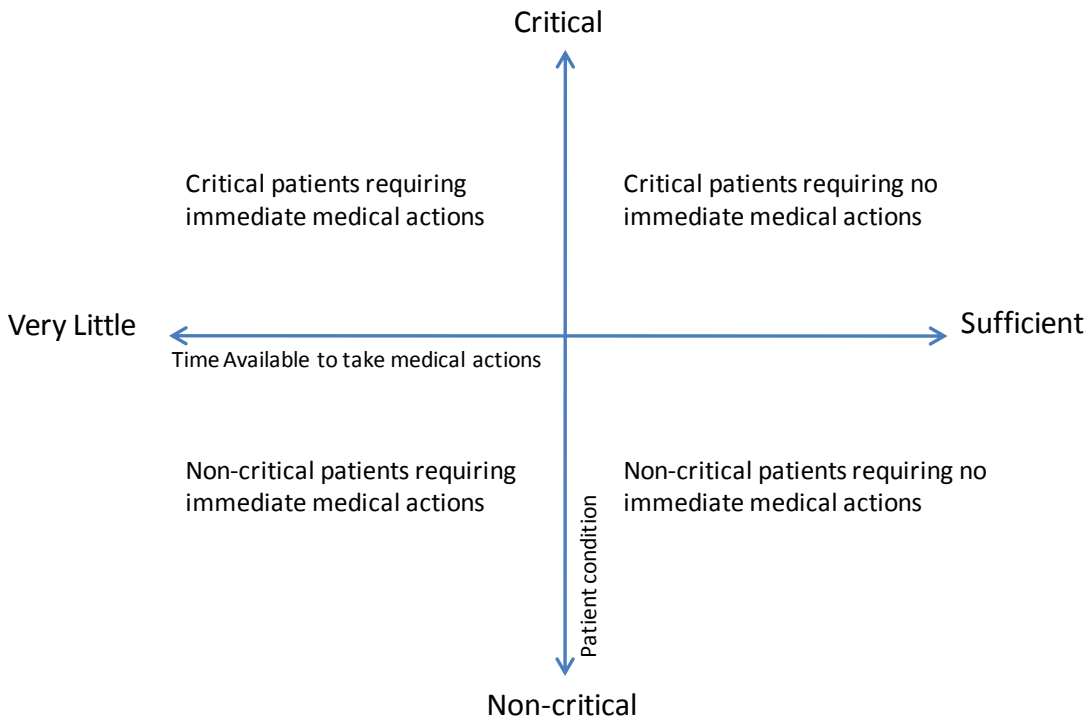
foundation of the framework is based on the belief that space affects the ways in which various practice communities engage in face-to-face interaction in hospitals. Hence, spatial design is central to the success of face-to-face interaction in hospitals. In developing the framework, we first ask: Who, among the patients, require face-to-face interaction among care givers for their medical care?

### **Safety, Patient Needs, and Face-to-Face Interaction**

While safety may become an issue as soon as a patient enters the hospital seeking medical care, it is safe to assume that any threat to patient's safety increases as the patient's condition becomes increasingly critical and the time available for taking any medical actions becomes increasingly short. **Figure 1** shows this relation of patient condition to the time available for taking any medical actions in an attempt to classify hospitalized patients. The vertical axis of the figure shows patient condition from being non-critical to critical, and the horizontal axis shows the amount of time available for taking any medical actions from being very little to sufficient. Consequently, the diagram helps define four groups of patients:

1. Non-critical patients requiring no immediate medical actions – Include the patients who are at minimal risk. The needs of these patients can often be met through normal inpatient care in an acute hospital.
2. Non-critical patients requiring immediate actions – Include the patients who are at risk of their condition deteriorating at any time. The needs of these patients can often be met through normal inpatient unit care with additional advice and support from outside clinical experts.
3. Critically ill patients requiring no immediate medical actions – Include the patients who require more detailed observation or intervention, and who had recently been relocated from higher levels of critical care. These patients often require additional support and advice from the critical care team.
4. Critically ill patients requiring immediate medical actions – Include the patients requiring respiratory support alone or respiratory support together with support of organ systems.

