ORIGINAL ARTICLE

A Report on "the first Concept Map Design Contest on Infection Prevention and Control"

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Background: Educational achievement is highly important in the higher education and universities' system in all countries. Critical thinking and problem solving skills are the main outcomes of higher education and the accreditation criteria. Happiness is one of the fundamental emotions of human beings that has a crucial role in the health of individuals and society. It could be the catalyst and facilitator in the development of critical thinking. The purpose of the present study was to compare critical thinking skills and happiness among the students of different universities.

Methods: This is a descriptive analytical study conducted on 244 students of different universities of Ghaen that entered the study by multistage cluster sampling. Rytas questionnaire of critical thinking 2003 and Oxford Happiness questionnaire were used and the data were analyzed by SPSS (ver. 14), Pearson's correlation, independent t-test, and ANOVA and the statistical significance level was 0.05.

Results: 163 participants (66.8%) were male and 81 students (33.2%) were female. The results presented that there is a significant difference between the mean of critical thinking and happiness among the students based on universities (p 0. 05). Furthermore, there is a significant difference between critical thinking and happiness (r=0. 246).

Conclusions: Educational programmers should concern critical thinking and the methods to upgrade it. Moreover, the teachers should use new teaching methods in the curriculum in order to increase happiness in the students.

Keywords: Critical thinking, Happiness, Students

تقرير عن "اول مسابقة للرسوم والمخطوطات التعبيرية في موضوع التحكم و الوقاية من العدوى"

المقدمة: الرسوم التعبيرية ليست فقط طريقة للتأثير في التعليم ولكنها طريقة لتقييم التعليم أيضاً . لقد بينت بعض الدراسات أن الرسوم يمكنها أن تزيد من مهارة النقد الفني والتقييم السريري وأيضاً لها دور في تحسين طرق الوقاية و التحكم بالعدوى وفي النهاية تقليل انتقال العدوى ضمن الانظمة الصحية والعلاجية والمتمثلة بالمشافي وغيرها.

الوسائل: أقام مجموعة من الطلبة في فرع ميكروبيولوجي التابع لكلية الطب في جامعة مشهد وللأول مرة في إيران في عام 2015 مسابقة علمية في المخطوطات و الرسوم التعبيرية في مجال مكافحة العدوى في النظام الصحي العلاجي المتمثل بالمشافي وغيرها وقد طلب من المحققين والطلبة ارسال رسومهم التعبيرية في ما يتعلق بالسؤال التالي (كيف بالإمكان تقليل العدوى المنتقلة في النظام الصحى العلاجي؟)

تم استلام 40 رسم وكان 29 منها يستوفي الشروط للاشتراك بالمسابقة . و قد تم تقييم الرسوم حسب معايير Novak and Cronin's scoring (مع إجراء بعض التعديلات عليها) .

النتائج: من بين 29 رسم تعبيري تم حصول 4 رسومات على أعلى علامة حسب معيار التقييم المطروح وقد طرحت هذه الرسومات أفكار جديدة في ما يتعلق بالوقاية والتحكم بالعدوى . كل الرسوم والمخطوطات موجودة على الرابط التالي
https://goo.gl/8IEA7i

النتيجة: كانت هذه التجربة دليل على أن هناك دور مؤثر للرسوم التعبيرية في ما يتعلق بالتحكم و الوقاية من العدوى .

وهذه الطريقة تعتبر طريقة سريعة لجرة تعليم الأمور الضرورية .

الكلمات الدليلية: رسم تعبيري ، الوقاية والتحكم بالعدوى ، التعليم الطبي ، إيران

گزارشی از اولین مسابقه نقشه مفهومی در ارتباط با کنترل و پیشگیری از عفونت

مقدمه: نقشه های مفهومی به طور کلی نه تنها به عنوان یک روش تاثیر گذار در یادگیری بلکه به عنوان یک روش ارزیابی کیفیت یادگیری نیز مطرح شده اند. برخی بررسی ها نشان داده اند نقشه های مفهومی با افزایش مهارت های تفکر نقادانه و قضاوت بالینی نقش مهمی در بهبود اجرا و پایبندی به راهکارهای پیشگیری از عفونت و نهایتاً کاهش عفونت های ناشی از سیستم بهداشتی- درمانی می شود.

مواد و ابزارها: گروه تحقیقاتی دانشجویی میکروبیولوژی دانشکده پزشکی مشهد برای نخستین بار درکشور، در دی ماه 1394 رقابت علمی طراحی نقشه های مفهومی را برگزار کرد و از محققین و دانشجویان سراسر کشور درخواست نمود جهت شرکت در این رقابت نقشه های مفهومی خود را در پاسخ به این پرسش هدفمندکه "چگونه می توانیم عفونت های ناشی از سیستم بهداشتی- درمانی را کاهش دهیم؟" ارسال نمایند.

