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# Implementation of quality management system by ISO and feeling of work safety in hospital workers

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## ABSTRACT

**Introduction:** Medical services provide unique services. Their distinct feature is based on the fact that they provide immaterial product in contrast to industry sector. For medical personnel it means properly performed procedures which lead to health improvement. The final result is of vital importance for a patient and their family but also the course of treatment, participation in making decisions, relationship with medical personnel, good equipment and perfect organization. There are many supporters of quality management system by ISO 9001 and many who are opposed. A documented system is a requirement of today.

**Aim:** The aim of the paper was to find out whether implementation of quality management system by ISO had an effect on work safety in both public and non-public hospital personnel feelings.

**Material and methods:** Diagnostic poll method using the author designed questionnaire was used. The study was carried out on 200 persons of medical personnel from two Polish hospitals, public and non-public, before quality management system by ISO 9001-2000 was implemented.

**Results:** The study showed that 78.00% (n=156) respondents were of opinion that implementation of

standardization improved work safety while 9.50% (n=19) thought it did not, 12.50% (n=25) had no opinion.

**Conclusions:** The investigated public hospital personnel thought that introduction of standardization improved work safety than those more often from non-public hospital. The nurses and paramedics were of opinion that introduction of standardization improved work safety slightly more often than the physicians.

**Keywords:** ISO standards, medical personnel, safety, quality.

## 1. INTRODUCTION

Quality management system is a way to run and steer activities in organizations dealing with quality. Quality may be looked at from different perspectives: technical, humanistic, economic or medical. Improvement of quality requires establishing quality politics and quality aims [1].

Public and non-public health care providers offer their products - medical service. Implementation of quality management system requires description of a type of quality system such as eg., accreditation, certification or quality standards by

ISO. Implementation of ISO encounters many barriers, one of which is non-medical terminology, different from the specialized language specific to the health care field [2].

ISO standards are neither the only nor the best system, however, for various reasons hospital managers introduce quality management system based on these requirements. It is due to increasing patient awareness of their rights thus patients have become more demanding. The introduced standardization and results noted in the record, it is carrying out medical documentation by ISO standards, enable health care providers to protect themselves against legal claims and prove their patients - clients that health care was provided according to standards. What is more, device passport shows that equipment used in medical procedures works properly [3, 4]. The implemented standards are controlled and updated by internal and certifying audits. They are aimed at not only being certified but also being synchronized with new trends in management and continuous updating [5, 6].

Medical services provide unique and personified services, where a recipient actively participates in their creation. Their distinct feature is based on the fact that they provide an immaterial product in contrast to industry sector. For medical personnel it means properly performed procedures which lead to health improvement. The final result is of vital importance for a patient and their family but also the course of treatment, participation in making decisions, relationship with medical personnel, good equipment, perfect organization, even cuisine. Relationship patient - medical personnel is a social relation, manners, professionalism, feeling of security. If these are not met patients often seek legal help.

There are many supporters of quality management system by ISO 9001 and many who are opposed. A documented system is a requirement of today. All credible medical units must hold a document which confirms fulfilling the requirements [8]. It is anticipated that the process of introducing quality management system by ISO and personnel experience from this process will contribute to understanding the nature of quality management in health care facilities

The aim of the paper of the paper was to find out whether implementation of quality management system by ISO had an effect on feeling of safety in

both public and non-public hospital workers.

## 2. MATERIALS AND METHODS

Diagnostic poll method using the author designed questionnaire consisting of a series of open-ended and close-ended questions was used. The study was carried out on medical personnel working in two Polish hospitals, public and non-public, before quality management system by ISO 9001-2000 was implemented. At the time of the study the public hospital was an independent institution with the quality standards introduced 7 years before while the non-public hospital had been having the quality system implemented for two years.

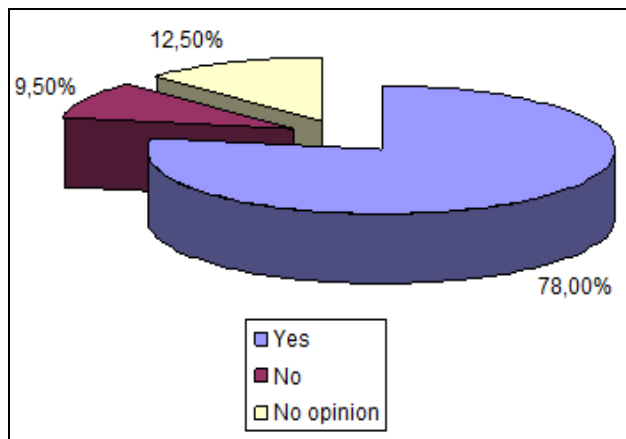
The investigated groups consisted of 100 respondents each. The subjects were selected at random, most of them were females. In the non-public hospital group, the individuals up to 35 years made 37% whereas in the public hospital they made 25% of the respondents. The analysis of employment duration showed that the biggest group of respondents (41%) from the public hospital worked relatively long, mean duration 11-20 years, whereas those from non-public hospital worked for comparatively short time, up to 5 years (46%).

In both groups majority of the responders were nurses (non-public 82%, public 80% hospitals); physicians (non-public 14%, public 15%), paramedics (non-public 3%, public 5%), midwives (non-public 1%, public 0% hospitals). Most respondents completed secondary education (non-public 50%, public 66%) whereas those with tertiary education were in non-public and public hospitals, 31% and 28%, respectively.

## 3. RESULTS

The study showed that 78.00% (n=156) respondents were of opinion that implementation of standardization improved work safety while 9.50% (n=19) thought it did not, 12.50% (n=25) had no opinion (Fig. 1).

Statistical analysis showed that the respondents from the public hospital were of opinion that implementation of standardization improved work safety significantly more commonly (89%) than those from the non-public hospital (67%), ( $p=0.00006$ ). The obtained results were presented in Table 1.



**Fig. 1.** Percentage of responders opinions whether implementation of standardization improved work safety.

**Table 1.** Responder opinions whether implementation of standardization improved work safety considering position at work.

