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Cartoons for E-Health Informatics

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CARTOONS FOR E-HEALTH INFORMATICS

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Abstract

Not only is Hepatitis B serology often misunderstood because of its complex serological implications, but advances in medical science have revolutionised screening and treatment of hepatitis B. To maximise such evolution however, this new information must be relayed effectively and efficiently to current and future medical professionals. Cartoons have been well regarded as a teaching tool in a variety of different settings as is the use of web based technology. Therefore the delivery of a cartoon based learning tool, accessed via on-line learning modules was considered a novel and potentially effective way of disseminating new knowledge. To increase health professionals' understanding of hepatitis B serology and skill in interpreting the tests that indicate the appropriate treatment, a cartoon series was developed. The cartoons are located on an online educational website and include characters that represent the different antibodies and antigens associated with hepatitis B. The cartoon characters are involved in a series of adventures that represent the various phases of hepatitis B infection, and the paper describes their development. Subsequent research demonstrated that exposure to the online cartoon based learning tool indicates that they are a fun and useful way to increase knowledge.

Keywords

Cartoon, Comic, Illustration, Visual Learning, Internet Learning, E-health, Hepatitis B.

INTRODUCTION

Hepatitis B is a viral infection that causes liver inflammation and can lead to serious illness and death. It is spread through unsafe sex, and activities where blood or body fluids are exchanged. It can also be passed from an infected mother to baby (State Government Victoria: Department of Health, 2013). A safe and effective hepatitis B vaccine has been available since 1982. The Australia Immunisation Handbook recommends that all babies, adolescents and those from high risk groups (e.g. sex industry workers, migrants from hepatitis B endemic countries and prison inmates) be vaccinated against hepatitis B (National Health & Medical Research Council, 2013).

Despite the availability of the hepatitis B vaccine, chronic hepatitis B remains a major public health concern and is the tenth leading cause of death in the world (Lavanchy, 2004). More importantly, it is associated with predictions of an increasing burden of disease from the long-term complications of liver cirrhosis, liver cancer, liver failure and premature death. To determine whether someone has hepatitis B, serological blood tests are performed to determine past infection, current infection, immunity and infectivity of the hepatitis B viruses. The results of these tests determine the treatment regime. Despite remarkable improvements in outcomes from new antiviral drugs, a large proportion of people do not benefit from this because disease detection and referrals for treatment remains suboptimal. Disease prevalence continues to escalate and in Australia over 200,000 people were estimated to have chronic hepatitis B in 2011, with a third of these cases remaining undiagnosed (The Kirby Institute, 2012). Without earlier disease detection and treatment, this number is expected to triple by 2017 (Butler, Korda, Watson, & Watson, 2009; Dev, Nguyen, Munafo, Hardie, & Iacono, 2011).

Unfortunately, the majority of current practising medical practitioners were trained before effective treatments for hepatitis B became widely available. It was only in 2004 that a landmark hepatitis antiviral treatment trial revealed improved long-term outcomes yet a tentative approach to recommended patient selection was taken. (Hoofnagle, 2006). It was not until the 2000's that patients found with positive HBsAg antigens (a serology marker for the presence of acute hepatitis B) were considered "healthy carriers" and active therapy was not usually recommended. It is therefore not surprising that the screening and diagnosis of hepatitis B has not been a high priority for general practitioner (GP) activity (Wallace, McNally, & Richmond, 2007). Clearly early detection and pro-active management of hepatitis B by primary care providers has the potential to improve disease outcomes. A need for improvement in knowledge in hepatitis B has been recognised by GPs (Dev,

Nguyen, Munafo, Hardie, & Iacono, 2011; Guirgis, Yan, Bu, & Zekry, 2011; Wallace, McNally, & Richmond, 2007).

The breadth of general practice activity and the limited time for educational opportunities means that hepatitis B competes with many other important and far more common diseases and health issues. Capturing the attention of GPs and other primary care providers is the first step to further developing knowledge and encouraging a pro-active approach in hepatitis B prevention and management. To this end novel educational methods which will appeal and be remembered, are required. This paper describes one such novel education approach and how this interprets the disease serology for hepatitis B.

