

## A Functionally Interactive Intranet Clinical Information and Tracking System for Managing Pediatric Populations with Chronic Diseases

By Ronald E. Williams, MD,  
Enrique Gaete, PharmD, MBA  
John R. Moran, BSAM  
Edward Curry, MD, FAAP

***The Pediatric Department at the Kaiser Permanente Medical Center in Fontana, California, has implemented an innovative tool to support the efforts of their population-based care management programs and of some subspecialty clinics.***

***In collaboration with the Learning Behavior Clinic and the Pediatric Asthma Clinic teams, project leaders have developed and deployed a functionally interactive intrafacility Web site through which clinical information and tracking systems are used as a tool to manage chronic diseases efficiently and effectively in large populations of patients.***

***This Intranet approach provides a common platform to solve unrelated problems. In addition, the lessons learned in serving one population are easily transferred to expedite successful management of another, unrelated group once the proper infrastructure is established.***

***Introduction of the electronic medical record is forthcoming, and a system for tracking specific patient populations will complement—not supplant—this technology.***

### Background

The Pediatric Clinical Information and Tracking System is a product of a joint effort by the Pediatric, Pharmacy, and Information Technology Departments of the Kaiser Permanente (KP) Medical Center in Fontana, California. The idea of creating a functionally interactive Web site was conceived to support the Pediatric Department's population-based care management programs and selective subspecialty clinics.

Development of the Pediatric Clinical Information and Tracking System originated in September 1996, when the initial impetus arose to create a dedicated Intranet Web page to help manage a population of 2400 patients with Attention Deficit and Hyperactivity Disorder (ADHD) and related diagnoses. This idea was formulated by a multidisciplinary team of general pediatricians, a pharmacist, nurses, administra-

tors, and clinical assistants who had been holding "brainstorming" sessions to analyze the problems that faced their department in managing patients with ADHD and related disorders. The team identified three major management problems: 1) lack of chart access for timely refill of medications; 2) need for a system to coordinate clinic visits, monitor appropriate prescriptions, and identify prescribing physicians; and 3) need for a readily accessible database for analyzing the effectiveness of the team's management ability. The team's efforts resulted in creation of a computerized Triplicate Prescription Refill Tracking System (RTS) for patients with ADHD.

The RTS used recently installed computers in each physician's office and an existing Intranet local area network. Five designated general pediatricians and one pediatric neurologist form the Learning and Behavior Clinic (LBC) team, which manages this population of patients. Only this team is allowed access to input information into the RTS; all others with computer access may only view the database of patient records. The RTS enables coordination of patient management as well as tracking of triplicate prescriptions without use of a chart. As a result, we were able to both hold prescribing physicians accountable for their actions and respond in a timely manner to requests for medication refills.

After the RTS was implemented, we concentrated on design and deployment of a pediatric asthma clinical information and tracking system based on our six years of experience managing a pediatric asthma

#### Abbreviations:

LBC: Learning and Behavior Clinic  
PAC: Pediatric Asthma Team Clinic  
GB: Gigabyte (1024 megabytes)  
RAM: Random Access Memory  
MHZ: Megahertz  
SQL: Structured Query Language  
RTS: Refill Tracking System  
IDC: Internet Database Connector

*"The idea of creating a functionally interactive Web site was conceived to support the Pediatric Department's population-based care management programs and selective subspecialty clinics."*

*"The RTS enables coordination of patient management as well as tracking of triplicate prescriptions without use of a chart."*



RONALD E. WILLIAMS, MD (top left), has been an SCPMG physician since 1984. He is a Board-certified pediatrician with clinical interests in asthma management, learning and behavior disorders, and neonatology. He is also the medical coordinator of the Pediatric Asthma Team, and Co-Chairman of the Pediatrics TQM Team.

ENRIQUE GAETE, PharmD, MBA (top right), has been a pharmacist with Kaiser Permanente since 1990. He is a Clinical Pharmacist Coordinator of the Pediatric Asthma Team.

JOHN R. MORAN, BSAM (bottom left), has been a Kaiser Permanente Information Technology Consultant since 1995. He establishes and manages Intranet development and physician computer training for KP Fontana.