Hospital	Yes	No	I don't know	Total
	n %	n %	n %	n %
Non-public	67 67,00%	18 18,00%	15 15,00%	100 100,00%
Public	89 89,00%	1 1,00%	10 10,00%	100 100,00%
<b>Total</b>	156 78,00%	19 9,50%	25 12,50%	200 100,00%

*Statistical analysis: Chi<sup>2</sup>=19,31; p=0,00006\**

**Table 2.** Responder opinions whether implementation of standardization improved work safety considering position at work.

Position	Yes	No	I don't know	Total
	n %	n %	n %	n %
Nurse/ paramedic	137 80,12%	15 8,77%	19 11,11%	171 100,00%
Physician	19 65,52%	4 13,79%	6 20,69%	29 100,00%
<b>Total</b>	156 78,00%	19 9,50%	25 12,50%	200 100,00%

*Statistical analysis: Chi<sup>2</sup>=3,16; p=0,21*

It was found that the questioned nurses and paramedics thought that implementation of standardization improved work safety (80.12%) slightly more often than the physicians (65.52%). However, the differences were not statistically significant (p=0.21), (Table2).

#### 4. DISCUSSION

Patient safety is an integral part of quality management system which means activity to prevent medical error and avoid adverse healthcare events. According to European Hospital and Healthcare Federation data presented by M. Kautsch 4% to 16% patients admitted to hospital suffer from adverse patient events [9]. Thus the role of standardization is of vital importance. Proper and effective introduction of procedures enables to avoid errors and perform given activities correctly each time [10].

The study found that 78.00% (n=156) respondents were of opinion that implementation of standardization improved work safety while 9.50% (n=19) thought it did not, 12.50% (n=25) had no opinion. Medical personnel in both types of hospitals perceived work safety as observing principles and measures when providing medical services.

The subject literature approaches the problem from the patient's point of view. Their authors emphasize advantages of standardization [11]. This paper presents medical personnel feelings after implementation of quality standardization system. The study showed that the public hospital responders found that implementation of standardization improved work safety (89%) significantly more often than those from the non-public hospital (67%), (p=0.00006).

The analysis of the results demonstrated that there were differences in perceiving introduction of standardization by public hospital responders; the nurses and paramedics thought it improved work safety more commonly (80.12%) than the physicians (65.52%). The differences were not statistically significant (p=0.21).

#### 5. CONCLUSIONS

According to the medical personnel 78.00% (n=156 responders) introduction of management standardization by ISO improved work safety in

the investigated hospitals.

1. The responders from the public hospital were of opinion that implementation of standardization work safety (89.00%) is significantly more often than those from the non-public hospital (67.00%).
2. The nurses and paramedics thought that implementation of standardization improved work safety slightly more commonly than the investigated physicians (65.52%).

#### **AUTHORS' CONTRIBUTION**

All authors contributed equally to this work, read and approved the final manuscript.

#### **TRANSPARENCY DECLARATION**

The authors declare no conflicts of interest.

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# Proliferative lesion arising within chronic burn scar – deceptive bane

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## ABSTRACT

Malignant degeneration of chronic burn wound is a known complication. These tumours are almost always squamous cell carcinomas although other rare types have been described. Malignant fibrous histiocytoma (MFH) which is usually originated from muscles and deep fascia is the most common soft tissue sarcoma. However MFH arising in chronic burn scar wound is a very rare entity. Only 8 cases have been reported so far. A female patient with history of childhood burns, presented to us with proliferative lesion over the left thigh; arising within the burn scar. Pathological diagnosis of pleomorphic storiform type of MFH was made. She underwent wide local excision with 2 cm margin including deep fascia up to the muscle. The defect was resurfaced with intermediate thickness split skin graft. This case represents a very uncommon complication of burn injury and reemphasizes, that the best prophylaxis for development of malignancy in chronic burn scar, is to achieve a stable cover of burn wound.

**Keywords:** Malignant fibrous histiocytoma (MFH), Burn scar.

## 1. INTRODUCTION

Malignant degeneration of chronic burn wound is a known complication. These tumours are almost always squamous cell carcinomas, although other rare types have been described [1]. Malignant fibrous histiocytoma (MFH) usually originating from muscles and deep fascia is the most common soft tissue sarcoma. However MFH arising in chronic burn scar wound is a very rare entity.

## 2. CASE REPORT

52 year old female patient with history of burns at the age of 12 years to her left thigh and groin which was then managed conservatively, presented to us with an ulceroproliferative growth arising within the burn scar present since the last 4 months. She also gave history of recurrent breakdown and healing of wound over the burn scar, since past four years. On examination, there was a burn scar extending over the anterolateral aspect of the left upper thigh and groin with areas of contracture bands and hypopigmented patches. An irregular lesion of 7 x 6 cm was noted in the anterolateral aspect of the left upper thigh extending

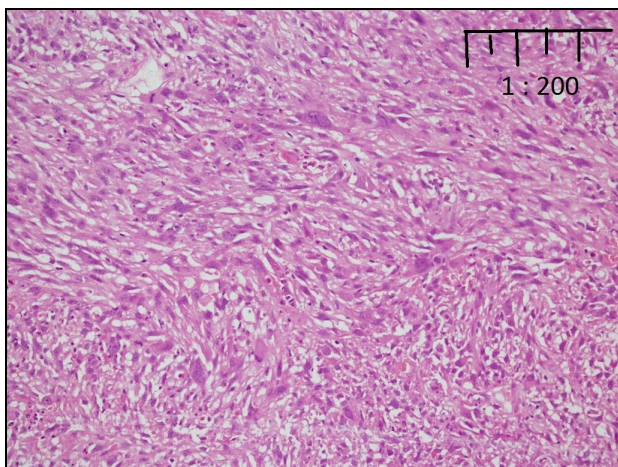


on to the groin (Fig. 1). It was painless lesion with rubbery consistency and was free from the underlying muscles. There were no palpable lymph nodes and CT scan of abdomen/pelvis did not reveal any metastatic lesion. Her chest X ray was normal. She underwent wide local excision with 2 cm margin including deep fascia up to the muscle. The defect was resurfaced with intermediate thickness split skin graft.