چهل نقشه مفهومی دریافت شد که 29 مورد واجد معیارهای شرکت در رقابت بودند. تمامی نقشه های مفهومی بر اساس معیارهای Novak and Cronin's scoring (با کمی تغییرات) مورد ارزشیابی و داوری قرار گرفتند.

نتایج: از میان 29 نقشه مفهومی دریافت شده، 4 مورد که بالاترین امتیاز را بر اساس سیستم ارزشیابی مذکور کسب نموده و همچنین ایده های جدیدی را در رابطه با پیشگیری و کنترل عفونت مطرح نمودند به عنوان طرح های برگزیده انتخاب شدند. تمامی نقشه های مفهومی در آدرس https://goo.gl/8IEA7i قابل دسترسی هستند.

نتیجه گیری: تجربه جاری حاکی از نقش امیدوار کننده و تأثیر گذار نقشه های مفهومی در راستای پیشگیری و کنترل عفونت در سیستم بهداشتی- درمانی می باشد و این روش به عنوان یک طرح سریع و آسان جهت آموزش و یادگیری مباحث مطرح شده پیشنهاد می شود.

کلمات کلیدی: نقشه مفهومی، پیشگیری وکنترل عفونت، آموزش پزشکی، ایران.

عفونت کو کنٹرول اور اس سے بچاو کے سلسلے میں مفہومی منصوبوں کی تیاری کے بارے میں ایک رپورٹ

بیک گراونڈ: مفہومی منصوبے نہ صرف حصول علم میں موثر ہوتے ہیں بلکہ تعلیمی روشوں کا جائزہ لینے کے لئے نہایت اہمیت رکھتی ہیں۔بعض تحقیقات سے پتہ چلتا ہے کہ مفہومی منصوبے عفونت سے بچنے اور نتیجے میں عفونت میں کمی لانے میں نہایت موثر ثابت ہوتے ہیں کیونکہ یہ ڈاکٹروں کو مرض کا پتہ لگانے اور کلینیکل تشخیص میں مدد دیتی ہیں۔

روش: مشہد فیکلٹی آف میڈیسن میں مائکرو بایولوجی میں طلباء کے تحقیقاتی گروہ نے دوہزار پندرہ میں مفہومی منصوبے بنانے کا علمی مقابلہ رکھا، اس مقابلے میں ملک کے تمام محققین اور میڈیکل طلباء کو دعوت دی گئی تھی کہ وہ اس سوال کے جواب میں کہ ' حفظان صحت کے اصولوں اور علاج معالجی کی روشوں میں عفونت کو کس طرح سے روکا جاسکتا ہے ؟ اپنی نظریات ارسال کریں۔ اس دعوت کے بعد چالیس جوابات موصول ہوئے جس میں انتیس جوابات معینہ معیارون پر اترتے تھے ، مفہومی منصوبوں کا نواک اینڈ کرونز اسکورنگ کے ذریعے تجزیہ کیا گیا۔

نتیجے: موصولہ انتیس جوابات میں سے چار کو سب سے زیادہ نمبر ملے تھے، ان میں عفونت کو کنٹرول کرنے کے لئے نئے نظریات پیش کئے گئے تھے۔ان چار جوابوں کو بہترین منصوبوں کی حیثیت سے چنا گیا۔یہ سارے منصوبے آپ کو http//goo.gl/81EA7i پر دیکھے جاسکتے ہیں۔

سفارش: موجودہ میڈیکل اور حفظان صحت کے میدان میں حاصل تجربی سے یہ ثابت ہوتا ہےکہ مفہومی منصوبے موثر واقع ہوئے ہیں اور ان سے میڈکل نصاب کو بآسانی اور تیزی سے مکمل کیا جاسکتا ہے، اسی بنا پر ان مفہومی منصوبوں کو اپنانے کی سفارش کی جاتی ہے۔

کلیدی کلمات : مفہومی منصوبے، عفونت ، کنٹرول کرنا

INTRODUCTION

Concept maps (C-maps), developed by professor Novak and his team, are graphical tools designed to facilitate the process of organizing, representing, and learning different aspects of knowledge. The theory underlying the C-maps is based on the learning psychology of David Ausubel which states that learning transpierces by the assimilation of new ideas and conceptions into existing cognitive structure of the learner (1).

Concept maps are efficient tools for learning and creating knowledge which try to answer a focus question and are comprised of two pivotal parts: 1. *Concepts* (perceived regularities in events/objects designated by labels); and 2. *Propositions* (statements about some objects or events in the universe, either naturally occurring or constructed) (2).

Based on many studies performed on infection prevalence, despite the presence of different guidelines and measures for infection prevention, healthcare-associated infections (HAIs) are still considered a major peril for patients. One of the key concerns in this regard is the compliance of healthcare workers (HCWs) with preventive methods and strategies. Studies have shown that the length of healthcare experience has a negative correlation with the adherence to preventive measures, and suggested that participating in educational interventions may increase the adherence (3).