EDWARD CURRY, MD, FAAP (bottom right), has been an SCPMG physician since 1984. He is a Board-certified pediatrician with clinical interests in asthma management, learning and behavior disorders, and neonatology.



population. Since September 1992, our Pediatric Asthma Clinic (PAC) team has evolved to include 13 general pediatricians and a clinical pharmacist, who care for a population of 2500 patients. Throughout these years, the PAC team focused on establishing and defining an infrastructure and clinical process. The final product of these efforts was development of a proactive approach to asthma care within a tightly integrated clinical system. This approach used a system consisting of many different departments (eg, pediatrics, nursing, emergency, respiratory therapy, allergy, family medicine, pharmacy), outlying clinics, pediatric hospital staff, social services, and home health services. To coordinate this diverse collection of participants, a computer-based clinical tool seemed a logical step to unify and enhance the flow of information. To meet this challenge, we used an established Intranet Web site accessible to all members of the PAC team.

The utility of this electronic platform has encouraged us to expand the PAC information and tracking system and to consider developing other clinical information and tracking systems for subspecialties, such as gastroenterology, rheumatology, diabetes care, and cardiology.

### Objectives

The main objectives of the PAC team were to design and deploy a cost-effective Intranet platform which allows physicians to provide efficient, effective care to patients affected with chronic diseases. This platform would: 1) improve the quality and consistency of care delivered to a targeted population of patients; 2) enhance and improve physicians' access to patient records; and 3) reduce costs by using a relatively inexpensive preexisting Web-based system. The Intranet site must be secure, selectively accessible, easy to maintain, able to function at a good to high level of performance, and reliable to preserve data integrity. Applications created for the site should also be easily transferable to other medical departments at their request.

### Clinical Significance

We have been fortunate to experience the potential usefulness and cost-effectiveness of an Intranet management and tracking system. This approach to clinical information tracking systems development is "a winner" for Kaiser Permanente.

The Intranet Web site is designed to be a functional tool. Because most physicians are familiar with the Netscape® Navigator browser, Intranet applica-

tions can be delivered without changes to any workstation. Intranet applications can be rapidly developed and deployed. Moreover, the Intranet is an ideal platform for disseminating clinical guidelines, promoting standards and procedures, visualizing clinical images, and for generating feedback and case discussions between involved users. Security of confidential information can also be achieved.

Our pediatric asthma management program has enabled us to have a solid clinical infrastructure in which to successfully use an Intranet tracking system. Our original experience with the RTS showed that clinical issues vary among subspecialties. Nonetheless, an Intranet approach provides a common platform from which to attack unrelated problems. For example, to manage our asthmatic patient population, we focus on therapy and on integration of clinical services. For the LBC population, we work to make information more timely, to increase regular follow-up visits, and to make the medication refill system more efficient. The lessons learned in serving one population are easily transferred for managing other, unrelated groups successfully after the proper infrastructure is in place.

### Design Process

The first step in creating the new information system was to develop a KP Fontana Pediatric Department Web site, which would incorporate all the clinical information and tracking systems developed by project leaders in collaboration with subspecialty teams.

The second step was to include five useful features: 1) Internet links through which pediatricians are given immediate access to sites of interest; 2) a channel through which any clinician with access to the KP Intranet and e-mail system can consult a specialist about clinical issues; 3) the KP Fontana Pediatrics Department contact list, which contains direct phone extensions and fax numbers of all KP Departments of Pediatrics throughout Southern California's Inland Empire; 4) the KP Regional Pediatric Subspecialty list, an easily searched directory of telephone numbers for all pediatric subspecialists in the KP Southern California Region; and 5) the Chief of Pediatrics Hotline section, from which the Chief of Pediatrics can release administrative information to the entire Pediatrics Department.

Another important feature of the Pediatric Department Web site is a program that facilitates administration of the site by allowing the site administrator to exchange messages with pediatricians, process

---

*"The main objectives of the PAC team were to design and deploy a cost-effective Intranet platform which allows physicians to provide efficient, effective care to patients affected with chronic diseases."*

---



---

*"Our pediatric asthma management program has enabled us to have a solid clinical infrastructure in which to successfully use an Intranet tracking system. Our original experience with the RTS showed that clinical issues vary among subspecialties."*

---

electronic referrals, troubleshoot problems of the system, and maintain records describing usage of the patient tracking system.

