Futurama

Four futures for scientific and medical publishing

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Strong forces are operating that may change radically the world of scientific and medical publishing. These include:

- The appearance and spread of the world wide web, opening up the possibilities that authors might communicate directly with readers and that many intermediaries may not be needed
- Increasing resentment in the academic community that it is having to pay ever more for information that it effectively produces itself
- The rise of evidence based medicine and systematic reviews in particular, making people understand how medical information is disorganised and "Balkanised" and that finding information is expensive and difficult
- Increased understanding of the "information paradox," which says that doctors are overwhelmed with information and yet cannot find the information they need when they need it
- Increased evidence that most medical studies are of low quality and of limited relevance to clinicians
- Globalisation of medical publishing, exposing weak local products to strong international competitors
- Appearance of new players—such as HighWire Press, BioMed Central, and PubMed Central—who are trying to capture value that currently belongs to publishers
- Greater pressure on doctors to base their treatments on evidence
- Increasing recognition that information alone will not change practice
- Better understanding that improved health care will come not from exhorting individuals but by improving systems
- The rise of patient power and doctor-patient partnership, meaning that patients expect access to the same information as doctors and that patients' evidence is just as important as doctors' or research based evidence
- Growing acceptance that doctors cannot work effectively without considerable support from information and decision making tools
- The spread of handheld technology, opening up new possibilities of delivering "just in time" information
- Doctors and other health workers have to be regularly revalidated or recertificated
- Those doing applied research are becoming increasingly impatient with systems that reward basic researchers but not them, and they are proposing new evaluation systems that place more value on change in the real world and less on scientific originality
- The price of information is falling as many organisations such as pharmaceutical companies make information available for free on the internet
- The marginal price of electronic information is effectively zero
- The real price of long distance telephone calls is close to zero.

Nobody can know what kind of world will result from the interplay of these forces, but it is possible to envisage plausible futures. The table shows four possible futures.

Summary points

Scientific and medical publishing is changing dramatically because of many forces, including severe pressure on library budgets and the possibility of publishing scientific research not in journals but on the internet

Four possible futures for medical and scientific publishing are named after the Simpsons, a cartoon family

In the Marge world, academics innovate and publish primarily on the web not in journals; publishers must publish large numbers at low cost to succeed.

In the Homer world, publishers adapt to the electronic world and continue to publish research

In the Lisa world, publishers have largely disappeared, and communication takes place mainly through global electronic conversations

Publishers have also disappeared in the Bart world, where large organisations have become the main purveyors of research

All the worlds are global and depend heavily on electronic communication; in all of them there is intense competition for the attention of doctors and others

Lisa (the smart, well informed daughter): a world of global conversations

Information exchange occurs predominantly not through "published" information but through conversation (much of it over the telephone), email, list serves, bulletin boards, and informal websites. A paediatric surgeon, Lisa, with a specialist interest in liver surgery who also happens to be interested in cricket, romantic poetry, and camels will be connected to a series of electronic communities who will keep her up to date with her interests. She will keep electronic copies of some of the material. An advanced search engine will allow her to find whatever she wants within her own database.

The research Lisa is conducting is part of a multicentre study. The data are kept centrally, and a constant electronic—and sometimes voice—conversation goes on between all those involved in the research. Once a week there is a conference call that many of the participants join. In some ways publication of the research is unimportant because everybody who needs to know is part of the research, but the research is archived on an academically sponsored website. Conversation about the research circulates around related communities, and sometimes—but rarely—clinicians and researchers from other parts of medicine will access the archive. Lisa's academic credit comes from the "buzz" in the community. Everybody knows who is thinking originally and doing highly innovative work.

Sometimes Lisa needs information from beyond her special interests. She then either uses a search engine to direct her to the relevant electronic community or she asks somebody within her communities she thinks will know where to go. "I don't know, but I know a man who does" is the mantra; and, even though the world has six billion inhabitants, we are all only five links from each other.

Lisa picks up general information from the mass media and from chat in her communities. The conversation is not all about the special interests. When something interesting happens in medicine or health care it spreads very quickly, like gossip, through the linked communities.

Companies producing hardware are making money in Lisa's world, but there's little role for publishers. The communities are self generating and contain the information they need. Information is a side product of their professional and leisure activities. People keep their own databases.

Although this world might sound far fetched, it exists already. Doctors, we know, get most of their information from each other, not from published material. The information from colleagues is directly relevant to them, is more credible than what is published, can be understood and internalised through conversation, and may be directly actionable in a way that is unusual with published material. Many doctors belong to groups, often international, related to their special interests. And most research that is published is already known to the "invisible college" of people interested in that area of research.

