

HISTORICAL ASPECTS OF MEDICAL SIMULATION

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Medical simulation is a technique that replaces and enhances real experiences that has been used in education of health-care professionals since ancient ages. The wise, educated men of that time understood the importance of medical simulation by using simple models and techniques aiming at studying various medical fields, especially anatomy, physiology, obstetrics, and surgery. Simulation is a technique that replaces and enhances real experiences. It can evoke and replicate significant aspects of the real world in a completely interactive fashion. It has been widely used in the military and aviation industry, and in the last decades the use of simulation in medicine has also been established.

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Introduction

Medical simulation is a technique that replaces and enhances real experiences that has been used in education of health-care professionals since ancient ages. The wise, educated men of that time understood the importance of medical simulation by using simple models and techniques aiming at studying various medical fields, especially anatomy, physiology, obstetrics, and surgery (1).

In 1908 a sculpture was excavated in Willendorf, Austria, dating back to the Paleolithic period. The figurine was cut from stones, with traces of red colour, disproportional physical attributes, representing a female figure.

It has been suggested that she is a fertility goddess. The figurine known as the Venus of Willendorf is estimated to have been carved around 24000 BC and is considered a forerunner of modern simulation mannequin. This type of figurine is a common art found in sites throughout Eurasia (2).



Figure 1. Sculpture of Vennus of Willendorf

(Preuzeto sa: <https://arthistoryproject.com>)

Numerous discoveries, especially scientific studies of mummies from ancient Egypt, revealed that people from such a civilization possessed a substantial knowledge of human anatomy, as additionally supported by carved figures from that time.

One of the earliest models in anatomy learning dates back to the ancient Maya civilization and a 'memento mori' clay sculpture from 300-750 BC, designed to remind us that life is short and death is inevitable.

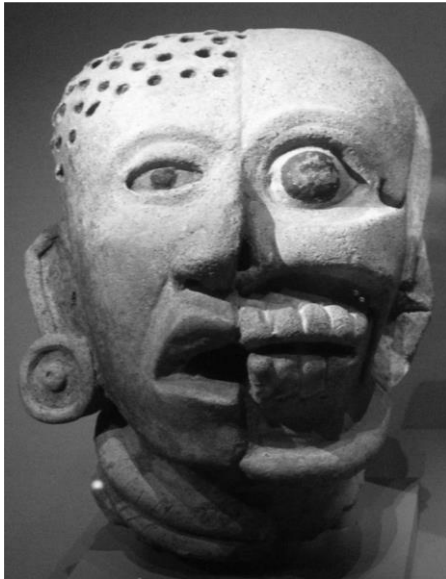


Figure 2. Pre-Columbian Mayan clay sculpture

(Preuzeto sa:
http://commons.wikimedia.org/wiki/File:Ngv,_veracruz,_te_sta_con_vita_e_morte,_300-600_dc.jpg)

During the Song dynasty in China, the imperial court physician Wang Weiyi (987-1067) was responsible for standardizing teaching of acupuncture. He designed two life-sized bronze figures for studying acupuncture points (3). Under the Qing dynasty, examinations of female patients were performed indirectly by using miniature naked female models made of ivory. At that time only men were allowed to enter medical profession, but they were prohibited from touching female patients during examinations, except for pulse palpation, following a strict code of ethics. Family members of a female patient described the type of discomfort and indicated the painful location using these naked female figures. Then the doctor would make his medical opinion (4, 5).

The Sushruta Samhita medical text written in Sanskrit between the 4th and 6th century BC and discovered via the Silk Road in Asia had a great importance in the development of surgical technique simulators (6). The text describes how to repeatedly practice surgical skills and procedures using various experimental models for trying each surgical proce-

dure. It was not until the 19th century that surgical stimulators were described again.

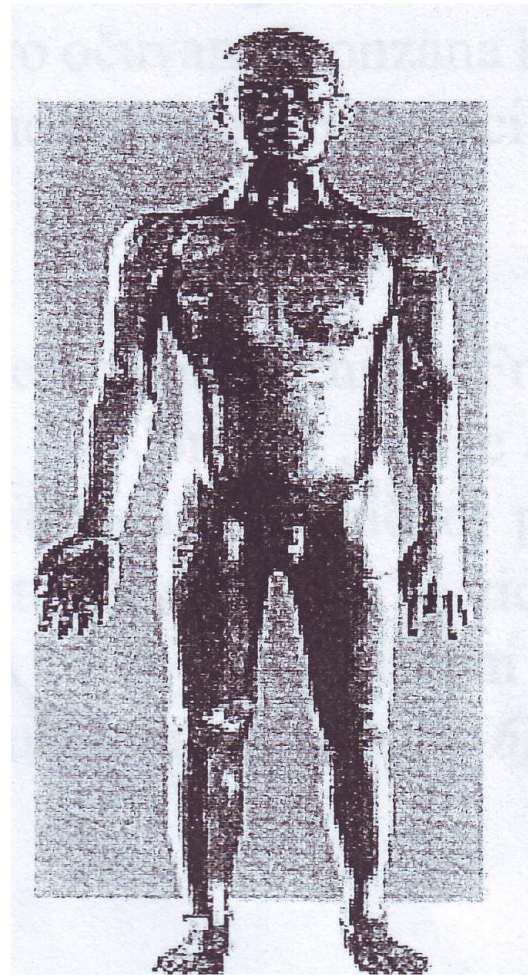


Figure 3. A figure of a man with acupuncture points

(Preuzeto sa:
<http://acupunctureforall.blogspot.com/2012/02/history-of-traditional-chinese-medicine.html>)

In 1868 New York Medical Association Journal issued a report on Dr. Howard lecture "On the Radical Cure of Hernia", using a mannequin to demonstrate a new hernia operation technique (7).

