

A ViSion to Transform the Practice of Structured Reporting

Introduction

Several initiatives are underway that will transform the practice of medicine and consequently diagnostic radiology. In the United States, the Institute of Medicine is calling for the creation of Learning Health Systems, the Radiological Society of North America is promoting the Quantitative Imaging Biomarkers Alliance, and the Patient Protection and Affordable Care Act is giving rise to Accountable Care Organizations⁽¹⁻³⁾. All of these initiatives aim to improve the quality of healthcare and enhance patient safety while simultaneously decreasing costs. A common denominator among them is the need to implement information technology solutions, particularly structured reporting (SR).

Ever since Roentgen discovered x-rays in 1895, radiologists have produced narrative descriptive reports of image findings, but narrative reports do not readily provide the structured data that is required for data mining and outcomes analyses. Many SR schemes have been proposed over the past few decades, but have not been widely adopted due to the perception that they are tedious and time-consuming^(4, 5).

My team at the MD Anderson Cancer Center in Houston, Texas, has examined this problem and developed a novel solution, called ViSion, which allows a radiologist to practice naturally (i.e. randomly identifying and speaking about findings) while simultaneously capturing data in a multimedia SR.

ViSion Technology

ViSion is a client-server software solution that is analogous to being the Facebook of medicine. Key images are captured and tagged with metadata during the radiologist's interpretation of image findings. The client software runs in parallel with any original equipment manufacturer's (OEM's) picture archiving and communication system (PACS) or advanced imaging system (Figure 1). As a radiologist randomly identifies image findings, he or she presses a button on a microphone or keyboard to initiate a screen capture and

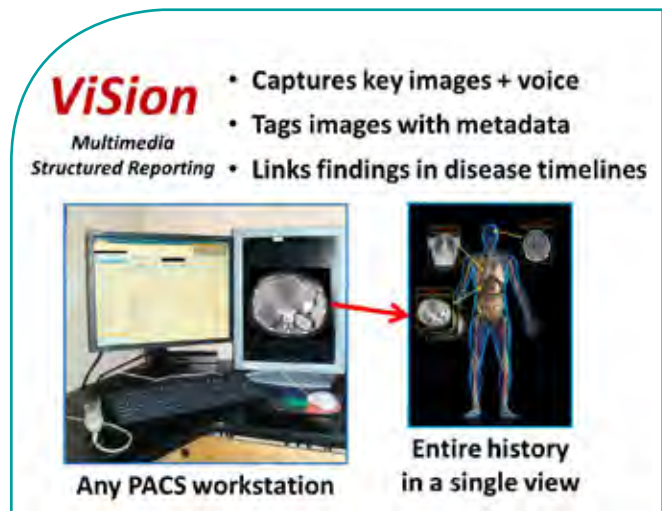


Figure 1: The ViSion system works by capturing key images from any PACS or imaging workstation, tagging the images with anatomy and pathology metadata extracted from verbal dictations, and assembling a multimedia report on a server that is accessible via a web browser

record a verbal description of each finding. ViSion's use of screen captures makes the solution OEM-independent by eliminating the need to integrate software with that of proprietary imaging systems.

A radiologist may speak *ad nauseum* about an image finding, but that description becomes a secondary feature which is linked to a key image and metadata (i.e. anatomical location, radiological observation/diagnosis, disease metrics, and medical priority) which defines the finding. The image and speech data are uploaded to a server where metadata are extracted using natural language processing to tag the images in a database. Alternatively, a radiologist may use pull-down menus in the web-based reporting system to tag the images using an integrated ontology (i.e. controlled vocabulary and defined relationships between terms). The ViSion ontology contains over 12,000 radiological observations/diagnoses which have been translated to multiple languages and cross-referenced to other ontologies (e.g. RadLex, SNOMED, LOINC, ICD-10). The data are assembled into a multimedia SR organized by an anatomical hierarchy, but the data can also be displayed in a patient graphic with image icons linked to specific sites of disease (Figure 2).