BioMed Central is trying to create a business for this world by providing infrastructure (even electronic journals) for the communities. It is perhaps doubtful, however, whether communities need much more infrastructure than is easily and cheaply available through Yahoo and the like. It's the quality of the conversation that matters, not the technology or infrastructure.

Homer (the lazy father): it ain't that broke, so there's no great need to change

Despite the drivers for change, the world in this scenario doesn't change that much. Researchers continue to publish in the same old way because it's familiar and doesn't demand big changes in the academic reward system. Homer, a professor in neurology, thinks: "It may be a flawed game, but it's a game I know. I've done OK with this game. If we play a new game I might lose out." He reads the journals he's always read and prefers them in paper form. They come to him through his membership of various societies, and he can't see the point in subscribing to a journal. He has more than enough to read. Although he sometimes uses the web to find material, he always reads on paper.

Characteristics of four possible publishing worlds, named after characters in *The Simpsons* cartoon series

	Homer	Lisa	Bart	Marge
Description	Status quo	Global conversations	Big companies rule; publishers disappear; all is spin	Academic innovation; publishers publish magazines
Paper publications	Yes	No	Yes	Yes
Distilled material	Yes	No	Yes	Yes
Educational material	Yes	No	Yes	Yes
Individuals and information	Greater need for filtration and distillation	Few intermediaries—simply search engines such as Yahoo and Google	New intermediaries—for example, BT, Tesco, and Microsoft	Original science free to end user on web
Knowledge creation communities	Become more end user focused	Consensual knowledge	Large organisations	Academic community in charge
Marketplace	Traditional, libraries	For technology providers	Supermarkets or space for niche boutiques	Distillation and selection publishing businesses left
Technology	Printing and simple web	Every form of electronic communication must be fast and personal	Huge systems controlled by organisations	Institutions pay (on behalf of end users). More £ for more journalistic work
Academic system	Reward system survives	From the "buzz" in the community	Ability to raise money from large organisations	"Hits" on large databases
Philosophy	"The status quo is the way forward"	"I know somebody who knows just what you need to know"	"There's no such thing as unbiased information"	"Get it up on the web"
Who gets most attention	Contributors and readers	Contributors and readers are the same	Readers (customers)	Contributors by the academics; readers by the publishers
How many journals	10 000	0 or 1 000 000	500	10

JEREMY SUTTON/REX

In the Lisa world, it's all about "buzz"

Homer is, however, finding it increasingly difficult to keep up with all the material that is published—and he has now to revalidate every five years and show he's up to date. He's thus grateful for the distilled information he receives. Some of it is sent to him free (paid for by advertising, he assumes), and the rest is provided either by his society or by his hospital, which has recognised its responsibility—through clinical governance—to keep him up to date.

This is a familiar world for publishers. They have increased the value they add to information—through filtering, distilling, and organising better. And they have broken out of the bad old model of "more for less" (where subscriptions fall and so prices are raised to make up for the loss) to a world of "more for more" (electronic access to much more material for slightly more money, based on the marginal cost of electronic material being zero).

Marge (the wise mother): a world of academic innovation

All original research is made available for free through the web—either through something like PubMed Central or on sites owned by universities, research institutions, or companies. Marge, a geriatrician, rarely accesses original research. Instead, she is sent magazines that summarise for her the small amount of research that matters for her practice. Some come on paper, but increasingly she reads them on the screen that she carries in her purse: the resolution is marvellous.

The magazines contain news and gossip about her specialty and the rest of medicine. They also include educational material, most of it linked to material on the web. All the magazines are free to her, paid for by advertising, the associations she belongs to, or her hospital. It is the hospital that pays for her to access the educational material on the web. She has to show that she's used it in order to get revalidated.

Marge's consultant colleague, Philip, who has an academic appointment, is electronically alerted to the small amount of research that is directly related to his research interest. His academic status is based partly on the number of hits received by his research on the web, partly on how much his research is mentioned in the magazines all doctors receive, and mostly on whether his research improves patient outcomes.

Marge has several decision support systems to help her in her clinical work. These are portable, linked to a constantly updated evidence base, and extremely easy to use. They prompt her gently. Her patients and their carers have access to exactly the same information sources and decision support systems.

Publishers have given up on publishing science. They produce the magazines and must add a great deal of value in order to stay ahead of their competitors. The added value is expensive, and the publishers are profitable only because they sell large numbers of paper and electronic copies at low unit price to purchasers like governments, health care plans, or hospitals.