Concept maps are considered not only as a powerful method of meaningful learning, but also as an instrument for evaluating the efficiency of learning and accuracy of thinking process. In recent years, concept maps are being employed mostly as tools for planning and evaluation of healthcare services. Different inquiries suggest that concept maps by promoting critical thinking and clinical reasoning may play a significant role in increasing adherence to infection prevention methods and therefore reduce healthcare-associated infections (4). Based on this idea, we held "the First Concept Map Design Contest on Infection Prevention and Control" with two goals. Our first goal was to promote infection prevention and control (IPC) basics and to motivate people, especially students in different healthcare associated fields to expand their knowledge on IPC and our second goal was to obtain new ideas on IPC in order to find new solutions for healthcare-associated infections prevention. In this paper, we aim to discuss our experiences of this contest.

METHODS

In January 2015, Mashhad Medical Microbiology Student Research Group (MMMSRG) invited all academics from all over Iran, especially students, who were interested in infection prevention and control, to design concept maps trying to answer this focus question: "How can we reduce the Healthcare-associated Infections?"

We received about 40 concept maps, from which 29 met our inclusion criteria:

1. C-maps were preferred to be designed in English.
2. C-maps should have contained at least one of the 5 basic concepts of infection prevention and control (including: 1-CDC standard precautions, 2-Hand hygiene, 3-Isolation standards, 4-Environmental cleaning and 5-Surveillance).
3. All concepts and links should be referenced appropriately (According to the Vancouver referencing style).
4. All C-maps should be designed as 100 * 70 cm landscape posters.
5. Approved fonts were: Times New Roman, Calibri, Arial and Arial Black (font size should be at least 35 pt.)
6. The logos of 'The first International Congress on Prevention Strategies for Health care-associated Infections' and 'The first Concept Map Design Contest on Infection Prevention and Control' should be included.
7. The author's affiliation and e-mail should be mentioned in the poster.
8. All the references should be mentioned separately at the end of the poster.

All the attendees presented their C-maps on April 14th and 15th as posters during a poster section in the "First International Congress on Prevention Strategies for Healthcare-associated infections". All the C-maps were judged based on the designed rubrics, which were adapted from Novak (5) and Cronin's (6) scoring criteria with some modifications (Table 1).

Table 1. The grading rubrics of the first Concept Map Design Contest on Infection Prevention and Control			
Inclusion Criteria			
Is the Presenter in attendance?	Yes □	No □ (- 5 points)	
The C-map contains at least one of the 5 basic concepts of infection prevention and control*?	Yes □ (+ 0.25 points for each more; + 1 if all the 5 concepts are mentioned)	No □ (- 2 points)	*including: 1. CDC standard Precautions 2. Hand Hygiene 3. Isolation Standards 4. Environmental cleaning 5. Surveillance
Are Concepts and links referenced appropriately? Are Hypothetical links specified with a symbol or a color?	Yes □	No □ (- 0.5 points for each link without a reference*)	*If the reference is mentioned in a higher segment and the lower links are adopted from that reference, No negative points should be given.
The map contains hypothetical valid links?	Yes □ (+2 point for each)	No □	

Table 1. Continued			
Inclusion Criteria			
At most 5 references are used?	Yes □	No □ (-0.25 points for each more)	*+0.5 points for each reference after 2013
At most 30 nodes are used?	Yes □	No □ (-0.25 points for each more)	
C-map Construction			
Concepts *are objects, events, or properties of things that are designated by a label or symbol	*How many?* *Score 1 point for each concept		
Propositions *Is the relationship between two concepts indicating by a connecting line and linking words?* *Is the relationship valid?*	*How many?* *For each meaningful, valid proposition shown, score 1 point		
Hierarchy *Does the map show hierarchy?* *Is each subordinate concept more specific and less general than the concept drawn above it?*	*How many?* *Score 5 points for each valid level of the hierarchy.*		
Cross links *Does the map show meaningful connections between one segment of hierarchy and another segment?	*How many?* *Score 10 points for each cross link that is both valid and significant, and 2 points for each cross link that is valid but does not illustrate a synthesis between sets of related concepts or propositions.*		
Examples	*How many?* *1 point for each specific event or objects that are valid instances of those designated by the concept label.*		
C-map Design			
Is the poster in English?	Yes □ (+2 Points)	No □	*Negative points should be allotted if there are grammatical mistakes.
Appropriate Fonts (size and Format)	Score from 1 to 5		
Appropriate color	Score from 1 to 5		
Concepts and links are clearly illustrated?	Score from 1 to 5		
References are mentioned in a separate box, numbered and in Vancouver style	Yes □	No □ (-2 points)	
The poster number is mentioned in the right upper corner of the poster	Yes □	No □ (-0.5 points)	

Adapted and Modified from: (Cronin, P. J., Dekker, J., Dunn, J. G. (1982). A procedure for using and evaluating concept maps. *Research in Science Education*, *12*(1), 17-24.) **And** (Novak, J. D., & Gowin, D. B. (1984). *Learning how to learn*. New York: Cambridge University Press.)