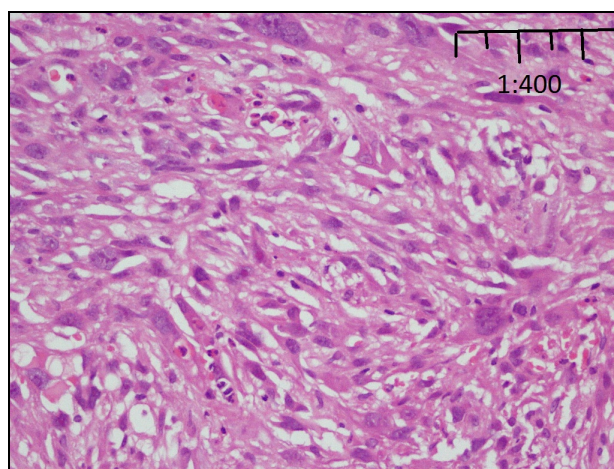
**Fig. 1.** Proliferative lesion arising within chronic burn scar in the left upper thigh with surrounding contracture bands and hypopigmented areas.

Histopathology of the dermis showed tumour cells arranged in whorls and vague interlacing fascicles. The tumour cells being markedly pleomorphic, plump elongated nuclei with blunt ends and one to two prominent nucleoli (Fig. 2).



**Fig. 2.** Tumor cells being markedly pleomorphic, arranged in storiform pattern and in short fascicles intermingled with inflammatory cells (H& E stain, 200x magnification).

Atypical pleomorphic spindle tumor cells admixed with many mononuclear inflammatory cells including lymphocytes, plasma cells, and histiocytes were noted with an average mitosis of 5/10 HPF (Fig. 3). Tumour cells were negative for smooth muscle actin (SMA) on immunostaining. Surgical resection margin was free of tumor. Diagnosis of Pleomorphic, storiform type of cutaneous Malignant Fibrous Histiocytoma was made. The patient was on regular monthly follow ups for the first six months, 3 monthly follow up for the next 6 months and biannually in the subsequent year. No evidence of any recurrence or metastasis.



**Fig. 3.** Atypical, spindle-shaped cells with abundant mitoses average of 5/10 HPF (H&E stain, 400x magnification).

### 3. DISCUSSION

Marjolin in 1828, described a tumour arising in burn scars but did not recognize its malignancy [1]. The term ‘Marjolin ulcer’ was coined to describe tumours arising mainly in burn scars; but also in chronic venous ulcers and other types of scarring due to chronic wounds [2]. Squamous cell carcinoma (SCC) is the most frequent burn scar neoplasm followed by basal cell carcinoma [3]. Cutaneous malignant fibrous histiocytoma (MFH) associated with Marjolin’s ulcer is an extremely rare tumor. Only eight cases have been previously reported [4-7]. Enzinger and Weiss described the histological appearances of MFH as pleomorphic, myxoid, giant cell, and inflammatory subtypes [5]. Storiform-pleomorphic histological subtype, necro-

sis within the tumor, dimensions larger than 10 cm and lymphnode involvement are bad prognostic factors [6].

Treves et al. reported 2% of chronic burn scars undergo malignant degeneration [3]. Few causes for the malignant transformation in an old burn scar are: anti-tumor antibodies cannot reach to kill the tumor cells due to obliteration of lymphatics [4], pruritis causing repeated insult and epithelial breakdown; unstable environment for wounds healing by secondary intention with more scarring and wound contraction [3]. Depressed immunity has also been suggested to play a role in the development of malignancy in burn scar [8]. Bostwick et al. attributed the aggressive nature of tumours, which grow beyond the scar and reach the regional lymphnodes [4]. Rapid growth occurs as the first contact of tumour cells with the immune system is occurring at this level, instead of the primary site - so called "immunologically privileged". Fleming and Rezek suggested that rare incidence of sarcoma is due to the deep position of mesenchymal cells of dermis, which is less vulnerable to trauma and undergoes less tissue regeneration [7].

Malignant degeneration of chronic burn wound is known entity and possibility of MFH though rare should be kept in mind. Tumor margin of 2 cm with one plane deeper to that involved is adequate for clearance. Resulting defect can most often be resurfaced with intermediate thickness skin graft. No need to excise the surrounding scarred region with wider margins, in fear of histopathological dilemma due to extensive scarring. This is ninth case report of MFH arising in chronic burn scar and fourth case observed in the lower extremity whose precise behavior and treatment is yet to be defined. Early stable cover for deep burn wounds is prime requisite to prevent such complications.

## AUTHORS' CONTRIBUTION

Conception and design, Development of methodology, Review and/or revision of the manuscript: CJ and AP; Acquisition of data, Analysis and interpretation of data, Writing of the manuscript: CJ; Administrative, technical or material support: RKS and RN; Study supervision: AP. All authors read and approved the final manuscript.

## TRANSPARENCY DECLARATION

The authors declare no conflicts of interest.

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# Reproductive behaviour of snail *Lymnaea acuminata*

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## ABSTRACT

One of the neglected food-borne diseases in the international public health arena is fasciolosis. The two species most commonly implicated as the etiological agents of fasciolosis are *Fasciola hepatica* and *F. gigantica*. The intermediate host for *Fasciola* is the freshwater snail of the genus *Lymnaea*. *Lymnaea acuminata* is oviparous and reproduce round the year and lays eggs on lower surface of aquatic vegetation. Oval eggs were laid in a row containing 2-196 egg. Increase in temperature resulted an increase in organism's reproductive rate. Temperature increases beyond 33°C the reproductive rate decline. Sudden drops in temperature promote egg mass abortion. A temperature of 25°C is considered for optimal for oviposition and growth in pomacean snails. The CDC cells (caudo dorsal cells) in the brain of the snail *L. acuminata* release ovulation hormone. The CDCs synthesize and release multiple peptides, among which is the ovulation hormone (CDCH). It is thought that each peptide controls a specific aspect of the processes involved in egg laying.