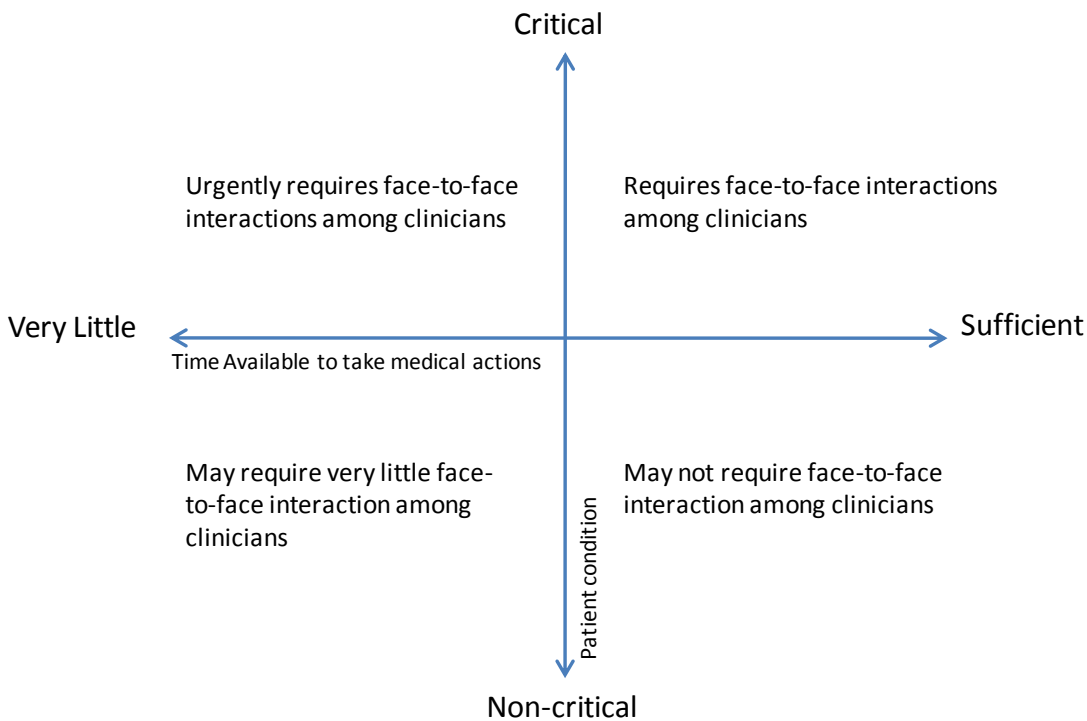
This level probably includes all complex patients requiring support for multi-organ failure.



**Figure 1:** Defining at-risk patients

If all hospitalized patients were taken care of by groups of caregivers having a similar makeup, the design of hospital spaces for interaction would be relatively simple. Spaces would then be designed to fulfill various interaction needs as they were related to patients' conditions, keeping the needs of caregivers constant in all cases. Probably, this is the way a family practice clinic is designed, where patients in the clinic are rarely critical and the makeup of caregivers rarely varies. Accordingly, as far as designing for interaction is considered, the only variable that needs particular attention in a family practice clinic is the interaction itself. Of course, this is not the case in hospitals. Here, the makeup of caregivers varies depending on the condition of a patient. Not only that, a patient may go through several stages of care during her hospital stay; and, consequently, may receive care from more than one group of caregivers. It is this interface between the changing patient condition and the changing makeup of caregivers that makes designing for interaction so much more difficult in hospitals.

Certainly, all hospitalized patients need effective communication among caregivers for safe and effective medical care. However, face-to-face interaction among clinicians may not be required for all patients. **Figure 2** shows the interaction needs of different categories of patients. It shows that for critical patients with immediate medical needs face-to-face interaction among caregivers may be just right, because it allows high quality information exchange involving more than one sensory channel. Since interaction involving multiple sensory channels help increase awareness of each other, the communication process may become more effective. In contrast, as shown in **figure 2**, for non-critical patients with no need for immediate medical actions, caregivers may prefer to use some kind of mediated interaction, such as telephone conversations or video conferencing, if and when face-to-face interaction is not an option. What is then important for us to know is: who, among the care givers, are responsible for taking care of these different categories of hospitalized patients; and what kind of practice communities do these caregivers create for themselves?



**Figure 2:** Defining interaction needs

## **Patient Care and Hospital Communities**

In hospitals, caregivers come from many different health care professions. Often, these caregivers form structurally distinct entities (i.e., communities) that enable them to share knowledge and resources in support of medical practice. A caregiver may participate in any number of these communities. Two most pervasive types of such communities are *communities of practice* (CoP) and *communities of interests* (CoI).

CoP consist of practitioners who work in any one particular knowledge or practice domain undertaking similar work (Wenger, 1998). CoP in hospitals may include, for example, a group of nurses who meet regularly to share stories about how to solve the problems they encounter in their work, or a group of cardiologists who commonly share stories on a particular kind of heart disease. As members, these practitioners perform different tasks in the interest of CoP, and develop and share all sorts of ways of dealing with the problems and issues they are interested in. They value their own collective knowledge and learn from each other, even though their value and/or existence may remain unnoticed by outsiders. Having the same job or the same title does not ensure membership in these communities unless these interested individuals interact and learn together. More often, newcomers enter the community from the periphery and move toward the center as they gain more knowledge about the common goals and interests of the community and as they gain trust and respect in the community based on their eagerness to help the community. Generally, hospitals as organizations do not impose any restrictions on when, where, and how these communities interact. With regards to critically ill patients, who often require that clinicians question their old ways of doing things or that they look for unorthodox solutions, the group thinking and sharing attitude of CoP can act as a barrier suppressing exposure to, and acceptance of, outside ideas.

Unlike CoP, CoI are formed by members from different knowledge and/or practice domains to perform a specific task, and are often dissolved once the task is completed. A common example of CoI in hospitals is the multidisciplinary medical team formed around a critically ill patient. The team includes not only physicians who may participate as consultants, but also the other health care professionals who work side by side with physicians. The most numerous of these professionals are the critical care nurses, who complement the physician staff in establishing plans, writing orders, and directing management. The team also typically includes respiratory