RESULTS

We received about 40 concept maps from different parts of Iran. Among the accepted concept maps, four maps, which had achieved the most scores and proposed some new ideas in infection prevention and control were chosen as the best concept maps (Figure 1-Figure 4).

All the C-maps presented in the first Concept Map Design Contest on Infection Prevention and Control are available in https://goo.gl/8IEA7i.

DISCUSSION

Finding the optimal learning method in education and science is not a new challenge in teaching-learning process (7). There are many teaching methods including lectures, discussions, Jigsaw puzzle maps, flashcards, media, role-playing and concept maps, which facilitate the learning process. C-maps have a great potential to lead the students
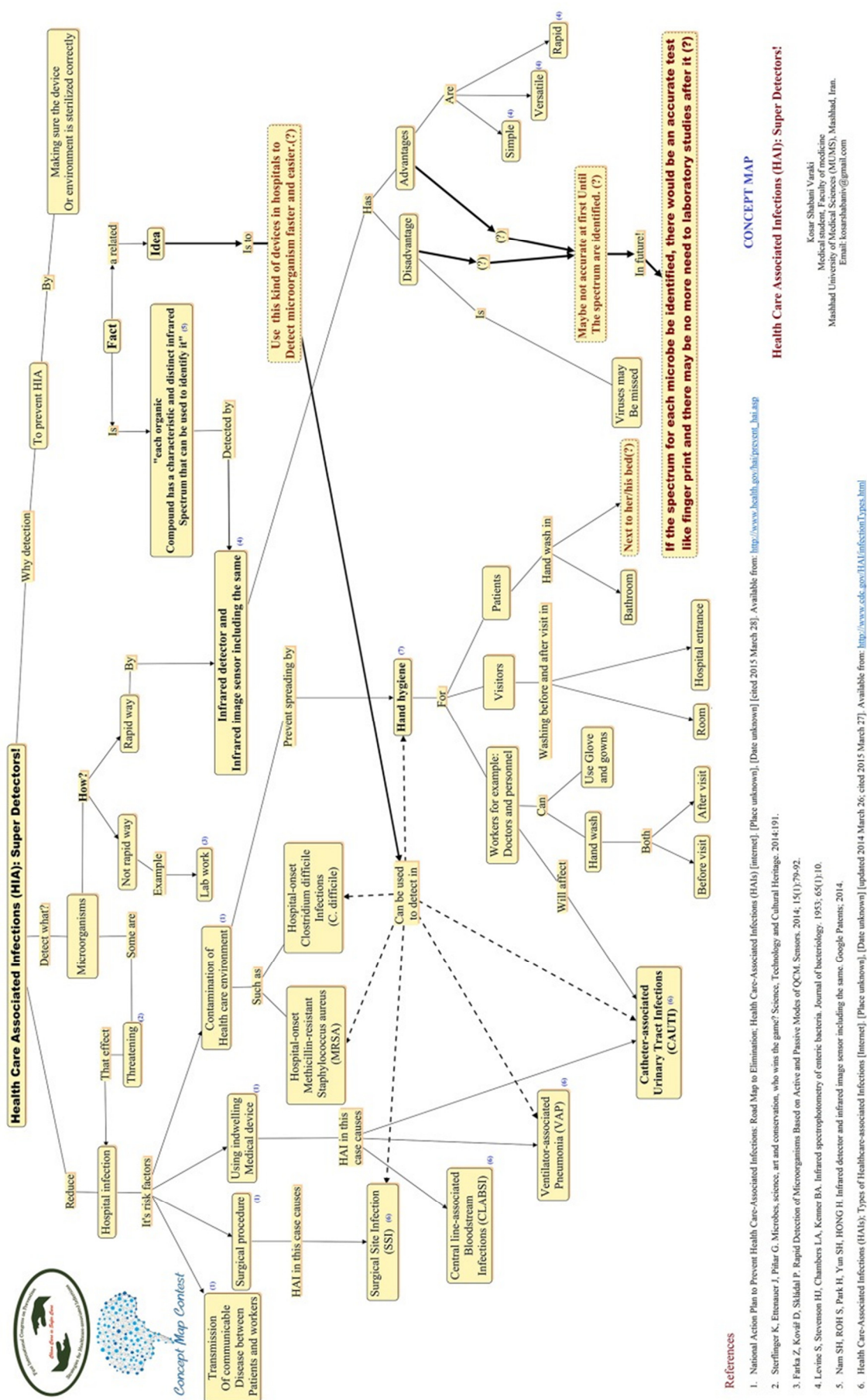
Health Care Associated Infections (HIA): Super Detectors!

