

Building Stronger Health  
Information Systems in the  
Developing World:  
Recommendations for Donors,  
Governments, and  
Nongovernmental Organizations

Research Paper and Strategic Briefing

Project support grant #2009 THS 325

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September 30, 2010

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## **“The obscure we see eventually. The completely obvious, it seems, takes longer.” Edward R. Murrow**

### **Focus on what the users in the health system need versus what the technology can do.**

Most health care delivery problems in the developing world are well documented. From inadequate infrastructure and supplies to lack of qualified personnel and access to care, numerous news stories, journal articles, books, and documentaries catalogue existing health system challenges and proffer “silver bullet” solutions to address them. One of the most passionately articulated solutions promulgated over the last few years has been the ability of information and communication technologies (ICTs), and specifically mobile phones, to address health system challenges. ICTs, often including mobile phones, are increasingly being used in the developing world to track health outcomes and indicators of success for monitoring and evaluation for donor-funded projects. ICTs are also increasingly being used at the health facility and community level to improve diagnostics and service delivery. The list of projects is long and growing, but how effective have these solutions been and what should donors, countries, and nongovernmental organizations (NGOs) implementing these ICTs do to increase their effectiveness?

The study investigators strongly believe in the power and promise of technology to address some of the health system challenges in the developing world. However, we do not believe in silver bullets. Reviews of ICT model projects implemented around the globe<sup>1</sup> over the last decade indicate that few of these projects have scaled beyond the initial implementation and been sustainable over time. PATH also investigated the status of 52 health management information systems (HMIS) pilots documented in *mHealth in the Global South: Landscape Analysis* and checked on the status of these projects. Of the projects documented in the report, only 7 of the 52 projects had gone beyond a pilot stage.

The global health community has increasingly recognized that pilots successfully show the “art of the possible” but are failing to scale at national levels and are rarely even conceived with the notion of national scale. To respond to this challenge, donors, governments, and NGOs have called for the increased use of common industry standards, proven software development practices, and available technology in the design and development of health information systems (HIS) applications for developing countries. The Rockefeller Foundation has been a lead sponsor of these efforts over the past few years through international fora (Bellagio 2008, 2009; Vancouver and Greentree 2010). Consequently, momentum has grown to ground new HIS projects within the concepts of a reference architecture at the development, donor, and governmental level, planning for a day when national scale may be possible.

PATH was awarded a grant by the Rockefeller Foundation in June 2009 to catalyze development of a reference HMIS architecture in low-resource settings. Since an HMIS reference architecture encompasses many health domains, PATH selected one focus area, logistics and supply chain management, to use as an example. A starting premise of the project, grounded in the investigators’ long experience in commercial software development, was that defining a common, robust set of user requirements was a necessary first step when designing a reference architecture. It is the investigators’ belief that the absence of robust reference architectures in global health is one of the root causes underlying why HIS projects fail to scale.

In order to identify interest and best practices for a reference architecture, the investigators conducted an extensive literature search and spoke with global subject matter experts (SMEs) regarding the use of user requirements in the development process. We also discussed with practitioners the areas where they felt donor investments in ICT would best be placed to improve the use of ICTs in the developing world. The following details our starting hypothesis, the research methods used, and the key conclusions and recommendations derived from this investigation.

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<sup>1</sup> *Health Information Systems in Developing Countries*, Vital Wave Consulting, May 2009.

**The research methodology scanned literature and diverse expertise for the use of, interest in, and best practices in reference architectures.**

Our initial hypothesis was that, although there is broad acceptance of the need to determine and document user requirements in the information and communication technologies (ICT) industry, this practice is much less common in global health, is not standardized, and was based on only a few existing methodologies, if any. To test these assumptions and to leverage existing best practices to inform a reference architecture, we undertook a two-pronged research effort. We first conducted a literature review to determine whether gathering user requirements is a common practice for health management information system (HMIS) projects in low-resource settings. We then undertook a series of interviews with subject matter experts (SMEs) who are funding, advising on, developing, or deploying ICT projects globally.