Bart (the streetwise son): the big guys have taken over

Scientific and medical information is provided by large organisations, mostly companies—Microsoft, Tesco, Walt Disney, United Healthcare, WHO, Merck, and the like—as a side product of their usual business. Traditional scientific, technical, and medical (STM) publishers have gone. Editors now work for the large companies, and their job is not to think for themselves but to promote the mission of their employers. Most research is funded by the large organisations. Many academics are now employed by the companies, but even those remaining in academia tend to have their research funded by the organisations. Academic success is measured primarily by ability to raise money from the organisations. Teaching and research have been separated, and most universities are now teaching factories

Bart, a general practitioner, receives his information from his employer, United Healthcare, and from those organisations—such as Merck—that provide him with the products he needs to treat his patients. His patients have access to the same information. Nobody worries about the independence of information. The whole idea that information might be neutral is seen as naive and old fashioned. The market in ideas and the money markets are now tied closely together, which ensures that good ideas are quickly exploited. There is none of the delay that was so common in the old world, when academics and business were suspicious of each other. Bart sometimes amuses himself late at night by accessing the rabble-rousing website run by the 80 year old Tony Delamothe which attacks the big companies. Nobody needs to stop such inflammatory material because nobody much pays attention.

Preparing for these futures

It is impossible to predict the future, particularly at times of great change. We are moving now from the industrial age to the information age, and we are probably nearer the beginning than the end of that change. Imagining scenarios is a way to think about the future and so prepare for it. Some things seem to be important for all of these futures. What follows are thoughts we had on how to prepare for the future.

- Community information (gossip) will be important in all of these worlds
- All the worlds are "global"

- Patients are a growing audience in all of the worlds; patients' evidence may become as important as doctors' evidence
- A strategy that depends on publishing original research will work in only one of these futures—Homer world
- Producing distilled, value added material will be important in three of the worlds
- Educational material will be important in three of the worlds
- Doctors don't pay for the material in any of the worlds; money comes from large organisations or advertisers—meaning that "sales" is steadily more important and that relationships with many sorts of organisations may be important
- The web is important in all the worlds, and so potentially are other means of delivery (handhelds, digital television)—emphasising the importance of producing information independent of platform
- Paper survives in three of the worlds
- In all the worlds there may be increasing competition for doctors' attention
- Even in the Homer world there is ample room for innovation in delivering information.

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Is that it? How online articles have changed over the past five years

Tony Delamothe

Five years ago *BMJ* readers responded to the challenge of predicting what online articles would look like in the future in five general medical journals. Has the development of electronic publishing lived up to their predictions?

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Our 1997 Christmas issue carried several descriptions of what an online scientific article would look like by now.[1] We asked readers for their predictions and promised a prize, based on comparisons with contemporary articles "appearing in online versions of the *Annals of Internal Medicine*, *BMJ*, *JAMA*, *Lancet*, and *New England Journal of Medicine* (should they still exist)."

These five general medical journals still exist. While all now have full text online versions, you'd be hard pressed to see much change in their articles over the past five years. Nevertheless, on closer inspection, vague hints of change are detectable, although for their full blooded realisation you'll need to look elsewhere.

The end of periodical publishing

With the web, articles no longer need to appear as part of a discrete issue. They can be published whenever they're ready, oblivious to the tempo of issue publishing. Weeks or months later they appear in the print journal. The *New England Journal of Medicine*, *JAMA*, the *Annals of Internal Medicine*, and the *Lancet* do this with fast track research papers, while the *BMJ* does this with "hot news" and noteworthy obituaries. Hundreds of journals now "publish ahead of print." The *Journal of Biological Chemistry* has probably moved furthest, embracing a model of continuous publication of newly accepted manuscripts.

For some types of articles, journals have begun to "publish instead of print." In these cases the articles never appear in the print journal. For the past four years the *BMJ* has been posting virtually all its "rapid responses" (electronic letters to the editor) on bmj.com, selecting fewer than 10% for print publication. Although the *New England Journal of Medicine* includes "Featured Images in Clinical Medicine" on its paper table of contents, you need to visit its website to see them.

Box 1: Reality check

Five common themes emerged in the published views:

- The article will become a living document (realisation: 1/10)

"Electronic publishing will turn scientific 'papers' from dead documents into live ones"; "the live publication will evolve continuously"; "there may never be a 'final version' of the work"

- The online article will be a superset of the current paper article (realisation: 3/10)

Online articles will have fuller methods sections; readers will have access to all the raw data and be able to manipulate them, drawing their own conclusions

- Links will proliferate greatly (realisation: 5/10)

"Hypertext links will make each individual scientific paper a gold mine of supporting information"; references will link to the full text of the cited works

- Articles will be available in different formats and at different levels of complexity (realisation: 2/10)

Users will be able to choose the onscreen appearance of the article they want to read, and at which level of complexity—the short, plain text version accessible to the public or something more complicated

- Peer review will change (realisation: 4/10)

Articles will be posted with comments from peer reviewers; open or semi-moderated peer review might occur. Letters to the editor will be replaced by letters to the author, to which authors will be expected to respond publicly on the website; this correspondence will be published immediately and could continue long after the original article's publication