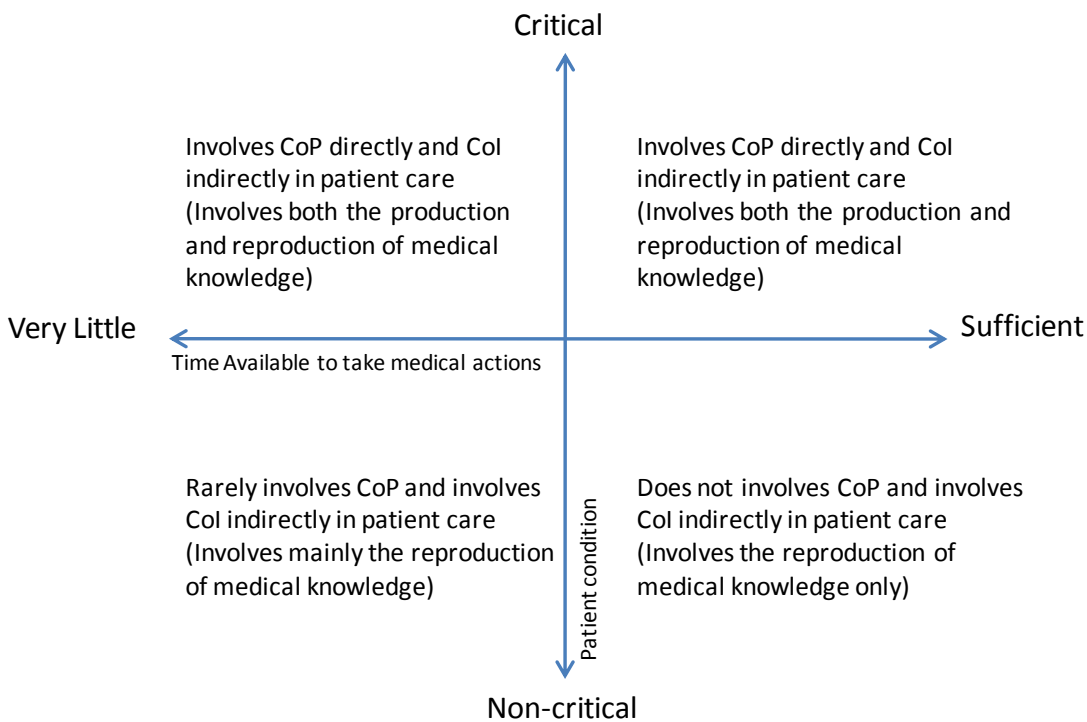
therapists, who are experts in many forms of pulmonary diagnosis and intervention; pharmacists, who help review medication profiles and determine if a patient is predisposed to side effects or drug interactions; a dietitian, who has advanced training in nutritional support strategies and pitfalls; a medical social worker, who provides ongoing psychosocial assessments and support; representatives of the chaplaincy staff, who are available on call to offer spiritual support to patients, families, and ICU staff members; and a unit secretary, who manages administrative tasks such as reception, telecommunications, and chart maintenance. In addition, the ICU staff generally includes many other trainees who are there to learn as fellows, residents, nursing students, and dietetics students.

A bias of a multidisciplinary medical team, like any other example of CoI, is its potential for creativity, because its members with different background, knowledge, and perspectives can lead to new insights regarding a critically ill patient. This is important because the knowledge to understand, frame, and solve many of the medical problems of a critically ill patient does not already exist. Among the barriers of a medical team is the fact that the members of a medical team may fail to create a common ground and shared understanding for the care of a critically ill patient because of their differences. Another barrier is that each member of a medical team possesses an important yet incomplete understanding of the problems presented by a critically ill patient. This kind of knowledge distribution implies that communication and mutual teaching and learning must be important among the members of a medical team. Yet another barrier is that opportunities for many face-to-face interactions among the members of a medical team are rare because the team is generally short-lived. As a consequence, creating and fostering a sense of community among the members of a medical team can be difficult. A sense of community, which provides a feeling of belonging, attachment and engagement, is needed for a member to perform at a higher level and claim ownership and responsibility of the problems and opportunities offered by a critical situation.

**Figure 3**, then, is an attempt at identifying how CoP and CoI get involved in the care of hospitalized patients. It must be noted here that these hospital communities exist (as in the case of CoI) or they come into being (as in the case of CoP) to work with those clinical entities that every hospital must possess to provide basic patient care in accordance with any standard patient care protocols or clinical pathways. They are never the substitutes for the standard clinical entities in any hospital. Now, as shown in the figure, all critical care patients require care



services from CoP, such as the multidisciplinary medical teams, because their medical conditions pose immediate threats to their lives. In contrast, non-critical patients, most often, do not require the services of a multidisciplinary medical team, because their medical conditions are rarely life threatening. Also shown in the figure is that most often CoI may serve all patients, most often in a serendipitous manner, regardless of their medical conditions. Their services may sometimes be beneficial to patients, as in the case when CoI work to improve patient safety. At other times, their services may be harmful to patients, as in the case when their group-thinking and sharing attitudes act as a barrier suppressing exposure to, and acceptance of, outside ideas that may even be beneficial to patients. Therefore, any hospital design must consider the needs of both CoP and CoI, in addition to the needs of the standard practice of patient care. In other words, hospital design must support the creation and evolution of these communities, over and above the support it provides for the routine functions related to patient care.