### Triplicate System for Tracking Prescription Refills

After a specific patient population was identified for each Intranet tracking system, the patient demographic data were electronically transferred to the tracking system's database. Access to the system was restricted by a secured log-in designed to be used by participating physicians only (Figure 1). With the pa-

tient medical record number, the user could navigate through the system to view the specific demographic, clinical, and drug information for the patient and thus to refill prescriptions for monitored, controlled substances appropriately on the basis of the most recent patient contact.

The demographic and clinical information was input by the case manager, by a designated clinical assistant, and by participating physicians and included patient name, age, address, education, diagnosis, medical evaluation information and test results, name of designated LBC physician, last visit date, other comments, and latest date at which the patient's file was updated.

The patients' pharmacy data were also electronically transferred from our regional pharmacy information system, thus enabling the user to view the most recent date on which triplicate medication order was dispensed, medication name and dose, quantity dispensed, directions for use, and prescribing physician's name.

Another feature allows LBC specialists to add a new triplicate prescription by using a pull-down menu of medications. If the medication is not listed, physicians specify the prescribed medication by entering alphanumeric characters into a data field available for this purpose.

After the information for a newly prescribed medication has been entered, a printout of the triplicate prescription history is placed in the patient's chart. Posting this printout replaces the former handwritten list.

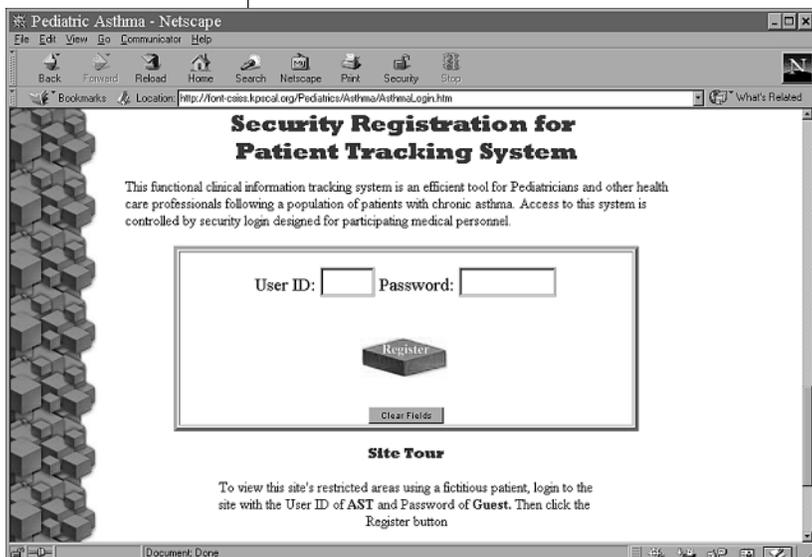


Figure 1.

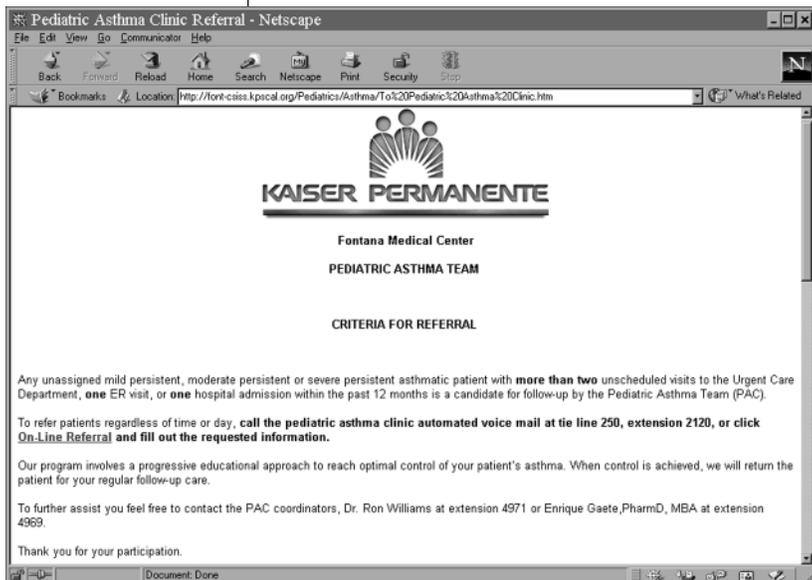


Figure 2.