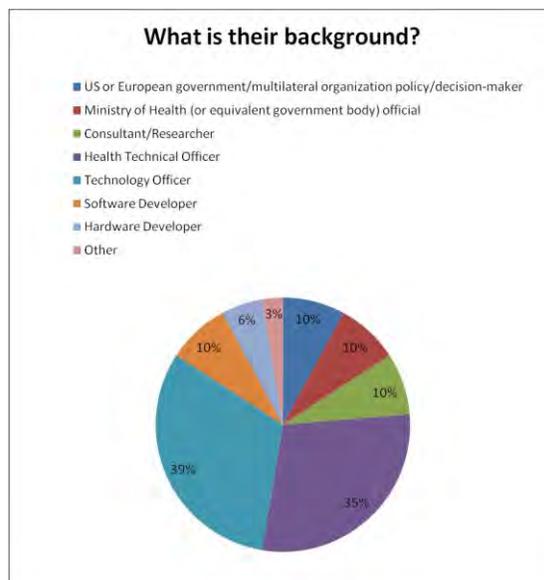
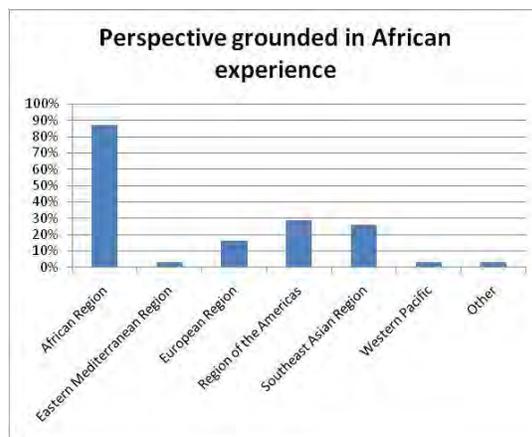
PATH started its investigation through a literature review by researching to see if gathering user requirements is a common practice in HMIS projects in low-resource settings. Follow up and validation of findings to understand the results and search for nondocumented examples was then conducted in the form of qualitative one-hour phone interviews with global ICT experts.

The literature review covered documentation of prior and existing HMIS pilots. The literature review examined two questions: (1) What does the literature say about ICT experience in low-resource countries? and (2) How does the literature speak to the use of ICT for improving health in low-resource countries? The review focused on ICT frameworks and methods currently used to identify user requirements and software design.

Our comprehensive review considered academic, industry, government, and nongovernment publications and case studies. The most relevant articles were annotated for the review from among a larger list of 75 articles addressing ICT in low-resource countries. A complete list is available in Appendix A. The research revealed a common glossary of terms, concepts, and approaches as well as a list of 15 common journals for ICT in

global health. Our intention was to cast a wide net to ascertain what was available in regard to ICT.

PATH then collected feedback from stakeholders (donors and country HMIS experts) and software practitioners (developers, program managers, etc.) on system design and requirements-gathering processes being employed today. While diverse backgrounds and opinions were solicited, the respondents' prior experience was dominated by sub-Saharan African project work and backgrounds either in public health or in technology development.

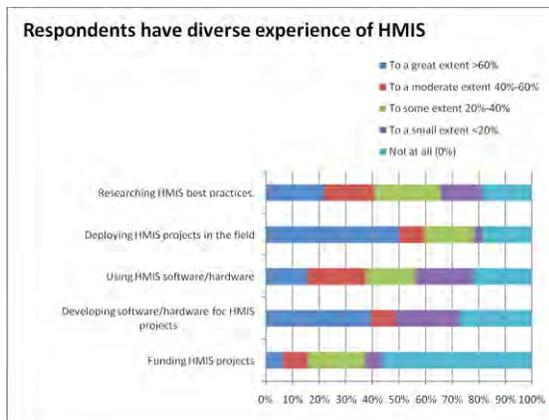


**Figures 1 and 2. Respondents' experience grounded in Africa and strong bias from health perspective.**

Interviews were qualitative discussions conducted by one interviewer, primarily by phone, for 45 to 60 minutes. Respondents were asked to provide basic information about their background and experience in global health and ICT. They were

also asked a series of questions on opportunities and challenges facing the use of ICT in health information systems (HIS), the use of user requirements in their current projects, and actions they felt would have a profound effect on the development of HMIS in low-resource settings. More than 90 percent of the interviewees had more than 10 years of experience in HIS in the developing world, and 80 percent had more than 20 years of experience. Eighty-four percent had personal experience gathering user requirements, and almost 60 percent had direct experience in deploying projects. Experience with deploying projects was counted whether involvement consisted of national-level experience in shaping the project or direct experience working with end users on a pilot rollout.