**Figure 3:** Defining the role of hospital communities in patient care

### Hospital Communities and Knowledge

It is in the above context, we try to find out a more rigorous way to define the relations of hospital communities to the production and reproduction of the knowledge of medical practice

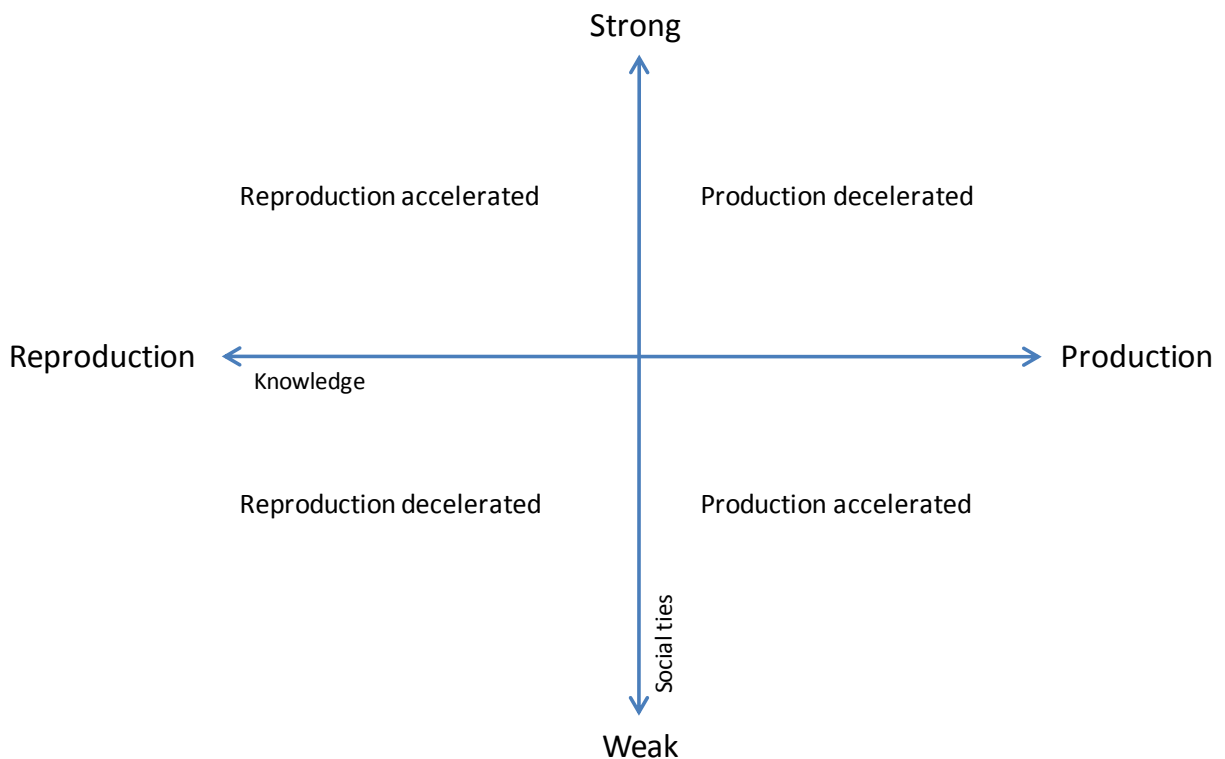
using the ideas of *strong* and *weak ties* (**Figure 4**). Following the line of arguments Granovetter presents, we may argue that at any time any individual can be a part of multiple communities. In some of these communities people are less likely to be socially involved with one another than in some other communities. That is because the density of network among the people varies from one community to another. In a low-density network (one in which many of the possible relational lines are absent), people are less likely to interact frequently for they have weak interpersonal ties, or simply weak ties. In contrast, in a densely-knit network (one in which many of the possible relational lines are present), people are more likely to interact frequently for they have strong interpersonal ties, or simply strong ties (Granovetter, 1983, 1973).

The implication of the fact that every individual has strong and weak ties on the re/production of knowledge is this: Ideas or information cannot traverse greater social distance if they are passed through strong ties only. Probably, many will receive the same information a second or a third time, since those linked by strong ties tend to share friends. Therefore, if the motivation is to spread the idea or information over greater social distance, then one should pass it through a person linked by a weak tie, who is not likely to share one's friends and have a collection of close of friends of her own. "It follows, then," writes Granovetter:

[That] individuals with few weak ties will be deprived of information from distant parts of the social system and will be confined to the provincial news and views of their close friends. This deprivation will not only insulate them from the latest ideas and fashions but may put them in a disadvantaged position ... The macroscopic side of this communications argument is that social systems lacking in weak ties will be fragmented and incoherent. New ideas will spread slowly, scientific endeavors will be handicapped... (Granovetter, 1983:202)

For our purposes, we may suggest that CoP involves clinicians who are linked by strong ties and CoI involve clinicians who are linked by weak ties. Because of their structural limitations, CoP are better in preserving and reproducing knowledge, while CoI are better in creating and advancing knowledge. However, as we have shown in **figure 3**, in hospitals there are many situations where both CoP and CoI are involved in the reproduction and production of medical knowledge at the same time. From a clinical point of view, sometimes the effects of these concurrences can become counterproductive. As shown in **figure 4**, in situations where the

production of knowledge is important, any involvement of communities with strong ties may decelerate the process, because these communities tend to cling to old ideas disrupting the process of production. In contrast, in situations where the reproduction of knowledge is important, any involvement of communities with weak ties may decelerate the process, because these communities offer far too many new ideas disrupting the process of reproduction. The notion of this paper is that, space, if designed properly, can help not only to minimize any negative effects of the conflicts between CoP and CoI, but can also help to enhance the positive role of a community in patient care. In order to further clarify the notion, we must explain the role of space in the re/production of knowledge.