E-HEALTH INFORMATICS

It has been shown that health promotion and communication mediated by computers and/or other digital technologies has the potential to encourage preferred behavioural changes (Neuhauser, 2003). Many computer based platforms however are primarily text based and do not address the needs of diverse and varying groups of people (Leask & Wallace, 2011). Graphic-based narratives have been shown to be an effective teaching tool (van Wyk, 2011) and comics have been found to be not only simpler and more appealing than a PowerPoint® presentation but are also more beneficial (Webb, Balasubramanian, O'Broin, & Webb, 2012). Providing education in a relatively low technology format, i.e. embedded into a website rather than video, also ensures that health professionals in rural and remote locations without high speed broadband can access the information quickly. Comics have been around for more than a century and remain a popular entertainment genre even in the electronic age (Wright & Sherman, 2006).

CARTOONS

Cartoons have been used for many years as a valuable teaching aid (Green & Myers, 2010) as they were founded on the dual coding theory that imagery and language combined improves cognitive function and enhanced recall (Clark & Paivio, 1991). Since cartoons have an interactive nature (Gillenwater, 2009; McCloud, 1994) and words are scarce, the reader is forced to interpret the content thereby increasing their involvement and cognitive state (McCloud, 1994). McCloud, referring to the panels between each image as the gutter, suggests that this space allows the reader to integrate with the pictures, converting several pictures into one idea building a relationship between the images. This presents the transition from one image or panel to be more meaningful than when looking at each individual image (McCloud, 1994). Furthermore, several authors have reported that when cartoons are integrated into the curriculum, increased motivation, interest and dialogue are also evident (Green & Myers, 2010; Kovalik & Williams, 2011). Incorporating comics into medical training has been regarded as beneficial (Green & Myers, 2010) with the combination of text and visual images improving comprehension via different processing systems being activated in the brain (Mayer & Sims, 1994) thereby increasing recall of medical information (Houts et al., 1998). Personification of nonhuman entities (such as a virus), and the use of the narrative form encourages learners to use schema-based inferences of how humans behave to understand new concepts (Jee & Anggoro, 2012).

The use of cartoons for education is not new, however, whilst there is some research on the use of cartoons for patient health education ("Cartoons educate," 2011; Houts, Doak, Doak, & Loscalzo, 2006) there is little on its use for continuing medical education of health professionals. The limited research on adult cartoon based learning in medicine and science does however show that it is useful to cater for multiple learning styles particularly when used as part of a broader training environment (Elliott & Misselbrook, 2002; Keogh & Naylor, 1999).

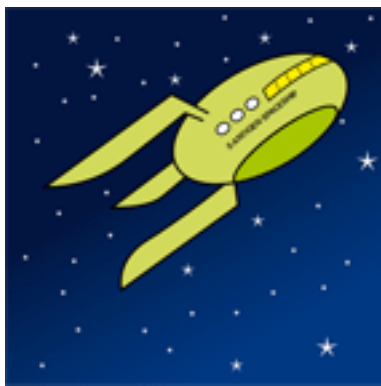
To enrich health professionals' knowledge and communicate advances in treatment regimes, a hepatitis B online training program was developed and hosted at hepatitis.ecu.edu.au. The project, funded by the Sexual Health and Blood Borne Virus Program, Department of Health, WA, is a comprehensive program that incorporates the use of text, illustrations, cartoons, diagrams, tables and case studies. The concept of a cartoon based learning tool (CBL) was initiated by two of the authors (MS and EK), both general practitioners, who recognised that hepatitis B serology is a confusing concept and difficult to remember, and therefore not always understood in the primary healthcare setting. As noted in the literature (Luccasen, Hammock, & Thomas, 2011), cartoons (and other multimedia examples) are a novel and potential medium to convey these difficult concepts and as an adjunct to the traditional text. The cartoons were developed to visualise the stages of infection and as an aide memoire. These can be accessed at <http://hepatitis.ecu.edu.au/hepb/cartoons/index.php>.

This research was not designed to undertake a comparison of online learning based methods with traditional learning methods, but used a previously proven methodology based on similar work by the authors. The intent was to design the cartoons and then test the knowledge levels before and after using the tool.

The characters

Each character represents one of the components of hepatitis B serology. Whilst there are a number of concepts to understand, the use of characters representing each component allows the reader to synthesise the image with the name and serological marker, ultimately simplifying the concepts. The use of colourful illustration and humour are designed to encourage engagement in a serious medical issue. The selection of Sci-Fi characters was based on their universal recognition, non-offensive nature, ease of understanding, and gender neutrality.