**Keywords:** Fasciolosis, Caudo-dorsal cell, Oviposition, Ovotestis, Prostaglandins, Snail.

## 1. INTRODUCTION

Phylum mollusca is a large bunch of animal groups having diverse shapes, size, habits and occupy different habitats [1]. Based on their habitat preference, molluscs can be classified into aquatic and land communities. The class gastropoda includes 80,000 species of snails and slugs [2]. Among these, approximately 5,000 species are freshwater snails that inhabit lakes, ponds and streams worldwide [3]. Mollusca – a word meaning 'soft' includes a variety of most visible invertebrate animals such as clams, oysters, snails and octopuses. In freshwater environments biomass of molluscs is significant in some environments for example, in temperate countries, lake bottoms may be covered with the small bivalves, which accounts for 80% of the biomass of benthic invertebrates [4]. Some molluscs are important (to the ecosystem) as parasite vectors. Freshwater molluscs, especially gastropods are important from the medical and veterinary public health point of view. About 100 species of freshwater gastropods are reported acting as intermediate hosts for the digenetic trematodes parasites and among Prosobranchs, members of the family Pilidae and Thiaridae were recorded as harbors of larval trematodes [1]. Most are members of the subclass Pulmonata and some of the subclass Prosobranchia. Snails may directly transmit disease, or they may

serve as intermediate host/vector for parasites of human and animals [5]. Some of the fresh water snails are the vector of digenean trematode larva that causes endemic disease fasciolosis and schistosomiasis to man and his domestic animal [6]. Fasciolosis and schistosomiasis are caused by various species of *Fasciola* and *Schistosoma*, respectively.

## 2. FASCIOLOSIS

Fasciolosis is an economically important disease of domestic livestock, in particularly cattle and sheep and occasionally man [7]. The disease is caused by digenean trematode of the genus *Fasciola* commonly referred to as liver fluke [8]. The two species most commonly implicated as the etiological agents of fasciolosis are *Fasciola hepatica* and *F. gigantica* (Family Fasciolidae) [8, 9]. *Fasciola hepatica* has a worldwide distribution but predominate in temperate zone while *F. gigantica* is found in most continents primarily in tropical region [10]. The class trematoda belong to the phylum platyhelminthes and can be divided in to two subclasses, Digenia and Apidogastrea [11]. The Digenia are characterized by a complex life cycle in which one or more intermediate host are involved [11]. Many variations in the life cycle exist, but each typically includes molluscan primary or intermediate host in which larval multiplication occurs and a vertebrate or definitive host in which sexual reproduction occurs [12]. Member of the family Fasciolidae are hermaphrodite and self fertilization can occurs, although sexual reproduction is normally by cross-fertilization in the final host [11].

## 3. SNAILS AS INTERMEDIATE HOSTS

The ecology of the snail intermediate host contributes as a major afford in the epidemiology of fasciolosis. The intermediate host for *Fasciola* is the freshwater snail of the genus *Lymnaea* [13, 14]. In Europe, Asia, Africa and North America *F. hepatica* is transmitted via *Lymnaea truncatula*; whereas in North America and in Australia *L. bulimoides* and *L. tomentosa* are the main intermediate freshwater snail hosts respectively [15]. Other species like *L. viator* and *L. diaphena* transmit fasciolosis in South America and *L. columnella* in the USA, Australia, Central America and New

Zealand [16]. Fasciolosis in humans and animals in Brazil is mostly transmitted via *Lymnaea columnella*, which serves as the most important intermediate host [17]. Studies conducted in Indo-Pakistan, India and Malaysia identified *L. rufescens*, *L. acuminata* and *L. rubiginosa* as intermediate hosts for *Fasciola* spp. [16].

## 4. SYSTEMATICS

Phylum	Mollusca
Class	Gastropoda
Order	Hydrophila
Superfamily	Lymnaeodea
Family	Lymnaeidae
Genus	Lymnaea (Lamarck,1799)

## 5. LIFE CYCLE OF FASCIOLA SPP.

The life cycle (Fig. 1) take rise when a unaffected definitive host ingests the parasite in the form of a metacercaria encysted in a water plant [18]. Once inside the small intestine, the parasite encysts and migrates across the gut wall before finding its way to the liver [19]. The juvenile fluke then migrates through the hepatic parenchyma for 6-8 weeks before entering the minor bile ducts. This migratory phase gives rise to the acute form of the disease [19]. The fluke then establishes and matures in the major bile ducts, where their continued presence causes the chronic form of fasciolosis. *Fasciola* spp. are hermaphrodite and can either self or cross fertilizes [19]. The pre-patent period is 13-16 weeks for *F. gigantica* [20], 8-12 weeks for *F. hepatica* [21]. Eggs proceed into the digestive tract via the bile before being excreted with faeces. Most adult flukes die within 9-12 months, however, some live 3-4 years in cattle [22]. Egg output varies, being highest within the first 12 weeks of egg production, before tailing off [23]. Time taken for the egg to embryonate in the external environment is temperature dependent, from 10 to 33 days. Moisture is required for the eggs to hatch and for the resulting miracidia to escape from faecal matter, and this can take up to 14 weeks [20]. The miracidium enters the lymnaeids where upon development and asexual replication occurs, giving rise to multiple cercariae that escape the snail from 26 days posts 12 infections [24, 25] and encysts on plants immersed in

water. In the case of *F. gigantica*, many cysts are free floating rather than attached to plants, and this implication for the dispersal of the disease beyond areas inhabited by snails [26]. Cyst survival is longer in moist, cool conditions, and can be up to 6 months [27].

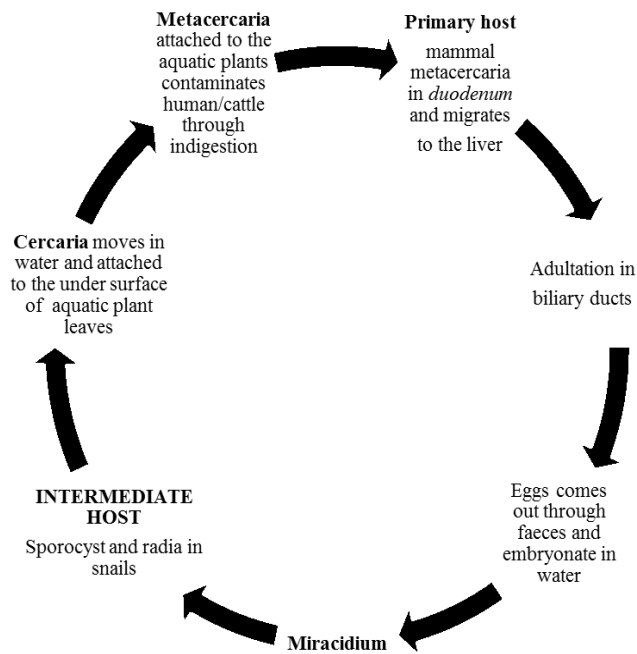


Fig. 1. Life cycle of *Fasciola* species.