### The Pediatric Asthma Management and Tracking System

This clinical system is completely integrated and is designed to support the medical staff who manage our moderate- to high-risk pediatric asthma patient population. Navigation of the site is similar to that of the RTS. The Intranet PAC team Web site is divided into three components: 1) Documents; 2) Referral Criteria and Methods; and 3) the Patient Tracking System.

The Documents section makes available the most common standardized forms for the team to view and to download as needed. Examples of such forms include two helpful communiqués: 1) the Did Not Keep Appointment letter, which is mailed to patients' homes after a missed appointment. This letter emphasizes the need for regular education with the designated specialists to control the child's asthma;

and 2) the Release From Asthma Team letter, which is sent to the referring physician after the patient, parent(s), or both have been educated and are maintaining good control of the asthma. Written contact through these letters assists continuity of care and facilitates these patients' access to the program.

We have also included a useful hyperlink to the revised 1997 National Asthma Education Prevention Program guidelines; important links to sites related to asthma; and educational tools and guidelines for management of pediatric asthma in the physician's office, in the Emergency Department, and at home.

The Referral Criteria and Methods (Figure 2) component allows KP physicians to send an asthma referral to the PAC team through the Intranet (Figure 3). This electronic referral system—the first of its kind—also lists criteria for referring patients to other contributing departments, such as Allergy, Home Health, and Social Services.

The third component, the Pediatric Asthma Patient Tracking System (Figure 4), was designed to facilitate physician contact with our patients at any point of service (eg, Urgent Care Department, Emergency Department, inpatient departments, or outlying clinics). The tracking system contains each patient's home treatment plan (Figure 5), laboratory tests and clinical procedures done, demographic data, comments about environmental control, diagnosis (noting any seasonal predisposition), and patient visit history. Ready availability of this patient information streamlines management of the clinical workload for these busy departments. Instead of spending valuable time gathering information, our clinicians can have all important information at their fingertips.

Written, interactive age-specific asthma treatment plans are a vital part of the tracking system and are formatted in one of two ways according to whether the patient is younger than five years or is five or more years of age. Each treatment plan form is divided into three zones: green, yellow, and red. Input is facilitated by the use of pull-down menus. The final document can be printed out for use by the patient and family and for inclusion in the patient's medical chart.

### Web Site Technical and Security Specifications

The address for the Intranet site is <http://font-csiss.kpscal.org/Pediatrics/>. The development team used Microsoft FrontPage® Web site development software and Microsoft Access® database software. JavaScript was used for all Web page script

programming. Internet Database Connector (IDC) Structured Query Language (SQL) scripting was used for all database programming.

The server platform used for the Web site is a Windows NT 4.0 operating system running Microsoft IIS Web server software on a Compaq Deskpro 4000 computer equipped with a 133-MHz Pentium® pro-

The screenshot shows a Netscape browser window titled "Pediatric Asthma Clinic Referral - Netscape". The address bar shows the URL <http://font-csiss.kpscal.org/Pediatrics/Asthma/To%20Pediatric%20@%20Clinic.htm>. The main content area displays the "Pediatric Asthma Clinic On-Line Referral" form. The form includes fields for Patient Name, Medical Record Number, Date of Birth, Phone Number, Primary Physician, Location (Fontana Medical Center), Referrer Name, Referrer Title (Physician), Purpose of Consult, Important Associated Medical Conditions, and Medications.

Figure 3.