**Figure 4:** Defining the relationships between knowledge and social ties

### Space and Knowledge

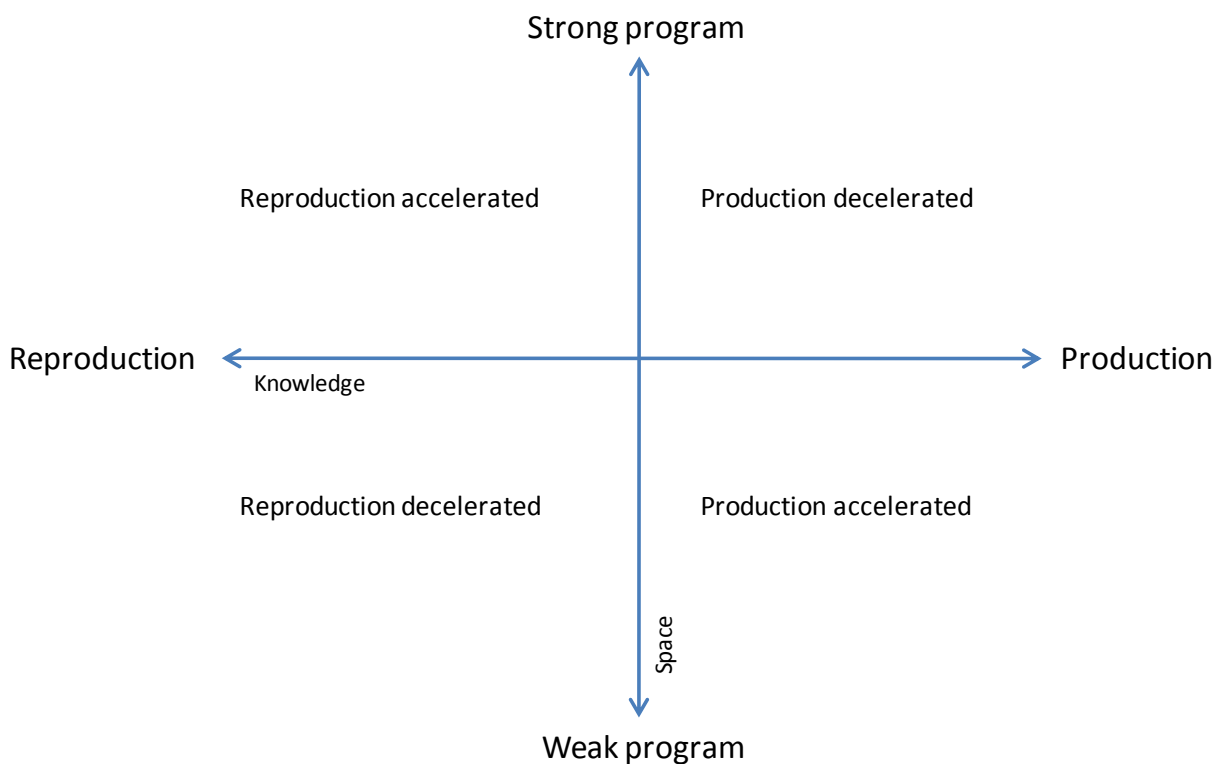
In order to explain the relation of space to knowledge, we use two related concepts—the continuum of long and short model and the continuum of strong and weak program—used by Hillier in his book *The Space is the Machine* (Hillier, 1996). Hillier uses a ritual and a party to illustrate the distinction between a long and short model. He writes:

A ritual is a set of behaviors in which all sequences and all relations are specified by rules — that is, it is a long-model event. Of its nature, a ritual eliminates the random. Its object is to conserve and re-express its form. A party, on the other hand, while it may be casually described as a social ritual, is a short-model event. Its object is morphogenetic: the generation of new relational patterns by maximizing the randomness of encounter through spatial proximity and movement. (Hillier, 1996: 193)

Implications of the continuum of long and short model event on space and knowledge are clear. As the list of sequences and relations of a set of behaviors in an event gets shorter, the need for spatial proximity and movement to help generate encounter and interaction becomes stronger. In other words, it is difficult for a short-model event to overcome spatial separation, because encounter and interaction diminish over distance. In contrast, spatial separation is the reason why any long-model event exists. A long model event is held to reassure a community that the relations among its members are important. In a similar vein, we may suggest that as the list of sequences and relations of a set of behaviors in an event gets shorter, opportunities for encounter and interaction get stronger. Consequently, opportunities for the creation of new relations, hence new knowledge, also get stronger. In other words, short-model events may help generate knowledge. Conversely, long-model events may help reproduce knowledge.

The other concept—the continuum of strong and weak program—was also used by Hillier in his book *The Space is the Machine* (Hillier, 1996). A program, as Hillier defines it, is the spatial dimensions of the interfaces among different categories of people and their functions in a building. According to Hillier, whether the program of a building is strong or weak depends on the list of sequences and relations of spaces within the building. Hence, in a strong program building, all or most spatial relations and sequences are predetermined by categorical identities and functional needs. As a result, each of the required interfaces in the building happens in a predictable manner and all unpredictable interfaces (i.e., encounter and interactions) are excluded. In other words, the purpose of a strong program building is to reinforce categorical identities, and to conserve and recreate knowledge. In contrast, in a weak program building, some, not all, spatial relations and sequences are predetermined by categorical identities and functional needs, and unpredictable interfaces are allowed to occur. As a result, boundaries among categorical identities become blurred and opportunities for the creation of knowledge improve.