ViSion provides the ability for a radiologist to link findings from serial exams to create disease timelines showing progression of disease in terms of images and graphed metrics. Furthermore, ViSion can produce a unique "composite" report that displays the most recent



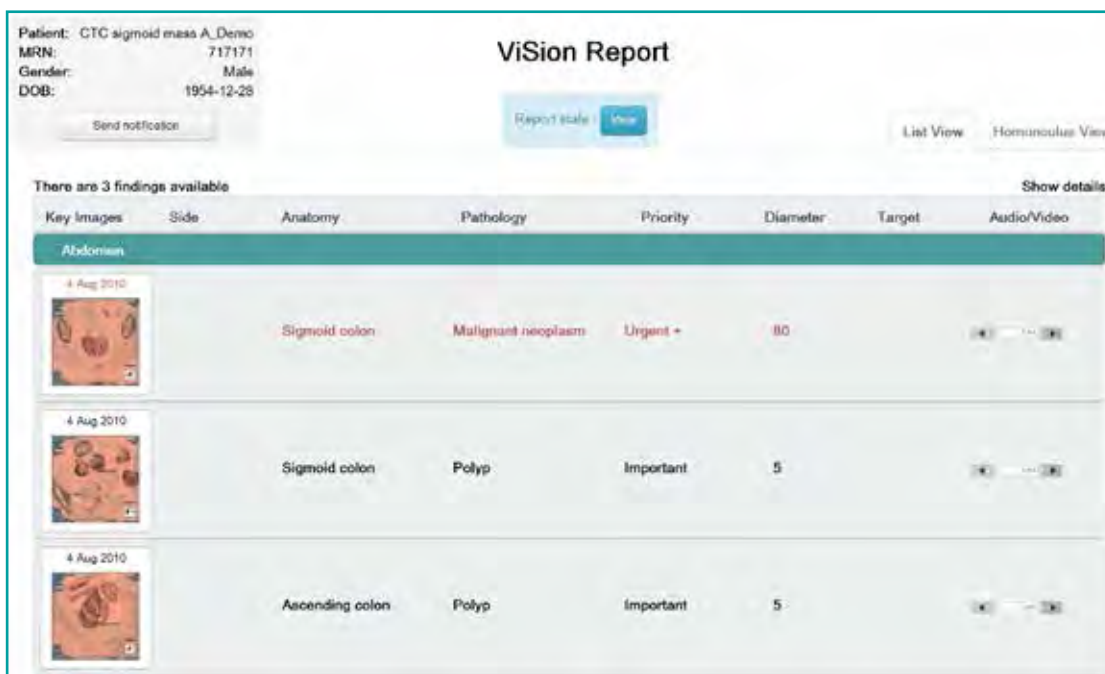


Figure 2: Example of a ViVision report generated in English. In addition to anatomy and pathology labels, metadata tags include a medical priority level, disease metric(s), and target lesion designation. The radiologist's original verbal dictation is accessible in the report, thus providing a radiologist with unlimited freedom for expression

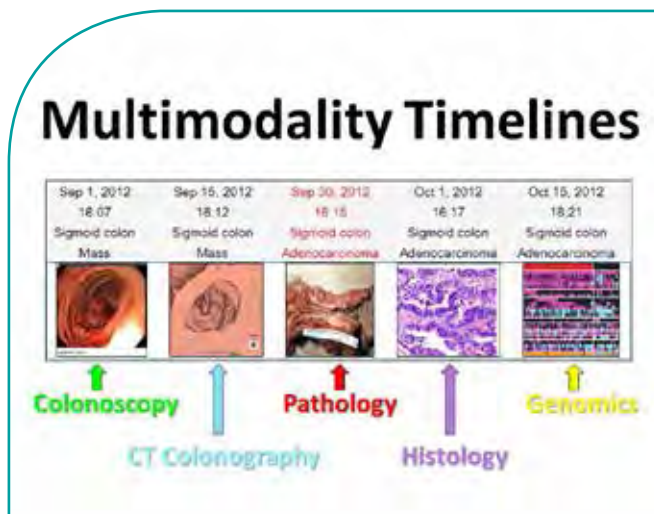


Figure 3: Linking image findings is not limited to radiology but can be applied to other image-based medical disciplines. For example, a colonoscopy image may be linked to CT colonography, pathology, histology, and genomic images. Note in this example how the diagnosis changes from a non-specific entity "Mass" to a more specific diagnosis "Adenocarcinoma" as more specific information is determined

image findings specific to anatomical sites of disease so that a patient's entire radiographic history can be shown in a single view with efficient and accurate access to historical data via the timelines.