## 6. REPRODUCTIVE BIOLOGY OF *LYMNAEA*

Islam et al. [28] reported that molluscs reproduce specially from gametes, although hermaphroditism (both simultaneous and sequential) and parthenogenesis are common. Most of the aquatic Basometophores hermaphrodite and male and female gonophores are generally disunite [28]. All member of this adaptable species are simultaneous hermaphrodite, able to reproduce both by self-fertilization and out crossing [29], the latter generally occurring as soon as copulation is possible. The reproductive system of Lymnaeidae is quit elaborate structure, consisting of a bisexual gonads, and male and female ducts with accessory glands [30]. Hermaphroditism is the dominant methods of exception to this rule. Health [31] reported that the cost of producing and maintaining two sets of reproductive apparatus in one animal is greater than the cost of building and maintaining single sets of apparatus in separate animals. Several patterns of

life cycle can be distinguish in the fresh water basometophorans of the temperate zone [32]. The most common is an annual life cycle with complete replacement of generation and breeding in late spring or early summer. The life span is usually approximately one year with recruitment most commonly occurring in June or July [33].

## 7. EGG LAYING BEHAVIOUR IN SNAIL

Reproduction in *Lymnaea acuminata* is round the year and lays eggs on lower surface of aquatic plant [34]. Hermann et al. [35] reported three phases of egg laying behaviour in *Lymnaea*. The first phase is a resting phase in which the animal stops locomotion, slightly contracts its foot and draws the shell partly over the tentacles. Two behaviours, turning and rasping, dominate during the next phase, which lasts for 1 hour or more. Turning behaviour prior to egg laying involves only the shell and mantle; the foot remains in place. A single turn moves the shell 60°-90°, always in a counter clockwise direction relative to the resting position. The new position is maintained for several minutes before the shell is returned to the resting position. Two to four such turns typically occur before oviposition. Their function is probably to help move the egg mass through the reproductive tract and into the genital pore. The rasping is done to clean the substrate surface so that the egg mass will adhere. Although the rasping movements prior to egg laying appear similar to those shown during feeding, the duration of the protraction phase is significantly longer during egg laying compared to during feeding. In the final phase of egg laying, the animal moves slowly forward while extruding the egg mass and pushing it against the substrate [35].

Davison et al. [36] reported the precopulatory mating behaviour of *L. stagnalis* pond snails is lateralized, in that dextral snails circle anticlockwise and sinistral snails circle clockwise. This asymmetry of behaviour is matched by an asymmetry of the brain, since snails have a brain asymmetry that corresponds with their coiling asymmetry. As the coil of the shell is determined by the maternal chirality genotype, and the asymmetry of the behaviour is in accordance with this, then it is possible, but not proven, that the behaviour is determined by a linked locus. These findings also suggest that the

lateralized behaviour of the snails is set up early in development and is a direct consequence of the asymmetry of the body. Snails that circle in the opposite direction are unlikely to mate successfully, because the species is usually fixed for a single coiling type, so there is strong stabilizing sexual selection on circling direction. Although the findings are novel, they are not unexpected. After all, gastropod molluscs in general are a model for understanding the neural control of behaviour [37]. It is also widely known that the mating behaviour of many species of snails has chirality [38], and in *Helix aspersa*, morphological and physiological results have demonstrated a right-sided bias in the mesocerebrum that correlates with the fact that sexual behaviour takes place almost entirely on the animal's right side [39]. Finally, descriptions or figures of molluscan brains frequently illustrate pronounced asymmetries [40]. *Lymnaea stagnalis* should now be added to the growing list of invertebrates for which lateralized behaviour has been documented. Moreover, although snails in general have not previously been subject to a strict test of lateralization, it is almost certain that many other species have the same lateralization for sexual behaviour. The relationship between the chirality of the shell and the behaviour has not been tested previously, to our knowledge. The reason is because the vast majority of species are fixed in their chirality, so genetic experiments are not possible. The conclusion is that if the maternal effect chirality locus is the ultimate determinant of chiral mating behaviour, then this is put into effect by asymmetries in the brain. This simple scheme is actually complicated because numerous genes must mediate between the controlling chirality locus gene product and the effector genes with the brain.

The CDC cells (caudo dorsal cells) in the brain of the snail *L. acuminata* release ovulation hormone [41]. The cerebral neurosecretory caudo dorsal cells (CDC<sub>S</sub>) of the fresh water pulmonates snail *Lymnaea stagnalis* control egg laying, an event that involves a pattern of stereotyped behaviour [42]. The CDC<sub>S</sub> synthesize and release multiple peptides, among which is the ovulation hormone (CDCH). It is thought that each peptide controls a specific aspect of the processes involved in egg laying [42]. The gastropods molluscs *Lymnaea stagnalis* and *Aplysia californica* are particularly

advantageous models for such studies, their CNS consist of only 10,000-20,000 neurons, many of which are unusually large and uniquely identifiable [42]. Egg laying in these animals is an extensively studied and well defined fixed action pattern involving a series of internal processes (ovulation, egg and egg mass or egg string formation) that closely correspond to a pattern of overt behaviour such as alteration of locomotion and feeding, specific postures and oviposition. *A. californica* is controlled by the neurosecretory bag cells (BC) which have similar morphological and electrophysiological characteristics as the CDC<sub>S</sub> [42].

David and Stanley [43] reported that prostaglandins (Pos) appear to stimulate egg production in the freshwater snail *Helisoma durgii*. When injected directly into the haemocoel of adults, ng quantities of PGE<sub>2</sub> produced apparent discomfort in all individuals and even death in isolated cases with no increase in egg masses or in eggs per mass. But when introduced into the female genital opening in a viscous fluid designed to approximate semen, POE<sub>2</sub> treatments stimulated a long-term increase in egg production. Four weeks after treatment of virgin snails with 25, 50, and 100 ng doses of PGE<sub>2</sub>, cumulative egg production was about 200, 425, and 650 eggs per animal, respectively [43].