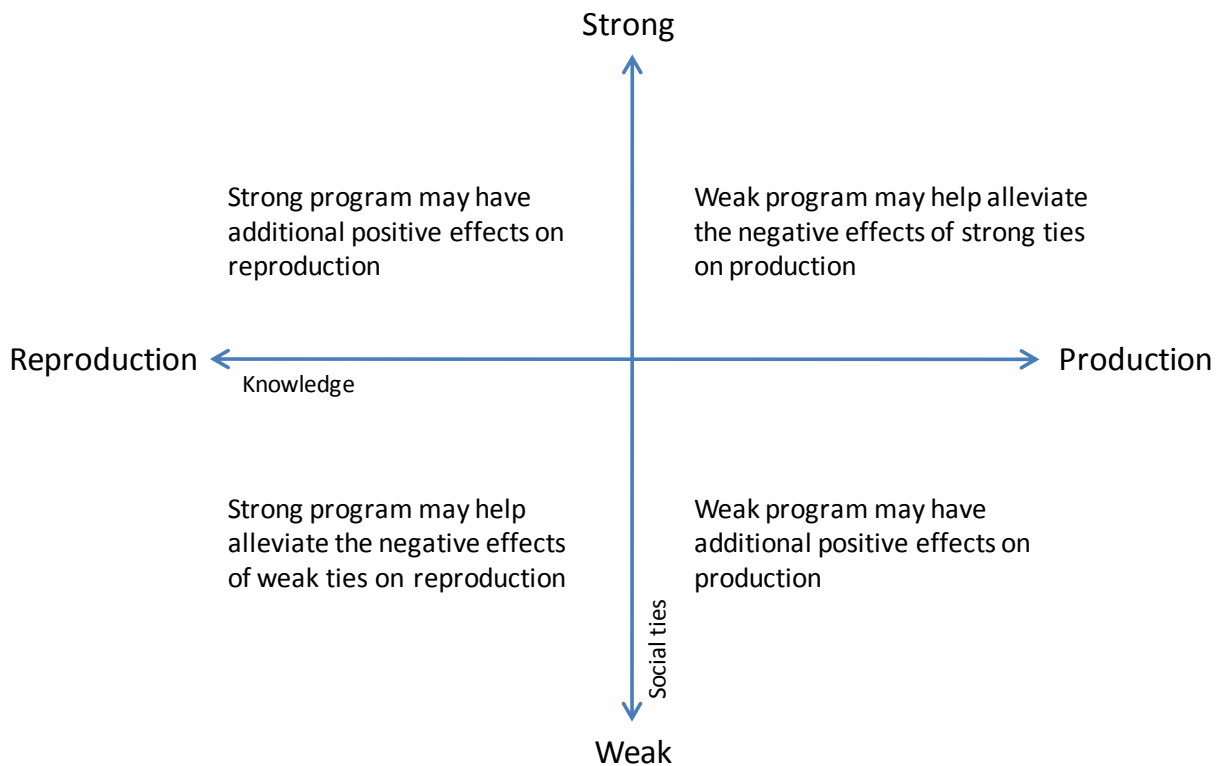
In the previous section, we have argued that weak ties generate knowledge and strong ties conserve knowledge. In this section, we argue that a weak program building, by permitting unpredictable interfaces such as the ones we expect among people with weak ties, may help generate knowledge. In contrast, a strong program building, by permitting only predictable interfaces such as the ones we expect among people with strong ties, may help conserve knowledge. In other words, as shown in **figure 5**, the effects of the continuum of weak and strong building program and of the continuum of weak and strong social ties on knowledge are quite similar (also refer to **figure 4**).



**Figure 5:** Defining the relationships between knowledge and space

Consequences of the above observation are significant for hospital design and are illustrated in **figure 6**. According to the figure, when the process of knowledge production (e.g., the creation of a new clinical regimen) decelerates due to any involvements of communities with strong ties (e.g., CoP) in a patient care situation, a weak program building may help alleviate some of the negative effects by promoting unpredictable interfaces. In contrast, when the process of knowledge reproduction (e.g., the recreation of an old clinical regimen) decelerates due to any involvements of communities with weak ties (e.g., CoI) in a patient care situation, a strong

program building may help alleviate some of the negative effects by excluding unpredictable interfaces. In other words, the program of a building (i.e., the spatial dimensions of the interfaces among different categories of people and their functions), if defined properly, should help create a hospital design that improves interfaces among hospital CoI and CoP through effective face-to-face interaction. We try to be a bit more specific on the issue in the next sections.



**Figure 6:** Defining building programs based on the relationships between knowledge and social ties

**Face-to-face Interaction and Hospital Design: Strategy vs. Tactics**

It has been argued in this paper that face-to-face interaction offers more unmediated access and more channels for high quality information exchange among its participants than any other forms of communication behavior. It also provides immediate and direct opportunities for eliminating any misunderstanding and mistrust among its participants. As a result, it can help create a common ground and shared understanding; help promote teaching and learning; help create knowledge collaboratively; and help create a sense of sense of community among its participants. We believe that these benefits of face-to-face interaction are as real in hospitals as they are in any other workplaces.