Regardless of the depth of hands-on experience, most respondents were keenly aware of the challenges involved in developing and deploying software. However, there was not a strong tradition of researching best practices. When probed on why this was not a larger portion of their work, respondents replied that they did not feel that there were many “best practices” to draw from and when projects were cited (i.e., Baobab in Malawi), their lessons were not well documented globally in terms of how to take the models that existed and replicate them to other countries. A notable exception to this practice of taking lessons and documenting them for other countries to learn from is the Health Information Systems Programme (HISP) which provides training on the District Health Information System (DHIS) which is deployed in many countries. Figure 3 provides an overview of the range of experience represented in the sample.



**Figure 3. Respondents’ experience with various HMIS activities.**

**User requirements are a key underpinning of reference architecture, but agreement on what they are is rare and the process is not standardized.**

Our findings from both the literature review and the SME interviews confirmed that a “replicable process” for determining and documenting user requirements is not a standard practice in building most HMIS projects currently deployed in the field. None of the literature reviewed mentioned a standard user requirements process, and only two of the SMEs interviewed had conducted or seen a documented, replicable, user requirements process. However, 84 percent of the SMEs interviewed indicated that they had some direct experience gathering user requirements. Further, all SMEs interviewed felt that gathering user requirements is critical, and both research investigations speculated that skipping this step may significantly contribute to the failure of HMIS projects reaching scale.

SME opinions differed about the exact definition of “user requirements” and the process for determining them. Respondents also disagreed about how much time should be spent at the national level gathering requirements from policymakers versus a much more bottom-up approach working directly with end users. Almost all of the software developers embraced a more bottom-up design process working directly with end users, which one classified as “under the banyan tree” iterative design. There was a very short phase where initial requirements were gathered, and then more iterative development was employed to show to a select number of end users working prototypes. Although classified by some respondents as gathering “user requirements,” this type of interactive development with prototypes is more commonly known as “usability testing” in the software industry. Respondents representing two firms also had recently begun using business process mapping methodology at the project outset. These firms started their development efforts with process mapping and then used an iterative design process guided by usability testing. A number of respondents suggested that the most valid reason for defining and determining user requirements at the national level is to ensure political buy in. Many noted that since information is power, if up-front participation in the process is not ensured at the

national level, the eventual software solution will never be used. Compounding this need from their perspective were the low levels of ICT experience in most ministries of health (MOHs) and lack of familiarity at each level of the health system with what scenarios may be possible. Because health officials are not cognizant of all the factors involved in ICT development and deployment and users may not know the full potential of the solutions, fully informed decisions on how ICTs could be used, designed or optimized to improve data collection or service delivery may not always be manifested.

In an effort to understand seemingly conflicting data among SMEs stating that user requirements are considered vital and that they have conducted them and the fact that there are few documented examples of this process, the investigator probed further with selected SMEs. The conflict is in the definition of and the process for determining and documenting user requirements that all will consider robust and replicable. Responses suggest that donor and country *focus should be on defining what is meant by user requirements; agreeing what is considered sufficient for gathering user requirements and creating a **standard** replicable user requirements gathering process for global health that anyone could use.*

#### **Conclusions:**

- Interviews with SME developers and review of the literature indicate that design, implementation, and evaluation are taking place concurrently, with no discussion of user-driven design as a discrete and deliberate first step.
- The literature shows that qualitative methods are predominantly used to ascertain user and system requirements. There is limited discussion of approaches to gather requirements and no discussion of how to document, validate, and share requirements.
- It was clear from the interviews that the global health community would welcome a recommended standardized methodology for determining and documenting user requirements. The basis that most respondents had used for their thinking in enterprise architecture was The Open Group Architecture Framework (TOGAF). The degree to which enterprise architecture and user

requirements methodology would be embraced by software developers depends upon (1) the cost of implementing the process, (2) the degree to which it is required and funded by the donor and/or country, and (3) the degree to which user requirements continue to embrace the practice of iterative design and not just a top-down design approach. The key will be to find the right balance between setting user requirements at multiple levels of the health system and providing practical applications for users to experience within constrained budgets.