Making sure the device Or environment is sterilized correctly

By

To prevent HIA

Why detection

a related — Idea — Is to

Fact

Is

"each organic Compound has a characteristic and distinct infrared Spectrum that can be used to identify it" (5)

Detected by

Use this kind of devices in hospitals to Detect microorganism faster and easier. (?)

Has

Advantages — Are — Rapid (4) / Versatile (4) / Simple (4)

Disadvantage

Is

(?) — (?) — Maybe not accurate at first Until The spectrum are identified. (?)

In future!

If the spectrum for each microbe be identified, there would be an accurate test like finger print and there may be no more need to laboratory studies after it (?)

Viruses may Be missed

Next to her/his bed(?)

Infrared detector and Infrared image sensor including the same (4)

By

Rapid way

How?

Not rapid way

Example — Lab work (3)

Detect what?

Microorganisms

Some are

That effect — Threatening (2)

Hospital infection

Reduce

It's risk factors

Contamination of Health care environment (1)

Such as

Hospital-onset Clostridium difficile Infections (C. difficile)

Hospital-onset Methicillin-resistant Staphylococcus aureus (MRSA)

Prevent spreading by

Can be used to detect in

Hand hygiene (7)

For

Patients

Visitors

Workers for example: Doctors and personnel

Washing before and after visit in

Hand wash in — Bathroom

Hospital entrance

Room

Can

Use Glove and gowns

Hand wash

Both — After visit / Before visit

Will affect

Using indwelling Medical device (1)

Surgical procedure (1)

HAI in this case causes

HAI in this case causes

Surgical Site Infection (SSI) (6)

Central line-associated Bloodstream Infections (CLABSI) (6)

Ventilator-associated Pneumonia (VAP) (6)

Catheter-associated Urinary Tract Infections (CAUTI) (6)

Transmission Of communicable Disease between Patients and workers (1)

Concept Map Contest

CONCEPT MAP

Health Care Associated Infections (HAI): Super Detectors!

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References

1. National Action Plan to Prevent Health Care-Associated Infections: Road Map to Elimination. Health Care-Associated Infections (HAIs) [internet]. [Place unknown], [Date unknown] [cited 2015 March 28]. Available from: http://www.health.gov/hai/prevent_hai.asp

2. Sterflinger K, Ettenauer J, Piñar G. Microbes, science, art and conservation, who wins the game? Science, Technology and Cultural Heritage. 2014:191.

3. Farka Z, Kovář D, Skládal P. Rapid Detection of Microorganisms Based on Active and Passive Modes of QCM Sensors. 2014; 15(1):79-92.

4. Levine S, Stevenson HJ, Chambers LA, Kenner BA. Infrared spectrophotometry of enteric bacteria. Journal of bacteriology. 1953; 65(1):10.

5. Nam SH, ROH S, Park H, Yun SH, HONG H. Infrared detector and infrared image sensor including the same. Google Patents; 2014.

6. Health Care-Associated Infections (HAIs); Types of Healthcare-associated Infections [Internet]. [Place unknown], [Date unknown] [updated 2014 March 26; cited 2015 March 27]. Available from: http://www.cdc.gov/HAI/infectionTypes.html

7. Boyce, J.M. & Pittet, D. Guideline for Hand Hygiene in Health-Care Settings Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. MMWR. October 25, 2002: 51(RR-16): [inclusive page numbers].