Reproductive tissues from virgin and mated snails, the ovotestis, seminal vesicle, bursa copulatrix, and oothecal gland presented substantial PG-biosynthetic activity *in vitro*. Mating significantly altered the activity in two of the tissues. In ovotestis, synthesis of POE<sub>2</sub> decreased while PGA<sub>2</sub> synthesis increased with no change in synthesis of PGF<sub>2a</sub> [43]. Synthetic activity changed in the bursa copulatrix, with PGE<sub>2</sub> and PGA<sub>2</sub> reduced to effective zero after mating; PGF<sub>2a</sub> was again unchanged. Differences in PG-synthetic activity did not occur in seminal vesicle or oothecal gland [44]. These two lines of evidence the effects of PG treatments on egg production and alterations in PG-synthetic activity suggest that PGs play important reproductive roles in this snail [43].

## 8. OVULATION

The release of ova from the gonad, is controlled by hormones, at least in the opisthobranch and the basommatophoran pulmonates (freshwater

snails), and probably also in the stylommatophoran pulmonates [45]. The neuroendocrine cells that secrete these hormones have been well characterized in *Aplysia californica* and in *Lymnaea stagnalis* [45]. In *Aplysia californica*, they belong to two bilateral clusters of cells lying at the origins of the pleural-visceral connective nerves in the visceral ganglion; these cells are known as bag cells [45]. When stimulated to produce prolonged discharges of action potentials, the bag cells release at least five peptide hormones, one of which, the “egg-laying hormone” (ELH), is responsible for ovulation [46]. The caudodorsal cells (CDCs) of *Lymnaea stagnalis* are similar to the bag cells of *Aplysia californica*. They lie in bilateral clusters of the cerebral ganglion, and they release two structurally related ovulation hormones during prolonged bursts of action potentials [42]. One of these, CDCH-1, contains an amino acid sequence that is 39% identical to the amino acid sequence of *Aplysia* ELH.

The mechanisms responsible for the body movements and lack of locomotion during egg laying are controversial [37]. According to one view, the cocktail of hormones released by the neuroendocrine cells is fully responsible. Mate location in many aquatic gastropods is mediated by water-borne chemicals [47]. Mucus-trail following may be an alternative or a complementary mate-searching strategy to these chemical. In the mostly hermaphroditic opisthobranchs and pulmonates [48], mate-searching involves discrimination of species. Conspecific trail following is commonly observed in these gastropods and, as it often results in courtship; this behavior has been associated with mate-searching [49, 50]. Few studies have provided experimental data to confirm this link, although Townsend [51] demonstrated that sexually aroused freshwater pulmonates, *Biomphalaria glabrata*, showed a higher degree of conspecific trail-following than non-aroused conspecifics. Nakashima [52] also provided experimental evidence for trail-following as a means to locate mates in opisthobranchs, showing that in the mating season two nudibranch species (*Dendrodoris nigromaculata* and *D. nigra*) relied on mucus trails rather than on waterborne chemicals to locate conspecifics, and able to discriminate between conspecific and heterospecific trails. Prosobranchs generally have separate

sexes, male and female, but sex reversal is known to occur in several species [53]. Fertilization is usually internal, and the females lay their fertilized eggs in protective egg capsules, but some species discharge gametes into the water where external fertilization takes place [54].

## 9. FECUNDITY

*Lymnaea acuminata* is oviparous and reproduce round the year and lays eggs on lower surface of aquatic vegetation [14]. Eggs were laid in the gelatinous string and each egg then float in albuminous fluids bounded externally by albumen. Oval eggs were laid in a row containing 2-196 eggs [14].

## 10. EFFECT OF ABIOTIC FACTORS ON REPRODUCTION OF THE SNAIL

Srivastava and Singh [14] noted that increase in temperature resulted an increase in organism's reproductive rate. Bai et al. [55] observed that increase in temperature affect the reproductive rate of the ciliate, *Blepharisma intermedium*. Temperature increases beyond 33°C the reproductive rate decline [56]. Sudden drops in temperature promote egg mass abortion [57]. A temperature of 25°C is considered for optimal for oviposition and growth in pomacean snails [58]. Earlier study has shown that decrease in temperature from 20°C to 8°C stopped the oviposition of snail *Lymnaea stagnalis*, because of reduction in activities of neurosecretory caudo dorsal cells (CDCs) [59]. McDonald [60] reported that the Lymnaeide snails are more sensitive to warm temperature; continuous exposure to temperature greater than 30°C caused snail death. The rate of physiological processes increases markedly with increasing temperatures in the case of cold-blooded animals, such as snails [7]. Conversely, cercarial production is inhibited below a certain temperature without inhibiting the continuous production of rediae or sporocysts and the generative stages accumulate inside the snail. Thus, when temperature is low, infected snails may store radial population until they are exposed to temperatures of 20°C or higher. At this higher temperature the parasites switch from redial to cercarial production and the large accumulated redial population causes a disproportionate emergence of cercariae [61]. Although a

rise in temperature triggers an increase in cercarial output, this may be short-lived. It is quite likely that at higher temperature, and with cercarial production greatly enhanced, the snail host would not live as long as it would normally [7, 61]. Thus, increased temperature causes increased cercarial output but decrease snail survival [7].

It seems that the fecundity, hatchability and survival of young snails show positive correlation with temperature. Seasonal fluctuations in the secretory neuroendocrine cells of *Aplysia californica* inhibited the protein Kinase A and C which play a significant role in regulation of egg laying hormone [62]. According to their cAMP and diacylglycerol second messenger pathways are regulated on a seasonal basis [62]. Abiotic factors of the environment vary from one season to other [7, 63]. The aquatic environment has numerous physical and chemical parameters that may influence the physiology of fresh water organism [64]. Embryological development is highly influenced by the change of ecological factors in aquatic environment [65].