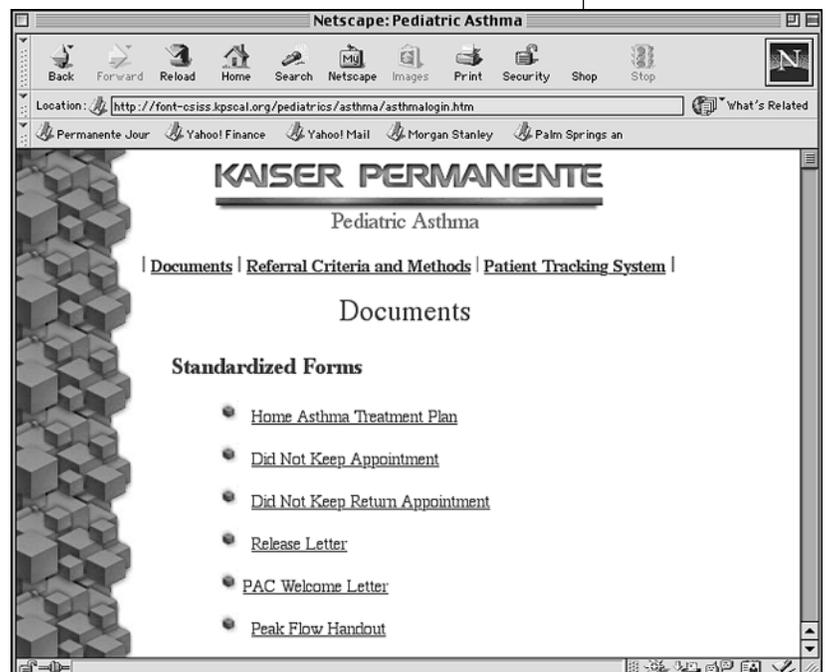


Figure 4.

***"This Intranet Web site patient management system was created by clinicians as a tool to enhance their productivity and interdepartment communication."***

cessor, 128 MB of RAM, and 2.5 GB of hard disk storage. (The platform is being moved to a 4-processor, 200-MHz, clustered, fault-tolerant NT server equipped with 650 MB of RAM and 60 GB of hard disk storage.) The client workstation uses a Windows NT, Windows 95, Unix, or Macintosh operating system equipped with Netscape® Navigator or Microsoft Internet Explorer browser software. The client workstation uses any personal computer or workstation system capable of running one of the two available browsers. Users have access to the Web site and server 24 hours per day, seven days per week.

The Web site containing the Pediatric Asthma Management and Tracking System is secured in a number of ways:

- Logical security: Entry to all sensitive areas of the Web site (eg, the tracking system) requires a user name and a password. Security access is controlled by the Web site administrator, and only persons who are cleared to view patient information (ie, cleared by Kaiser Permanente Security Access) may obtain a login.
- Browser security: Directories on the Web server that contain proprietary codes are set to disallow browsing, so no user can view these directories through the Intranet.
- Physical security: The Windows NT Web server is physically located in a secured building (the server farm). Access to the

server farm is restricted to authorized Information Technology personnel, and two security checkpoints must be cleared before gaining access to the server area. A key code exists on the first door, and a card or key is required for access to the second door. Devices capable of notifying appropriate personnel if limits are exceeded monitor the room's air conditioning and temperature.

- Data security: The Web site and associated databases are backed up nightly to a different tape. A long-term archive is created at the end of the week and is saved for a month. The process is then repeated.
- Databases: All databases containing proprietary data are password-protected and are stored on the secured server.

## Discussion

This Intranet Web site patient management system was created by clinicians as a tool to enhance their productivity and interdepartment communication. The impact of this Web site on physician access to patient records, the Web site's ease of use, and its utility as a platform for enhanced communication is constantly assessed by physician and other team member feedback and input. The Web site was the brainchild of clinicians who had initially developed a support system capable of handling a large population of patients, and we believe that this aspect of the site is crucial for the success of any electronic patient management system. A system for tracking specific patient populations will complement, not supplant, future introduction of the electronic medical record.

Desktop computers have given the vast majority of physicians access to this new technology, even if they have little or no computer experience. We have observed clinicians develop confidence navigating the Web site, make constructive contributions to improve the database utility, access Internet hyperlinks for information, and become more enthusiastic and receptive to future computerized applications. The Web site has thus been a highly effective way to support transition from a paper-based to an electronic clinical practice.

The success of this Intranet Web site has been shown by the high number of site visits, the e-mailed compliments by visitors to the site, and the satisfaction expressed by the team members who manage the