Figure 1. Healthcare-associated Infections: Super Detectors: a Concept Map; designed by Kosar Shabani Varaki
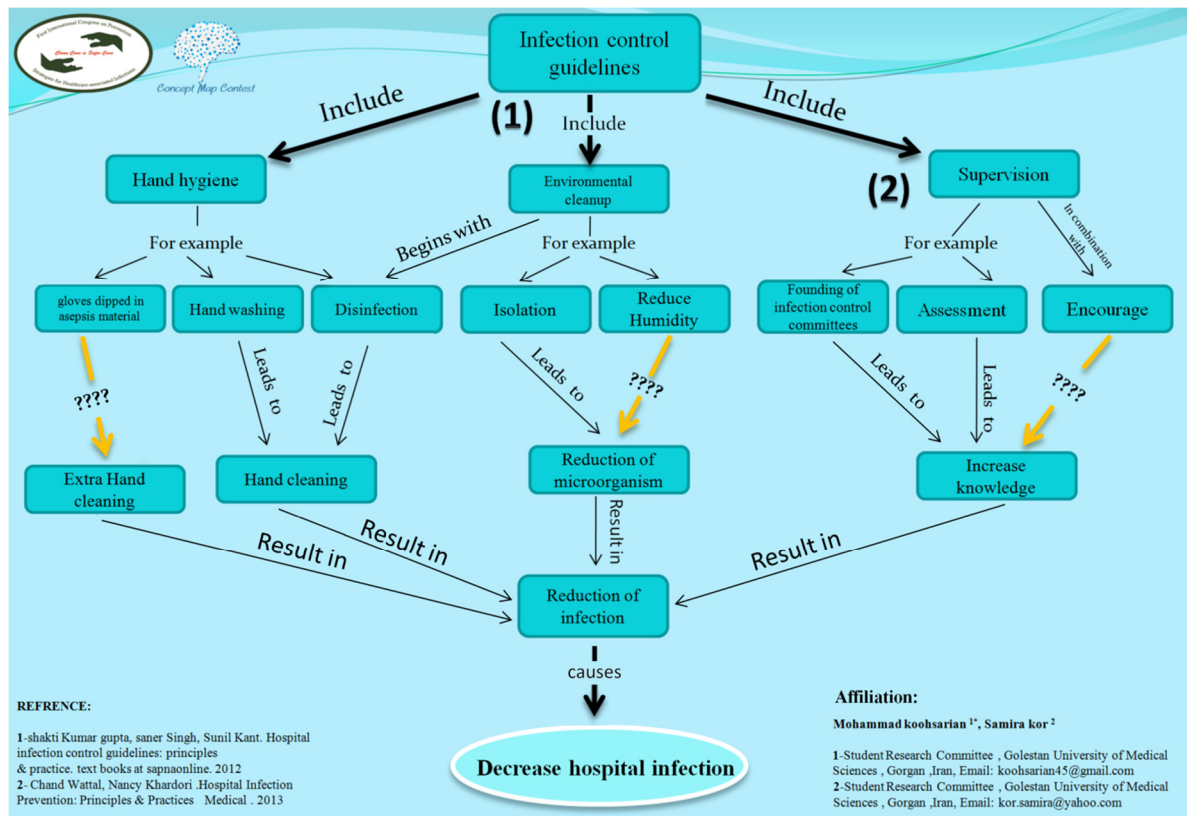
Figure 2. Infection Prevention and Control: a Concept Map; designed by Mohammad Koohsarian and Samira Kor