The story line is a classic tale of good versus evil; alien invaders try to subdue vulnerable, yet resistant earthlings. The characters are divided into two main groups; as aliens depicting a foreign body and as earth depicting the human body and its immune system.



The bad guys

First there are the alien forces that represent the antigens in the hepatitis B virus. The alien spaceship (Figure 1) represents the antigen HBsAg where 's' stands for 'spaceship'. The spaceship (antigen HBsAg) depicts the first sign of alien forces (hepatitis B virus) in the body. As this antibody is encountered at the onset of acute infection, the success of the body's response will determine if this spaceship is destroyed preventing the alien forces from further invasion, or allowing it to remain and invade. The presence of HBsAg means that the virus is in the body.

Figure 1: Spaceship belonging to aliens

The commander of the aliens represents the antigen HBcAg (Figure 2) and portrays an evil character. Again 'c' stands for commander for easy reference. There is no laboratory test for HBcAg. Since this antigen cannot be detected and measured in serum, the commander hides behind a mask. Behind any hepatitis B infection, the masked commander is always present, silently commanding his troops (hepatitis B viruses).



Figure 2: Commander of aliens



Figure 3: Enemy alien soldiers

HBeAg is represented by enemy ('e') alien soldiers (Figure 3) and the power of the aliens. As with their commander, they are presented as evil characters. The presence of enemy soldiers (HBeAg) signifies invasion and high levels of infection. Its presence is a bad sign that the infection is out of control in the body. The more successful the enemy soldiers are in spreading out on earth, the sooner war erupts and chaos is seen on earth. The objective is for earth to find a way to suppress and destroy HBeAg.

The good guys



Figure 4: Special Airforce

The second group of hepatitis B serology is the antibodies and these are represented by earth forces which must come to the rescue.

The special air force (Figure 4), (representing anti-HBs which are a protective antibody) is earth's first line of defence. It is capable of destroying the spaceship and where successful, they can prevent the enemy soldiers from spreading out causing devastation. The presence of anti-HBs means that the body is immune to hepatitis B, either following successful vaccination or a strong recovery after an infection.



Figure 2: Commander for Earth

The earth's commander (Figure 5) (representing anti-HBc) is always present when alien forces are detected. The character depicts a useless figurehead, the stereotypical politician who comes out for the press conference and is all words and no action. He comes out to have 'peace talks' with the commander of the aliens invades but his words fail and he is incapable of protecting earth. Despite this he hangs around for a long time. The presence of anti-HBc signifies that a real infection has occurred either in the present time or in the past.



Figure 6: Earth rebel fighters

Earth resistance fighters (Figure 6) represent anti-HBe and is the last resort to save earth if the enemy has evaded the earth's airforce. These characters are portrayed as courageous insurgents and when they emerge over a period of time, effective change occurs (providing an immune response). When the earth's rebel fighters (anti-HBe) destroy the enemy (HBeAg) a significant win is celebrated (seroconversion).

By highlighting the good, the bad and the ugly (Figure 7), the cartoon characters have a real representation of not only life but also a serological perspective of the disease as it changes. The good and bad guys are self-explanatory. The ugly refer to the damage caused by the infection, as measured by the liver function tests (LFT).

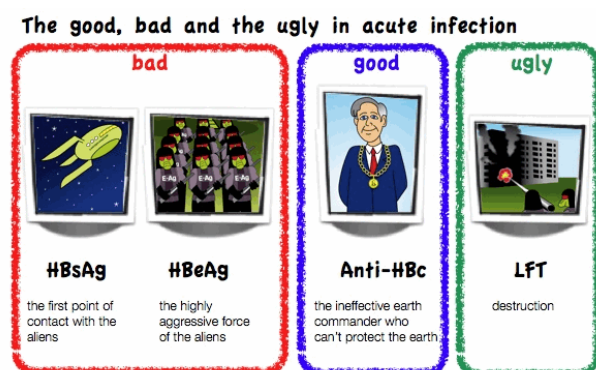


Figure 7: The good, the bad and the ugly in acute infection

The cartoon characters were then embedded into a series of stories, or comic strips to explain the different stages of the disease. The story lines also demonstrate potential developments should a particular path be followed, for instance resolved infection, deterioration into chronic infection (Figure 8) or how immunisation can prevent hepatitis (Figure 9).