#### **Recommendations:**

- *Global health projects which plan to utilize ICTs should **require** that a user requirements determination and documentation step take place before a software solution is defined.* This step should include a map of the existing business processes, an analysis of gaps in the existing system, and identification of the prioritized problems that the system must address in its initial implementation. This is an articulation of unmet customer needs and goes further than the use cases commonly deployed in existing projects.
- *The donor, nongovernmental organization (NGO), and development community should agree on a standardized definition of and process for determining and documenting requirements that can be applied across any health domain.*
- Our review of the literature and of existing pilots found that a “process” for defining, determining, and documenting user requirements was not a standard practice in building the HMIS projects currently deployed in the field. Experts speculated that skipping this step or doing a cursory collection may significantly contribute to the failure of most HMIS projects reaching national or international scale. Furthermore, the investigators concluded from discussions with health officials and donors that future HMIS projects, no matter the development source or funding agency, could potentially benefit from the development of a *replicable process for gathering user requirements* that would be generally available.

- *User requirements documentation and a standardized process for gathering user requirements should be commonly available to the global health community via a central repository.* A global repository established at a location such as the Health Metrics Network or the mHealth Alliance’s “HUB” network should be established with a plan to collect ongoing best practices after the repository is established.

**ICTs represent a real opportunity to improve service delivery, but the existing challenges need to be acknowledged and addressed.**

**Opportunities**

*Technology.* Most participants indicated that one of the reasons they were most optimistic about the future for health systems was the degree to which the changing infrastructure, growth of the Internet, and declining equipment costs will change the use of ICTs for health. The increase in bandwidth and cellular networks was most often mentioned, followed by declining costs for most hardware (and not just mobile phones).

Mobile phones were a strong focus of most interviews. However, with one interviewee stating, “there are no killer apps—just one killer device” as a way to frame how they thought of the future of health care service delivery. The opportunity to “leapfrog” from existing paper-based systems to advanced health care service delivery was an often voiced aspiration that participants felt mobile phones could enable. However, the bias toward the use of a mobile phone client at project outset was mentioned frequently followed by health technology officers implementing field projects. Their concern was that clients, particularly mobile ones, were focused on by the global community without enough attention being paid to what is required to build strong back-end systems. As one interviewee described it, this is like “building the house on a piece of land without sufficient infrastructure.” The increasing focus on the client without paying attention to the back end has already resulted in a lopsided spending and efficiency gap, and unless addressed soon could render what promising applications that are emerging useless.

Respondents also frequently mentioned the ability to use the Internet to roll out changes and rapidly

evolve a system that just a few years ago required the installation of many separate applications. Thus, *the potential* to scale applications has never been greater nor has it ever been easier to deploy system-wide changes. This evolution implies that nationwide systems are within our grasp.

*People.* Participants cited the extent to which MOH officials are beginning to become conversant in information technology and the degree to which they could take country leadership of ICTs with just a bit more education and another generation of leadership. Others referenced the “hunger” and “fire in the belly” of the individuals they had met who saw a future for themselves in ICT and the degree to which they soaked up training and could become the next generation of ICT thought leaders in the developing world. The degree to which technological know-how has increased even in the last decade gave many hope that the next ten years will see even more dramatic changes than occurred in the past decade.

*Improved care.* A number of SMEs saw a great opportunity and urged donors to focus more on how ICTs could be used to improve patient care and not just data collection. In fact, many of the SMEs interviewed were brought to ICTs because of their backgrounds in monitoring and evaluation. A large majority of ICT projects implemented to date have been used primarily to improve data collection, not patient care. Interviewees remarked that this is the direct opposite of the traditional logic in the developed world, where technology is first used to improve patient management and billing and only improves broader data collection after this is completed. In particular, addressing the challenges facing overburdened health workers at the last mile was seen as a key area where ICTs could improve both care for patients and serve as an educational opportunity and job aid for caregivers. SMEs encouraged donors to examine this trend and balance funding for projects between patient care and data collection.