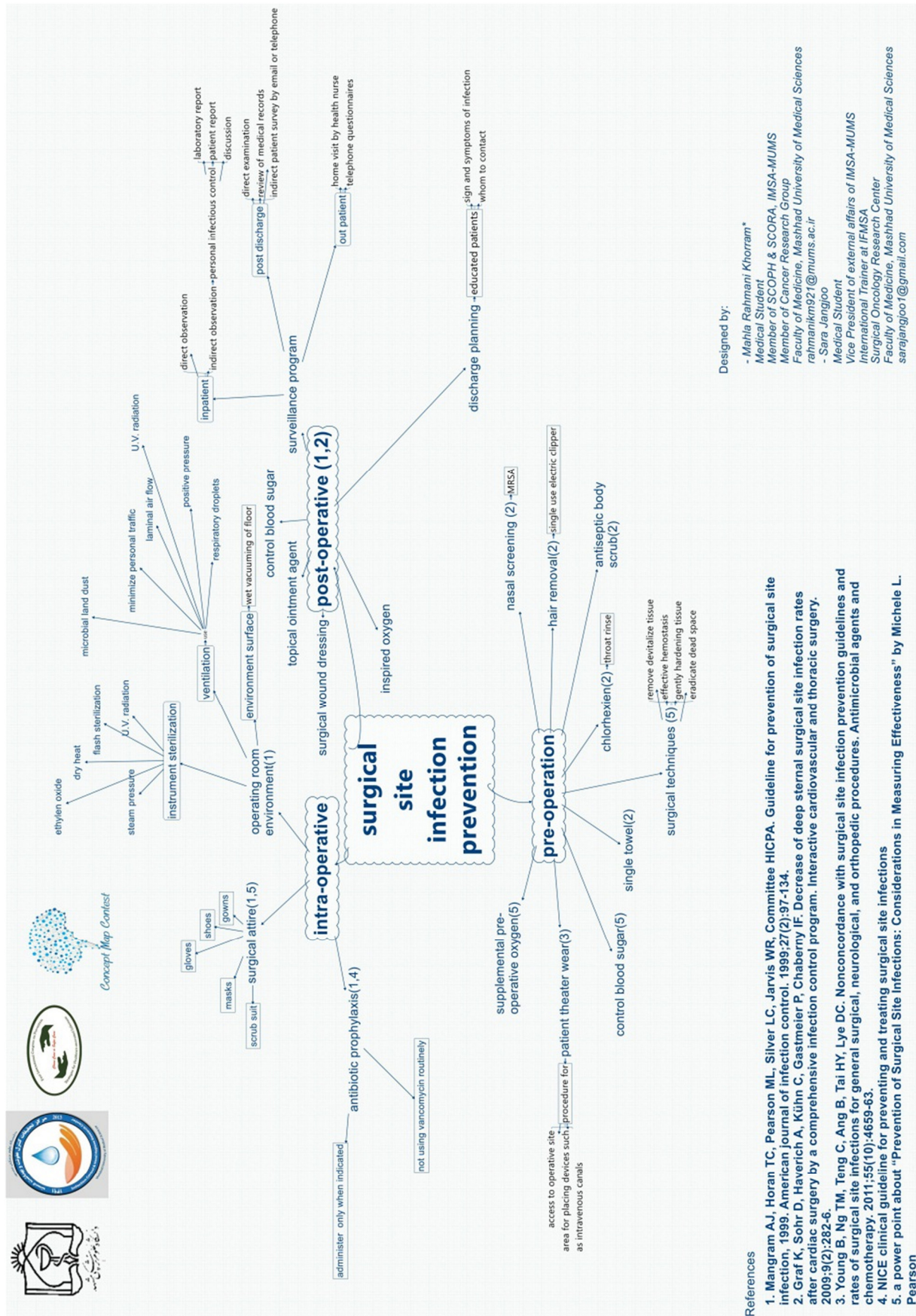**Figure 3. Strategies for Effective Hand Hygiene: a Concept Map; designed by Alizadeh M et al.**
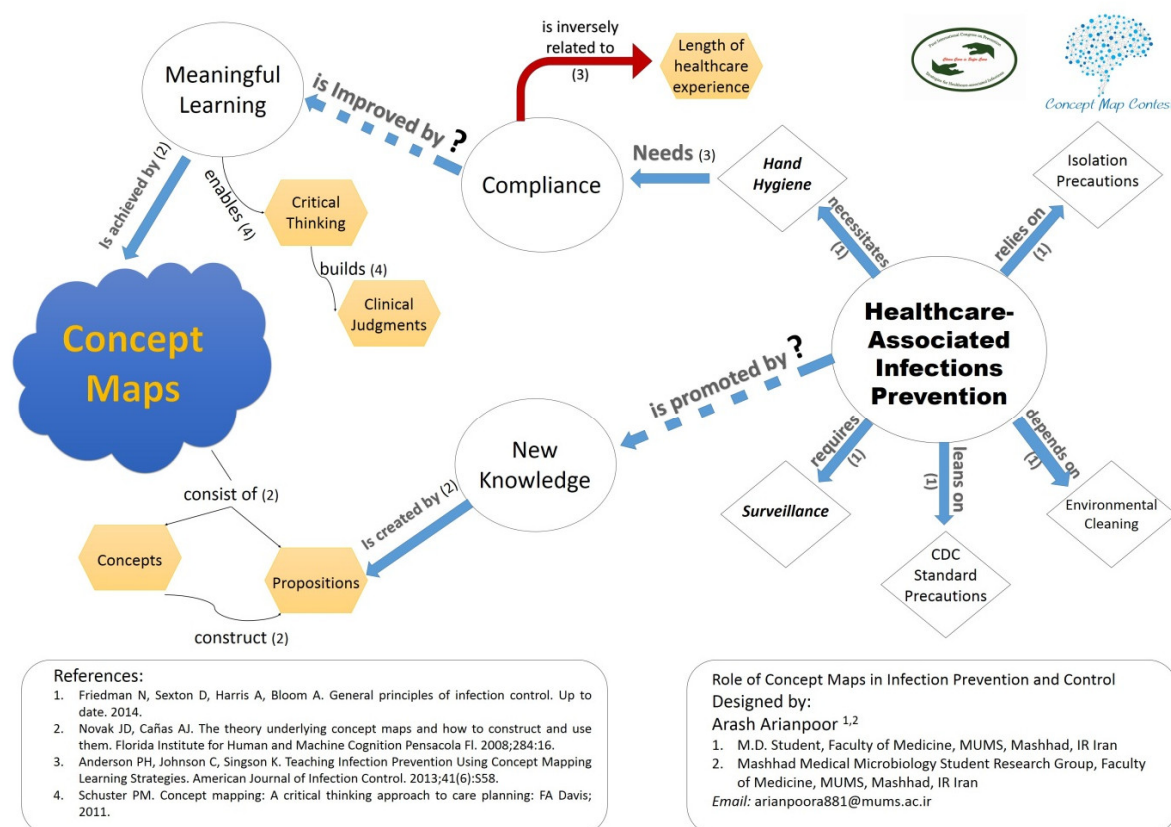
Figure 4. Surgical Site Infection Prevention: a Concept Map; designed by Mahla Rahmani and Sara Jangjoo

References

1. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR, Committee HICPA. Guideline for prevention of surgical site infection, 1999. American journal of infection control. 1999;27(2):97-134.
2. Graf K, Sohr D, Haverich A, Kühn C, Gastmeier P, Chaberny IF. Decrease of deep sternal surgical site infection rates after cardiac surgery by a comprehensive infection control program. Interactive cardiovascular and thoracic surgery. 2009;9(2):282-6.
3. Young B, Ng TM, Teng C, Ang B, Tai HY, Lye DC. Nonconcordance with surgical site infection prevention guidelines and rates of surgical site infections for general surgical, neurological, and orthopedic procedures. Antimicrobial agents and chemotherapy. 2011;55(10):4659-63.
4. NICE clinical guideline for preventing and treating surgical site infections
5. a power point about "Prevention of Surgical Site Infections: Considerations in Measuring Effectiveness" by Michele L. Pearson

Figure 5. Role of Concept Maps in Infection Prevention and Control; designed by Arash Arianpoor

and trainers to creative and critical thinking (8-10). Although the idea of using concept maps as a learning material may back to mid-twenty century, but they did not become of interest until recent two decades (11).