The comic strip shown in Figure 8 highlights the facts that the spaceship (HBsAg), enemy forces (HBeAg) and earth's commander (anti-HBc) are always present in phase 1 of chronic infection. Earth rebel fighters (Anti-HBe) are not present at this stage so there is no effective response and therefore the virus is coexisting with the host.

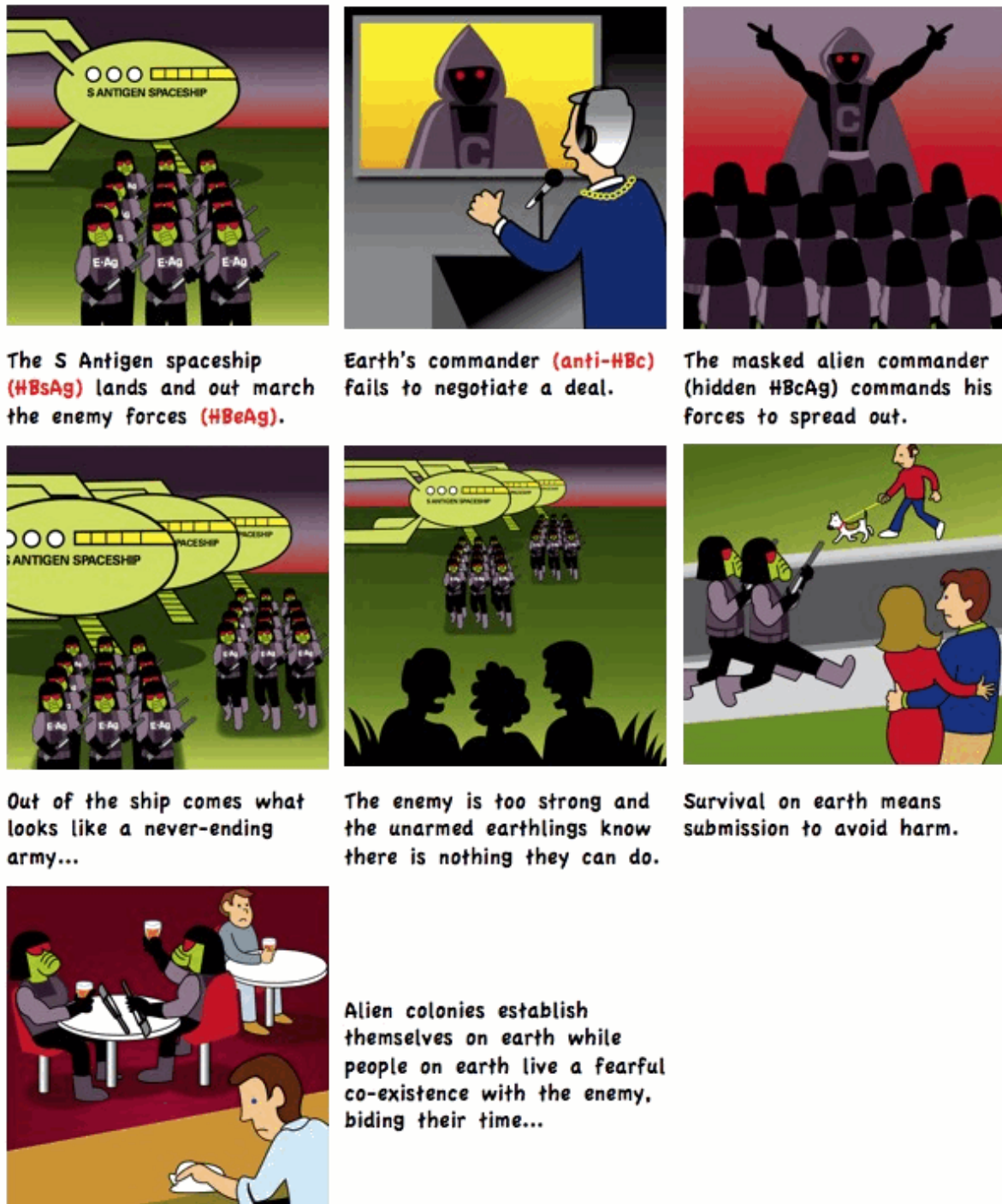


Figure 8: Phase I of Chronic hepatitis B infection

In figure 9 the mechanics of hepatitis B immunisation have been developed into a comic strip to portray how the special airforce (Anti-HBs), protects the earth (body) from future attacks of the hepatitis B virus. The main

focus of the comic strip is the special airforce, which on recall will be associated with immunisation and resolved infection.