*Market development forces.* Although interviewees disagreed on whether market forces represent an opportunity or a challenge, many cited the degree to which the private sector is beginning to explore the health ICT market in the developing world outside of Brazil, Russia, India, and China (BRIC countries) and how the private sector might be tapped to provide ICT skills that

are in short supply in the developing world. They also noted how the growth and presence of managed services offered by traditional software firms could catalyze the growth of electronic health services. However, many SMEs expressed strong skepticism that the private sector will truly design solutions appropriate for the developing world. They cited the extent to which “off-the-shelf” solutions have been deployed and how few of them were found effective. Identifying how and where to engage the private sector effectively for mutual gain could be a hallmark of the next ten years of ICT investments.

### Challenges

*Existing funding system.* A challenge frequently invoked by respondents was the degree to which the existing funding system pushes competition over cooperation and how *changes in the funding system are required before true integration could occur*. As one respondent phrased it, the “you theory” was prevalent, meaning that while in theory NGOs know that they should collaborate, there is no incentive in the system today to do so. Furthermore, “if I take the time to collaborate, I will be unable to meet the deliverables I owe my donor today” was a challenge often discussed with the investigator.

*Donor/country data harmonization.* A related problem to funding timelines is the degree to which donor-funded projects may or may not be integrated with country systems. A key example of this integration challenge is the streamlining of indicator sets. To build simple, easy data collection systems, indicators need to be coordinated at the national and the project level. In most projects, however, the indicators are disparate and not harmonized within a country or among provinces. The resulting outcome is either an ICT system that works perfectly for one project but does not integrate with others, or a system that captures a few things well for many projects but takes longer to roll out and then will not meet all donor requirements.

The related problem of data harmonization also extends to the MOHs. Many people interviewed cited the degree to which MOH officials do not encourage integration of data capture because this threatens their power base and potentially their funding base.

The final challenge discussed as part of the funding system was the timeline and process for ICT funding. In most cases, funding for the ICT portion of a project and its goals are set before conducting a true user requirements assessment. This means that the solution is predetermined before the country, the NGO, and the developer truly understand the system that needs to be designed. Most of the interviewees indicated that this system essentially renders moot the process of gathering requirements and needs to be adjusted. Although all recognized the need for clear funding parameters, one solution mentioned was funding the requirements process first and then working with the country and implementing NGOs on a second round of funding for software solutions that have a longer time horizon than traditional health projects.

*People.* People represent a chronic challenge as well as an opportunity. In many countries, a lack of understanding of what ICTs can do and why they should be supported continues to hinder more widespread acceptance at the national level. Adding to this challenge is the degree to which MOHs want to keep information in house and use their own developers or ICT professionals. Although this is understandable from a privacy perspective, in countries where information technology development personnel are scarce and demand is high, the degree to which NGOs or MOHs can retain newly trained ICT professionals remains a constant challenge.

One last “people” challenge is the degree to which record keeping or evidenced-based decision-making is a cultural norm. Although this varies widely by culture, there was a widespread belief among respondents that because the systems put in place over the past 20 years have not resulted in true change (i.e., if I report a supply stock-out, I will get new supplies), health system personnel have been increasingly disincentivized to provide accurate data (though both China and India were noted as exceptions to this problem). Further, experts noted that the culture of evidence-based decision-making varies widely by country. In order for ICTs to be truly effective as analytical tools, there needs to be a stronger statistical base across the board which has nothing to do with technology and everything to do with health system strengthening.

## Conclusions

- Human capacity and national technology prowess is your greatest opportunity and biggest challenge.
- Fragmentation of data indicators impedes the development of harmonized, rational, national-level ICT systems. Agreement on harmonization of data indicators among donors led by national-level efforts is a necessary prerequisite before a national-level ICT system can be developed. Ghana, India, and Zambia are locations where this first step has taken place and should be considered as models.
- Clinicians and facility-level staff spend a large portion of each day “reporting” on data indicators but rarely do available ICT systems provide actionable feedback to them that can help their work.
- Governments and developers are generally skeptical that public/private partnerships can be struck with commercial software developers. Building a bridge between these worlds over the next decade will be critical.