It is clear, then, that one of the goals of supportive spatial design for CoP and CoI in hospitals is to help promote face-to-face interaction among the members of these communities. Such a design must recognize the fact that face-to-face interaction serves many functions in hospitals.

Typical among these functions are:

1. To help reproduce any existing knowledge of medical practice when the patient presents usual and predictable complications
2. To help produce any new knowledge of medical practice when the patient presents unusual and unpredictable complications
3. To help mutual teaching and learning among the members of CoI who possess incomplete yet important knowledge about the patient
4. To help improve a sense of community where the short life span of CoI offers limited interaction opportunities
5. To help improve peripheral learning among the members of CoP in order for a newcomer to learn the core values of the community

The design needs of these functions are interrelated, but are not mutually exclusive. As we have already observed, the needs of spaces for the reproduction and production of knowledge (in this case the knowledge of medical practice) are different, even though they both may depend on face-to-face interaction.

According to the arguments presented earlier, one important strategy to organize and control face-to-face interaction for achieving its functional goals is the continuum of a weak and strong program. In theory, it should be possible to make use of the functional and/or social logic inherent in the program of spaces to enhance any social dynamics presenting itself as a complementary force or to thwart any social dynamics presenting itself as an opposing force to the clinical services being delivered at any time. However, tactics to create a weak or strong program building can be numerous, and are in themselves a formidable problem to reckon with.

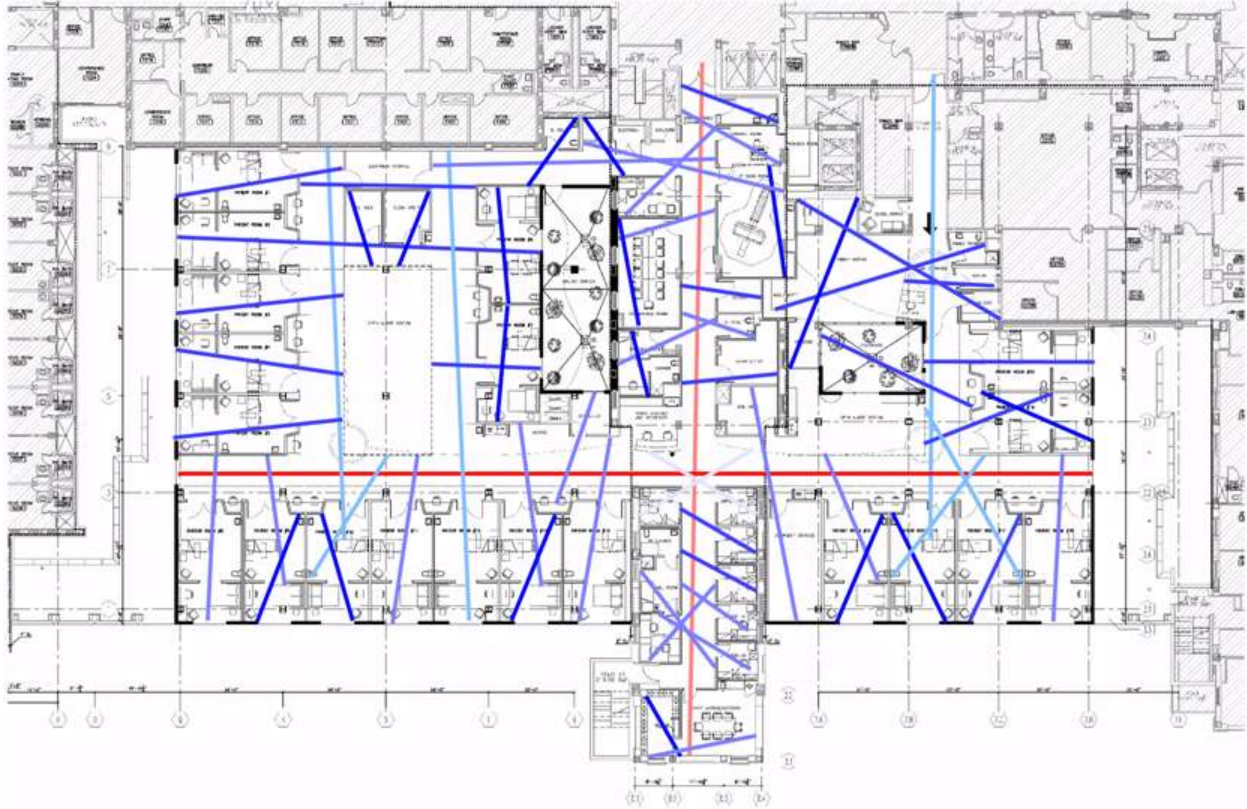
Design tactics involve changing the physical form and space of a building. The elements of physical form include the aesthetic, geometrical, physical, and technological properties of the boundaries (walls, ceilings, and floors) defining the spaces within a building. These properties can be different for every boundary of any space. As a result, it is impossible to take into account

every aspect of the physical form when making tactical design decisions regarding face-to-face interaction. In contrast, the elements of the spatial organization of a building are rather finite. These elements can be either the functional units as defined by the physical boundaries, or they can be the units of our experience of a building (e.g., our sightlines and visual fields from different locations within a building). Although changing physical form to create immediate visual and physical effects appears more appealing as design tactics, it is at the level of space that building design seems to have its far-reaching effects. It has been argued in the literature that the structure of space, through its effects on our everyday experiences, can not only help preserve old social relationships but also can help create new ones ((Hillier, 1996; Hillier, & Hanson, 1984). Thus, for our purposes here, we limit ourselves to defining appropriate building programs for face-to-face interaction using the elements of spatial structure.