A simulation of the real event - since prevention is better than cure!

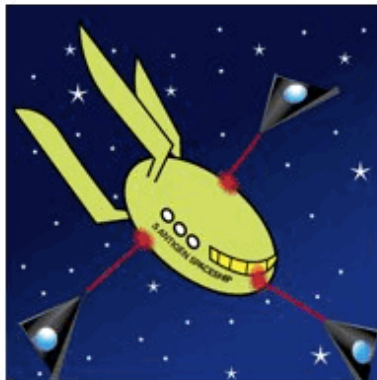
To make sure that this invasion never happens again regardless of which part of earth the spaceship heads towards, earth forces simulate an alien spaceship to practise their response...



The approach of the simulated spaceship is detected by the earth's radar systems.



The earth's special airforce (anti-HBs) are galvanised into action and board their aircraft to defend the earth.



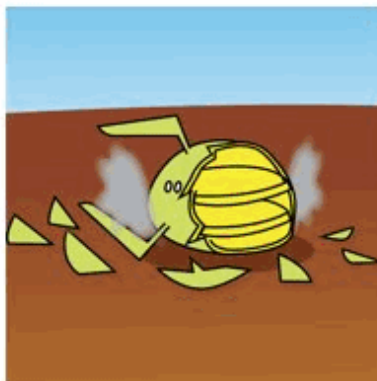
The special airforce crew fire at the spaceship.



They have hit the target! Could the mission be successful?



Yes! Practice makes perfect. The spaceship plunges to the ground.



The destroyed spaceship is no threat.

Saved by our heroes from the special air force, now on the alert and patrolling the skies. Spaceships who will be no match for them!



Figure 9: Immunisation

Subsequent assessment

Whilst not reported in detail in this paper, to examine the impact that the cartoons had on improving health professionals' knowledge of hepatitis B serology, a retrospective study was undertaken. From the online hepatitis B program, 718 pre-tests were completed prior to exposure of the CBL tool and 361 post-tests completed following the CBL tool. The pre and post-tests were identical and consisted of ten questions relating to the serology of hepatitis B including viral specific antigens and antibodies, having to ascertain the most

appropriate test required, the stages and phases of infection and interpreting results based on realistic case studies. Two of the authors (MS and EK), with over 48 years of combined experience in medicine, established the content and reliability of the test. On completion of the post-test, participants were invited to provide a written response of comments and suggestions relating to the cartoon based learning tool. An analysis of the pre and post test results revealed a substantial increase in hepatitis B serological knowledge suggesting that the CBL tool was successful, aligning with the proposition that cartoons are a valuable teaching aid. Furthermore, the large number of participants that voluntarily completed the module indicates that comics can be effectively conveyed through an on-line learning programme. The success of any learning program often correlates with participant's attitudes (Wong, Greenhalgh, Westhorp, & Pawson, 2012) and since feedback was predominantly positive, we can propose that the CBL tool is a fun, interesting and useful way to increase knowledge.

CONCLUSION

The development and design of story-telling using cartoons was used to explain the serology of Hepatitis B. The resultant cartoon based learning tool was embedded into the hepatitis on-line training program to simplify the complexities of hepatitis B serology. Subsequent research, reported elsewhere, indicates that health professionals' knowledge can be increased and positively reinforced in regards to this important disease. Indeed, the results suggest that cartoons, delivered on-line are an effective teaching aid and provide a novel educational method that will improve hepatitis B serological knowledge amongst health professionals, ultimately maximising the availability of highly effective hepatitis antiviral treatments.

What is innovative about this particular research is that the use of cartoons is not common in health for education of health professionals. The concept of cartooning for adult education is also not new, although not widely used. It is perhaps the cultural aspects of traditional and professional learning that has prevented the technique being more widely used for continuing medical education. However, as a learning style, cartoons cross several boundaries and in particular that of reinforcing other traditional methods of learning. Further, it certainly supports the constructivist approach to education. Whilst most commonly associated with humour, the cartoons developed in this research are conceptual cartoons that also include humour and are used as an alternative to the traditional methods of information transfer.. The cartoons demonstrated in this paper are associated with visual stimuli to clearly delineate between the differences in serology and therefore making it easier to identify infection markers, appropriate immunisation, and suitable testing-treatment regimes.

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