## Recommendations

- *Stop “re-inventing the wheel.”* Experts indicated that standardizing processes, methodologies, and some aspects of the enterprise architectures are things that the health community (e.g., donors, governments, NGOs) could rally around. Interviewee opinions varied, however, on the degree of standardization that was optimal. At minimum, most interviewees concurred that encouraging some level of common practices and guidelines for funding, streamlining, and harmonizing indicator sets and establishing enterprise architecture with common technology standards designed to be interoperable is important. The consensus was that citing specific solutions or requiring interoperability takes away a degree of freedom from countries’ rights to specify final solutions. Another “con” of this approach which must be considered is that technology innovations rarely result from heavily design-driven processes. Donors and countries will need to consider if they want “new” technology or adapted technology.

- Governments should take the lead to rationalize and limit the current data indicators that the last mile and ICT systems need to collect working with international donors. Common data indicator sets should be used where possible across program verticals.
- *Future ICT reporting systems implemented to capture data monitoring should include two-way information flows.* If these two-way information flows are not soon enabled, level 5 and 6 health care workers will continue to lose interest in providing accurate information. If users do not see value in the ICT system for them, they will not work to provide quality data, and their disillusionment with the entire system will be raised. Further, training in how data can help health workers make decisions needs to be *emphasized in health system work generally.*
- *All stakeholders (donors, countries, NGOs) need to increase ICT and informatics training budgets* as a component of their training curricula. Specific and distinct types of training investments are required: (1) Training should target increasing the “absorptive capacity” of the MOH and staff at the facility and clinic level. (2) Informatics and ICT training should be incorporated in national and regional medical training facilities with an emphasis on the possibilities for using ICTs to improve evidence-based decision making and rural service delivery. (3) Local coding and program management capacity should be built and used to support health ICT deployments.
- *Plan for interoperability.* All the experts pointed out that no country in the world is starting from scratch. There are existing HIS and technologies in place in many cases. Experts encouraged countries and donors to require up-front planning and documentation from implementing NGOs on either a transition or an interoperability plan for any new software deployments that includes discussions in their planning of how they are going to “wrap” the software solutions together.

**It is a marathon, not a sprint. Lasting change will take a generation, but we can lay the groundwork now for high performance health care systems supported by technology.**

The interviews ended with a discussion with the SMEs about what they would choose to invest in if they had a \$100 million dollars and it was up to their discretion to allocate. While all the questions were open ended, this final question stimulated the most discussion.

- *Develop an enterprise architecture for health.* A general theme that emerged was donor consolidation around standards and a collectively designed enterprise architecture that could be provided as a reference model for countries and implementing NGOs to consider. Wrapper classes of software will be an important consideration. No SMEs believe that a one-size-fits-all solution is appropriate. However, there are requirements that need to be set at the global level, and increased investment in developing this common base is needed.
- *A national case example* is needed. Quite simply, there is no demonstration case that investing in ICTs will have a tangible impact on a country's standard of care. Without a demonstration case, we are all speculating that this is a good investment. Over 50 percent of respondents indicated that they would invest with a country in a national example that looks at implementing ICTs across all health domains. Without an example where this is implemented nationally and data supporting the return on the ICT investment, respondents were not hopeful that ICTs would be implemented in more than a piecemeal fashion outside of a handful of countries.

What they are looking for are examples of complete solutions that overcome the common problems in their deployment *and* a demonstration that the required investment is more cost-effective than alternative investments. Further, a quarter of the respondents felt that doing one to three national deployments of ICTs working with responsive governments while funding a parallel study to examine the cost/benefits of deploying ICT systems would go a long way toward developing markets adopting these systems and the private sector assisting in the effort.

- *Capacity building.* As previously discussed, there were a number of variations on the theme of training that ranged from educating MOH professionals to building the next generation of leaders in Africa for ICT. All respondents agree that for ICT to be fully embraced, the investment to build capacity had to be made today to see a return over the next 20 years. This was the long-term investment that over 75 percent of respondents indicated was required to make a lasting impact.

In conclusion, all the respondents interviewed were passionate about the opportunity that employing ICTs in a measured way offers for both improved delivery of care and data collection in the developing world. Universal lessons that they wanted to emphasize were that this would all take time; that there is no silver bullet, and changes we are starting will take a generation to see real impact. As Bill Gates once stated with regard to technology, "we always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten. Don't let yourself be lulled into inaction."

Now is the time to act to lay the foundation for a reference architecture for health.

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