Ranjan [66] stated that breeding season and the incubation period vary with the nature of the environment. When the temperature varies between 32-37°C, the incubation period was 10-40 days and it was constant in rainy season. When the temperature come down to 21-26°C, the incubation period was about three weeks. Raut [67] concluded that the rate of breeding in the number of snail's viz., *Lymnaea acuminata*, *Indoplanorbis exustus* and *Acrostoma variabilis* were governed by temperature, rainfall and food. Temperature negatively influenced the incubation period that means they reduced the incubation period and enhanced hatchability of snails [65]. The snail *Lymnaea luteola* exhibited marked variation in growth, longevity and attaining sexual maturity at different temperature. At 30°C the snail had minimum life span, maximum death rate and lowest growth rate. At 15°C the growth rate was comparatively higher and the snails survived for a few more days. It may be possible that at low temperature the aerobic capacity of mitochondria may become limiting for ventilation and circulation [68]. Possibly due to high temperature, low intake of oxygen concentration in water and increase in CO<sub>2</sub> concentration and low pH of water.

The cerebral neurosecretory caudo-dorsal cells (CDCS) of the fresh water pulmonate snail *Lymnaea*

*stagnalis* control egg laying, an event that involves a pattern of stereotyped behavior [42]. The CDCS synthesize and release multiple peptides, among which is the ovulation hormone (CDCS). It is thought that each peptide controls a specific aspect of the processes involved in egg laying [42]. Seasonal variations were reported in mussel cAMP contents [69] were mainly observed in the mantle, reflecting a relationship with the gametogenesis cycle [70]. Besides temperature, also other environmental and nutrition condition influence gametogenesis and spawning [71], and a relationship with cAMP levels in the mantle was recently evidenced by Blanco et al. [72]. Indeed, high cAMP levels were found in autumn and winter, in parallel with lowest levels of ATP, ADP and AMP, possibly related to the activation of glycogen degradation to fuel gonadal development [71].

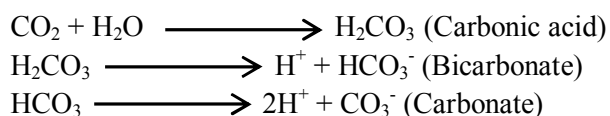
It is noted that in summer month (June-August) when the water pH is less in each months of the year the fecundity, hatchability and survival of snail decreases [34]. The synthesis of DNA and RNA are influenced by the intracellular pH of physiological range. The activity increases with increasing pH from 7.0-8.0. The process of cellular growth and divisions requires the synthesis of nucleic acids and protein [73]. Increase in pH from 7-8 caused a significant increase in DNA and protein level in ovotestis of *L. acuminata* [73].

Dissolved oxygen is one of the most important ecological factors for survival of snail and other aquatic life [74]. In general, most pond water can hold about 10 to 12 mg/l of oxygen [76]. Temperature is one of the most important factor affecting dissolved oxygen levels [68]. Oxygen dissolves easier in cold water than warm water. As temperature increases oxygen level decreases [68]. Critically, low oxygen levels can occur during, hot summer months, when capacity is decreases due to high temperature and organism have a higher demand. In winter season water holds more oxygen than summer season [76].

Different classes of gastropods show variation in oxygen consumption such as prosobranch and pulmonate snails have similar levels of oxygen consumption whereas, ophisthobranch snails have higher oxygen consumption [77]. *Lymnaea* is very sensitive to dissolved oxygen content of water [78].



It has been reported that fecundity in some animal does not respond to higher oxygen [79]. It has also been reported that dissolved oxygen below 20% saturation causes stress to fresh water muscles [80, 81]. High oxygen concentration changes the chemical composition of water as well as morphological characteristics of caudo dorsal cells (CDCs) and physiology of snails [82]. The low concentration of dissolved oxygen may act as physical sensor on aquatic animals [83]. Invertebrates show acute mortality at oxygen level below 4 mg/l with larval stages being in general, more vulnerable than other corresponding adults. Dissolved oxygen increased the incubation period and the hatchability through incomplete or slow development of the embryo [65]. Carbon dioxide is mostly soluble in water. When carbon dioxide combines with water, it form carbonic acid and dissociate to form bicarbonate [84-86].



These hydrogen ions determine the acidity of the aquatic body, accounting the change in pH [87]. Carbon dioxide decreases the pH of water because of increase in concentration of  $\text{H}^+$  [85]. The direct effect of high  $\text{CO}_2$  exposure can be reduction in metabolism, protein synthesis, growth rate and reproduction in marine animals [89].

Srivastava et al. [34] reported that feeding of 80% of 24h  $\text{LC}_{50}$  of Eugenol+Serine+Agar bait formulation caused maximum reduction in level of protein (49.97% of control) was noted in August and amino acids (11.89% of control) in month of June. Maximum reduction in level of DNA (21.65% of control) was noted in July and RNA (13.72% of control) in month of January. It seems that there was a cumulative effect of these abiotic factors on the levels of protein, amino acids and nucleic acids in ovotestis of *L. acuminata* which affect may be direct or indirect through CDC cells which release ovulator hormone and ultimately affect the reproduction of snail in each month of the year 2011-2012.

## 11. INFLUENCE OF MOLLUSCICIDES ON REPRODUCTION

Srivastava et al. [34, 89, 90] noted that the action of plant derived molluscicides on the reproduction (fecundity, hatchability and survival) of snail *Lymnaea acuminata* in different months of the year and concluded that VC (Ventral type-C neuron) and HSN (hermaphrodite-specific motor neuron) play a central role in egg laying behaviour and these neuron releases GABA, Dopamine, and Serotonin. It seems that after sublethal treatment of plant derived molluscicides (papain, piperine or eugenol) decrease the level of serotonin and inhibit prostaglandins synthesis by inhibiting 5-lipoxygenase and leukotriene directly or indirectly CDCs. Possibly, the active molluscicidal component papain, piperine or eugenol affect the CDCs and reduce the release of ovulation hormone, resulting a decrease in the fecundity of treated snail. Active component papain, piperine or eugenol cause more reduction in fecundity of snails than synthetic molluscicides. The plant derived active component eugenol has dose dependent influence on the fecundity of snails [91]. Possibly, the active molluscicidal component papain, piperine or eugenol affect the CDCs and reduce the release of ovulation hormone, resulting a decrease in the fecundity of treated snail. The reduced hatchability of *L. acuminata* exposed to papain, piperine and eugenol may be due to the interference with the embryonic growth and development of the snails. In the treated group some young snail larva were weak, they were unable to break the eggs capsule and died to starvation. Young snails hatched from the treated egg masses showed much delay in attaining maturity in comparison to the control group. They were mostly attached to the wall of the container and were apathetic towards feed. They have very thinner shells. Tentacles were short. Movement was slow. They were smaller in size. High percentage of mortality and low percentage of fecundity was achieved by the treatment of different type of toxicants suggest that these are able to control to population density of this pestiferous snails by inhibiting their development at any stage. The hatching period in control group of snail was 7-9 days. In treated group hatching was prolonged from 7-9 days to 8-19 days. It indicates retardation in