In the new era, medical simulations started to be utilized in the 17th century, first in Italy, then in Germany, France, and Great Britain. Specialized workshops "La Specola" that made anatomical models out of wax for students' education appeared in Italy in the 18th century. Today, they are preserved as a precious testimony in the eponymous museum in Florence. The popularity of these models tended to increase at that time. They were changed due to pathological changes and as a result of different illnesses patterns and were made out of wax or other materials. Anatomical models were exhibited to the public in Europe and America in the first half of the 19th century, but popular interest in anatomical mo-

dels waned in the late 19th century and they were viewed only by students from medical schools.

An Italian painter and an architect, Ludovico Cardi Cigoli, created the first anatomical model in wax in 1598, called "Anatomia del Cigoli" – 'The Skinned Man'. He used a technology of wax body parts used as votive offerings in Catholic churches. The statuette is preserved in the National Museum of Florence together with a bronze copy.

Models similar to aforementioned ones, known as 'ecorches', were also made in France. These figures in standing artistic poses showed the bodies without skin, exposing the muscles and blood vessels that were used for medical students' education.



Figure 4 "Ecorche"

(Preuzeto sa: <http://www.d-anatomystore.com/ecorche-male-anatomical-model>)

Carved models of males and females in pairs, with anatomical structure of removable internal organs and a fetus attached to the uterus in models of females were used in Europe in the 17th and 18th century (8).

The first movable musculoskeletal model was mentioned in the 'Satyricon', the oldest existing novel in the world, written by Petronius in 61 AD. This satirical novel illustrates Roman life during the reign of Nero. During a dinner ceremony, a slave brought in a silver skeleton with movable joints. An educational model was made in Italy in the late 16th and early 17th centuries.

The earliest described medical simulation for trauma cases dates back to the 16th century, when

king Henry II of France was injured. It was a serious eye-socket trauma and the king was treated by the royal court master surgeon Ambroise Pare who consulted Vesalius, the great anatomist. They performed experiments on executed criminals to find a cure for the king. The experiments were unsuccessful and the King soon died (8).

In the 18th century, Giovanni Galli, a surgeon from Bologna, developed the first obstetric simulator for the benefit of obstetricians and midwives. The simulator had a glass uterus and a flexible foetus. A female model with a glass uterus was also used in London in 1739 for obstetrics technique education (9).

Simulation of physiological processes started in the 18th century by using different mechanisms and machines and is associated with Abraham Choquet, a surgeon who designed a model of the fetal circulation in 1733. The circulation of blood was simulated through glass veins and arteries. In 1787 Dr. Cutler gave a description of the first cardiovascular simulator in a report to the Biological Society in Washington (9).

Ophthalmic surgery simulation is associated with the Ophthalmophantome, invented by Dr. Sachs in 1820. The mask phantom had a cadaver's or an animal's eye (10).

In 1879 Bacchi described laryngo-phantoms for exercising laryngoscopy. The first simulator for securing airways and endotracheal intubation was demonstrated by professor Otto Heubner in Vienna on the 5th of January, using O'Dwyer's tubes on cadavers (11).

In 1902 Killian demonstrated direct bronchoscopy to remove foreign bodies and he invented bronchoscopy simulator.

A computerized, realistic patient simulator, known as 'Sim One', was first used in 1966 for anesthesia training. The computer-controlled simulator was constructed to show drug dosage, blood pressure and heartbeat values. Replicated mannequin responses regarding the vital parameters and numerous side-effects were computer-controlled. The Sim One simulator was a phenomenon ahead of its time, nearly two decades before the introduction of computer technology and bioengineering in medicine.

Simulation is a technique that replaces and enhances real experiences. It can evoke and replicate significant aspects of the real world in a completely interactive fashion. It has been widely used in the military and aviation industry, and in the last decades the use of simulation in medicine has also been established.

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ISTORIJSKI ASPEKT SIMULACIONE MEDICINE

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Simulacija u zdravstvu je tehnika koja zamenjuje i pojačava stvarna iskustva, a koristi se u obuci zdravstvenih radnika i saradnika od davnina. Učeni ljudi toga doba su shvatili značaj korišćenja simulatora, jednostavnih modela i prostih tehnika u cilju izučavanja različitih oblasti medicine, posebno anatomije, fiziologije, akušerstva i hirurgije. Simulacija je tehnika koja zamenjuje i pojačava stvarna iskustva. Može da izazove i predstavi značajne aspekte stvarnog sveta na potpuno interaktivan način. Ima svoje potvrđeno mesto u avijaciji, vojsci, industriji, a poslednje decenije i u medicini.

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Ključne reči: simulacija, istorijski aspekt