### **The Elements of Spatial Structure and Face-to-face Interaction in Hospitals**

Like any other relational structures, it is possible to describe the structure of space using some local properties pertaining to individual spatial elements, some global properties pertaining to the whole system, and some properties pertaining to the relations of the local to the global. For example, following Hillier, if a building layout is described as a system of sightlines (**figure 7**), then a local property of a sightline in the system would be how many of the other lines of the system intersect the line (i.e., the connectivity value of the line), a global property would be how the line is connected to all other lines in the system (i.e., the integration value of the line), and a local-global property would be how the connectivity and integration values of the sightlines are related to each other in the system (i.e., the intelligibility of the system). In an intelligible system, the local and global values must have strong correlations, so that a peripatetic observer gets a consistent understanding of the global system from her experience at the local level. If the correlation is poor, the system may lose its coherence, hence unintelligible, to the peripatetic observer (Hillier, 1996).





**Figure 7:** The structure of sightlines of a hospital unit. The lines are colored using the integration values of the lines. The red lines have higher integration values than the blue lines. According to this analysis, the long horizontal corridor may attract most movement in the unit because it has the most integrated sightline.

Now, as we have observed earlier, the purpose of a weak program building is to maximize opportunities for interface and interaction. In order to do so, the building must also maximize flexibility in movement both at the local and global levels. At the local level, flexibility in movement should increase as the number of intersections increases over the length of a sightline representing a path or a segment of path. At the global level, flexibility in movement should increase as the interconnectedness of the sightlines increases. In addition, in a weak program building the connectivity and integration values of the sightlines should correlate with one another to give a strong sense of coherence to the system. Without a strong sense of coherence, the peripatetic observer may lose her motivation to explore the spatial system. In other words, the structure of space in a weak program building helps generate movement in the building, and this generative force of the structure of space gets stronger as intelligibility of the structure gets stronger in a weak program building.

In contrast, the purpose of a strong program building is to restrict opportunities for interface and interaction. In order to do so, the building must restrict movement both at the local and global levels. At the local level, flexibility in movement should decrease as the number of intersections decreases over the length of a sightline. At the global level, flexibility in movement should decrease as the interconnectedness of the sightlines decreases. The connectivity and integration values of the sightlines in the system may still correlate with one another to give a sense of coherence to the system. However, in this case any sense of coherence may not work to motivate the peripatetic observer to explore the spatial system. Rather, it works to give an order to the organization it accommodates. In other words, movement within a strong program building is generated by the program itself, and this generative force of the program gets stronger as intelligibility of the structure of space gets weaker in a strong program building.

It then follows that, if our goal is to help CoP in hospitals reproduce or reuse an existing clinical regimen when the patient presents usual and predictable complications, then the mean connectivity and integration values of its sightlines should be low to restrict movement, thus reducing unpredictable interfaces and interactions. The structure should also have a low intelligibility value defined by a low correlation among the connectivity and integration values of the sightlines of the system, again, to restrict movement. In other words, to meet our goal we should design a strong program building where movement is generated by the program of the hospital building.

If our goal is to help CoI in hospitals produce a new clinical regimen when the patient presents unusual and unpredictable complications, then we need a weak program building where the sightlines have high mean connectivity and integration values to encourage movement, thus encouraging unpredictable interfaces and interactions. The structure should also have a high intelligibility value defined by a good to strong correlation among the connectivity and integration values of the sightlines of the system, again, to encourage movement. In other words, to meet our goal we should design a weak program building where movement is generated by the spatial structure of the hospital building.

By providing more opportunities for interactions, the spatial structure of a weak program building should also help mutual teaching and learning among the members of CoI who possess incomplete yet important knowledge about the patient. Additionally, when a short lifespan of

CoI does not allow a sense of community to develop sufficiently among its members, a well-connected, intelligible spatial structure should help develop such communities by generating more movement, thus providing more opportunities for face-to-face interactions. Moreover, if the goal is to improve face-to-face interaction among the members of CoI in hospitals for the purpose of peripheral learning of a newcomer, a weak program spatial system should also be able to help by providing numerous opportunities for face-to-face interaction among the old and new members of CoI through increased movement.

In sum, the continuum of weak and strong program can be regulated using the structure of space in order to facilitate face-to-face interaction among the members of CoI and/or CoP in hospitals. However, as the discussion reveals, a hospital building as a whole can neither be a strong program building, nor can it be a weak program building. Rather, different parts of the building need to have different spatial programs depending on functional needs. For example, the layout may follow a strong program in clinical areas where CoI play a significant role in patient care. In contrast, the layout may follow a weak program in clinical areas where CoP play a significant role in patient care. In clinical areas, where both these types of communities come together, the layout may follow either a weak program or a strong program depending on functional needs. If CoP work as a barrier in a patient care setting, a weak program may help alleviate the negative effects by allowing unpredictable interfaces and interactions. Conversely, if CoI work as a barrier in a patient care setting, a strong program may help alleviate the negative effects by restricting unpredictable interfaces and interactions. As a result, face-to-face interaction among clinicians may become more effective in relation to patient care.

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