During these years, foundation of C-maps has been gradually developed and therefore, it has now some general accepted features and characteristics. Along with the progressive evolution of information technology in new century, many research groups work on softwares such as C-map Tools, Knowledge Manager, and Smart Idea to facilitate the construction of C-maps (11).

One of the interesting features of concept maps is that they are not limited to a special scientific field or even a special graduation level. They can be simple diagrams for high school students or even elementary school students or complicated illustrative presentations for university students (12). In any condition, it is modifiable and effective.

Regarding the use of C-maps in infection prevention and control, the study performed by Anderson *et al.* was aimed to evaluate the use of concept mapping learning strategy as an educational intervention to improve critical thinking and prioritization skills regarding infection prevention in novice graduate nurses. Their results showed noticeable improvements in the critical thinking and prioritization skills of the participants regarding the nursing assessments and interventions related to infection prevention (4). We can

summarize the role of concept maps in infection prevention and control in a c-map designed by the author (Figure 5).

"The First Concept Map Design Contest on Infection Prevention and Control" was held based on the idea that concept mapping could be an effective way not only to teach infection prevention and control strategies but also to develop new strategies, which may be more effective. Accepted C-maps were designed by different students majoring in different fields (medical, nursing, midwifery, and basic sciences). We also received some C-maps developed by experts in IPC, which indicates the ability of our contest to attract young minds to this field.

Although the basic concepts were similar in many of accepted C-maps, each of them were developed genuinely and showed a different point of view. However, some of the C-maps pointed out unique novel ideas in IPC, which may be considered a basis for new studies in this field.

The main limitation of this study could be the fact that concept map is a new learning method which many are not familiar with; this lead to relatively low participation in this contest. However, it should be mentioned that this was the first concept map contest in Iran. After this contest, the student research committee of Mashhad university of medical sciences have hold two other concept map contests (Stem Cell and Nastaran) which revealed that there is a growing attention toward concept maps as a method of

teaching, learning and idea development.

In conclusion, our experience indicates a promising role for concept mapping in IPC. We suggest using C-maps as a method for faster and easier learning of infection prevention and control.

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REFERENCES

1. Seel NM. Assimilation theory of learning. Encyclopedia of the Sciences of Learning. Springer. 2012: 324-6.

2. Novak JD, Cañas AJ. The theory underlying concept maps and how to construct and use them. Florida Institute for Human and Machine Cognition Pensacola Fl. [cited 2008]. Available from; http://cmapihmc us/Publications/ResearchPapers/T heoryCmaps/TheoryUnderlyingConceptMap s htm.

3. Siegel JD, Rhinehart E, Jackson M, Chiarello L, Committee HCICPA. 2007 guideline for isolation precautions: preventing transmission of infectious agents in health care settings. Am J Infect Control 2007; 35(10): S65-S164.

4. Anderson PH, Johnson C, Singson K. Teaching Infection Prevention Using Concept Mapping Learning Strategies. Am J Infect Control 2013; 41(6): S58.

5. Novak JD. Learning how to learn. Cambridge: Cambridge University; 1984.

6. Cronin PJ, Dekhers J, Dunn JG. A procedure for using and evaluating concept maps. Res Sci Educ 1982; 12(1): 17-24.

7. Martinez IL, Artze-Vega I, Wells AL, Mora JC, Gillis M. Twelve tips for teaching social determinants of health in medicine. Med Teach. 2014 Nov 6: 1-6. [Epub ahead of print]

8. Clayton LH. Concept mapping: an effective, active teaching-learning method. Nurs Educ Perspect 2006; 27(4): 197-203.

9. Novak JD. Concept maps and Vee diagrams: Two metacognitive tools to facilitate meaningful learning. Instruct Sci 1990; 19(1): 29-52.

10. Stoica I, Moraru S, Miron C. Concept maps, a must for the modern teaching-learning process. Roman Reports Physics 2011; 63(2): 567-76.

11. Novak JD, Cañas AJ. The origins of the concept mapping tool and the continuing evolution of the tool. Inform Visual 2006; 5(3): 175-84.

12. Novak JD, Bob Gowin D, Johansen GT. The use of concept mapping and knowledge vee mapping with junior high school science students. Sci Educ 1983; 67(5): 625-45.