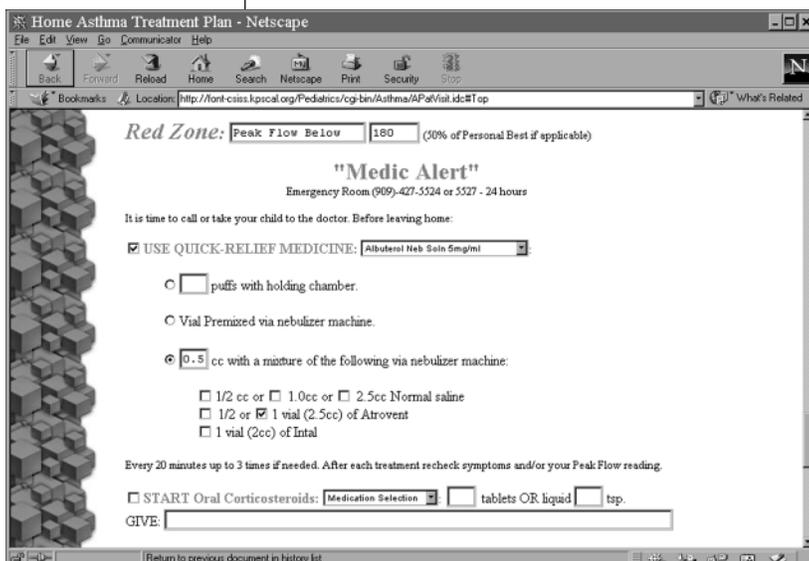


Figure 5.

targeted patient populations. We have received many inquiries on how to transfer this application to other subspecialty populations. We are currently creating a business process to expand the scope of the Web site to fulfill the demand for implementation in other geographic locations.

The success of this highly functional system has led us to envision a strong national demand for this electronic platform, whose utility includes 1) *minimal costs*, because KP physicians and their team members can use existing hardware and software; 2) *broad appeal*, because the applications can be customized easily for specific local needs; and 3) *less duplication of effort*, especially with increased clinician awareness of this type of Intranet application. ❖

*Acknowledgments* : The authors of this article would like to acknowledge the support and valuable contribution of the following doctors of the Learning and Behavior Clinic and Pediatric Asthma Clinic teams at KP-Fontana: Ernesto Carlos, MD; Marcia Hyvarinen, MD; Hla Hla Kyi, MD; David Lah, MD; Belen Leong, MD; Allison Nguyen, MD; Julie Mann, MD; Shoaib Patail, MD; Winston Rajasingham, MD; Robert Reyna, MD; Bertica Rubio, MD; Jae Shim, MD; Jay Tibbles, MD; and Alson Wong, MD.

#### References

(Disease management)

1. Algozzine T, Pannone R, Kozma CM. Opinions of disease management programs among medical directors of managed care organizations. *Am J Health Syst Pharm* 1998;55:1029-33.

2. Bazzoli F. Disease management. *Health Data Manag* 1997 Jun;5(6):69-72,74,77-8.

3. Stevens L. Looking online to chart disease state management frontiers. *Med Net* 1998 Mar;4(3):8-14.

(Background Intranet and Internet information)

1. JAVA's role in healthcare: benefits and obstacles. *Healthc Intranet Rep* 1998 Jan;2(1):7-10.

2. Morrissey J. Weaving a new Net: Web browser technology holds promise to become all-purpose information tool. *Mod Healthc* 1997 Aug 11;27(32):55-6,58,60-2.

3. Eid TA. 1997: year of the "Internet backlash"? *Healthc Inform* 1997 Feb;14(2):176.

4. Siwicki B. Crafting new methods of systems integration. *Health Data Manag* 1997 Jun;5(6):83-4,86,88.

5. Stevens L. Computer-based patient records: moving to the Web slowly. *Med Net* 1998 Aug;4(8):6-11.

6. Wayne-Doppke J. Test drive patient records on the Web. *Med Net* 1997 Jul;3(7):16-8.

(Designing an Intranet system)

1. Sechrest R. Designing the healthcare Intranet. <http://www.sechrest.com/mmg/proposal/#healthcare>. Downloaded August 1, 1998.

2. Bazzoli F. Intranets grow, but need infrastructure to develop. *Health Data Manag* 1997 Dec;5(13):6.

3. McCormack J. ActiveX vs. Java: what roles will these technologies play? *Health Data Manag* 1997 Sep;5(9):87-8,90,92-

4. Siwicki B. Health data security: a new priority. *Health Data Manag* 1997 Sep;5(9):46-50,52-4,56-8 passim.

5. Siwicki B. Systems integration: how will new standards help health care organizations tackle the challenge of easing the flow of data? *Health Data Manag* 1998 Feb;6(2):74-6,78,80, passim.

6. Sherter AL. Provider automation: breaking new ground. *Health Data Manag* 1998 Feb;6(2):134,136,138.

## Big Focus on Small

"Many of the most successful service enterprises in the world attained market dominance by an extraordinarily 'big' focus on the 'small' functional frontline units."

James Brian Quinn,  
Intelligent Enterprise