The structured data generated by ViVision supports many advanced applications including:

1. Calculation of tumor response criteria, such as RECIST⁽⁶⁾
2. Translation of reports to multiple languages
3. Notification of critical results and recommendations to referring physicians with return receipt verification
4. Quality assurance audit trails to identify when prior examinations have been corrected and/or modified
5. Data mining.

ViVision's simple methodology of using screen captures makes it applicable to any image-based medical discipline (e.g. pathology), and data from different sources can be combined in the timelines to facilitate outcomes analyses (Figure 3).

Summary

The adoption of SR is essential for transforming diagnostic radiology and facilitating several healthcare initiatives. The ViVision system is but one example that has unique capabilities

with global potential to operate in multiple languages. The adoption of structured reporting should increase a radiologist's role and value in the healthcare enterprise.

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Commentary: Digital solutions are a work in progress

There is considerable international interest in the potential of digital solutions to enhance the quality and safety of health care. Standardisation of medical records is not a new challenge, with implementations of transformative technologies underway globally, often at a considerable cost. It is recognised as one of the most rapidly growing areas in health today. Australia's own eHealth is an example of this with the use of information and communication technologies (ICT) for health data recording.¹

It is interesting that ViSion has specifically targeted the storage of images and radiological reports. To suggest that a radiologist 'randomly identifies image findings' underestimates the skill and search strategies employed by radiologists in interpreting images. While the benefit of viewing a patient's data on one page in a timeline sequence is attractive, it still doesn't solve the real issues in radiology service delivery. A timely report being made available to the referring clinician within a clinically useful timeframe would go a long way to improving the health care service delivery and patient safety. That being said, a number of applications offered by ViSion are certainly a step in a positive direction for radiology service delivery. Notification of critical results and recommendations to referring physicians with return receipt verification would be invaluable. This is currently an area of concern for radiologists due to the high incidence of litigation from radiologists not ensuring the referrer has been notified of the

radiological outcomes.

I would be interested to hear whether ViSion will help make the information accessible to the patient, and whether wider concerns of user privacy and confidentiality have been considered. Online security, be it for ViSion or eHealth records, needs to involve the implementation of appropriate safeguards, including appropriate collection and handling of user data, the protection of data from unauthorized access and modification and the safe storage of data.² Social media applications offer only limited safeguards, which is why the notion that ViSion is the "Facebook of medicine" perhaps raises more concerns than it does excitement.

There is a large gap between the postulated and empirically demonstrated benefits of eHealth technologies, owing to a lack of robust research on the risks of implementing these technologies and their cost-effectiveness, despite their appeal to policymakers and "techno-enthusiasts".

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References

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In reply...

I am appreciative of the comments provided above. Regarding a radiologist's "random identification of image findings," the point that I was trying to make is that many structured reporting systems restrict the order by which a radiologist must describe image findings, e.g. the reporting templates of the Radiological Society of North America (RSNA). ViSion, however, allows a radiologist to practice in any manner that he/she desires while simultaneously organizing the data in a universal format. A ViSion report can be delivered as soon as image interpretation is completed thus addressing the need for efficient communication.

The real benefit of ViSion is its ability to improve the continuity of information between serial exams with its disease timeline concept. We will present a paper at this year's annual RSNA meeting in December 2013 showing a lack of continuity in serial radiology reports at our institution, considered to be a world-renowned cancer center. A radiologist will dictate a set of findings, e.g. metastatic tumours, for a baseline exam, but different radiologists will often describe different sets of findings

for subsequent exams, thus creating confusion when clinicians try to determine whether a disease has clearly progressed or responded to therapy. ViSion should assure that the same lesions are followed consistently.

ViSion is currently a prototype but we intend to commercialize it next year. We will certainly address patient privacy and data security issues in a commercial product. The analogy of ViSion being the "Facebook of medicine" was to indicate that it tags key images with metadata, but unlike Facebook, the medical data is not displayed for public consumption. Of course, patients could be given access to their own reports with portals to additional medical information educating them about their diagnoses. Finally, ViSion's ability to aggregate anonymized data could be used to generate public health statistics on a local, regional, or even global scale which could help to shape the future of medicine.

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