embryonic growth or development of snails. In treated group egg masses swelled and turned viscous. The colour of the egg capsule in control group was dark cream. It changed to white due to the toxication of treated material [92]. The reduction in survivability newly hatched snails with respect to time may be due to the penetration of treated material in young hatched snails as the exposure period increases from 24h to 72h. Srivastava et al. [34, 89, 90] also reported that the feeding of bait formulation of 40% and 80% of 24h LC<sub>50</sub> of papain caused a significant change in certain biochemical parameters in the gonadal tissue of snail *L. acuminata*. It indicates that the biochemical changes in the gonadal tissue are altering the reproduction behaviour of these snails. Reduction of protein levels may be due to direct interference of the papain with the protein synthesis. The synthesis of protein in any of a tissue can be affected in two ways by a chemical, (i) it either affects the RNA synthesis at the transcription stage or (ii) it somehow affects the uptake of amino acid in the polypeptide chain. In this case the RNA synthesis would be inhibited resulting in reduced RNA as well as protein content and only the protein content would be affected [93]. Amino acid levels in the gonadal tissue of the snail exposed to different preparations were significantly lower than control. It indicates that they also interfere with the biosynthesis of amino acid in the cell [94].

Sublethal treatment with aridan isolated from *Tetrapleura tetraptera* has been shown to reduce the protein contents in cephalopods mass and digestive gland of *Biomphalaria glabrata* [95]. Mello-Silva et al. [96] have observed intoxication of *Euphorbia splendens* latex caused breakdown of protein in *Biomphalaria glabrata*, which led to the changed concentration of urea and uric acids in hemolymph.

Kumar et al. [97] reported that there was a depletion of amino acids and reduction of protein and nucleic acids level in the ovotestis of *L. acuminata* when directly released in the aquarium. Due to depletion of free amino acids, there is a significant decrease in the levels of protein. The reduction in levels of proteins in the ovotestis of the treated snail may be due to the reduction synthesis of RNA, along with DNA [97]. Biochemical changes in the ovotestis due to the treatment could also be a cause of reduction in fecundity, hatchability and survival

of young *L. acuminata*. The reduction in protein and amino acids levels could be due to the direct interference of the test compound with protein biosynthesis

Bhardwas et al. [98] observed that active component piperine inhibits P-glycoprotein and the major drug metabolizing enzyme CYP 3A4. Both are protein and are expressed in enterocytes and hepatocytes and contribute to a major extent to first pass elimination of many drugs. Reduction in the levels of protein in the ovotestis of the treated snails may also be due to the reduced synthesis of RNA as the levels of the nucleic acids along with DNA falls following treatment of *Piper nigrum*. Amino acid levels in the ovotestis of exposed to different preparations were significantly lower than the control. It indicates that they also interfere with the biosynthesis of amino acids in the cell [99]. Reduction in the DNA levels in the ovotestis of *L. acuminata* with the treatment of piperine is due to its genotoxic effect. Karekar et al. [100] reported the genotoxic effect of piperine on germ cells of the Swiss albino mice. The decrease in DNA contents may also be because of cascade of cell death caused by toxic aldehyde resulting from lipid peroxidation. Moreover, researches have proved the alcoholic extract of *Black pepper* to be genotoxic as it alters the sister chromatids exchange in chromosomes [101].

#### AUTHORS' CONTRIBUTION

Both authors contributed equally to this work, read and approved the final manuscript.

#### TRANSPARENCY DECLARATION

Authors declare that there is no conflict of interest.

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# Assessment of bioterrorism awareness in a group of nurses

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## ABSTRACT

**Introduction:** The threat of terrorist attacks in Poland has become a real and constant problem for the safety of our country. The danger of using mass destruction weapons, including biological warfare, seems to be serious. Thus preparedness for a biological attack of emergency services and health care workers is of vital importance. The most numerous group of emergency services are nurses who are employed in all types of organisational units of medical care and thus should have knowledge of emergency treatment during bioterrorist attack.

**Objective:** The thesis objective was to assess level of nurses knowledge of bioterrorist threat in Poland and need for additional training in this field.

**Materials and methods:** The study group consisted of professionally active nurses from the Łódź region, the applied research method was a diagnostic poll.

**Results:** Seventy eight percent respondents claimed that the threat of a bioterrorist attack in Poland was real. The majority of the respondents (89%) point to anthrax, plague, smallpox, tularaemia, botulinum toxin, viral haemorrhagic fever as the most important group of pathogens that could be used in a terrorist attack; 87% of the nurses claimed that their knowledge of biological warfare and infectious patients treatment was not sufficient; 92% of them understood the need to organise trainings for medi-

cal staff on bioterrorism threat and procedures in case of such an attack.

## Conclusions:

1. In the current political situation of Poland, the nurses consider a bioterrorist attack a real threat.
2. The respondents are aware of bioterrorism, can name risk factors, targets of the attack and epidemiological clues suggesting biological weapon was used.
3. Majority of respondents find the knowledge of bioterrorism not satisfactory and indicate the need to educate medical staff and the public.

**Keywords:** Biological weapons, Bioterrorism, Nurses, Education.

## 1. INTRODUCTION

The threat of terrorist attacks in Poland has become a real and constant problem of national security. Political support for fight against terrorism worldwide, participation of Polish Armed Forces in peacekeeping missions, western oriented policy are only some factors increasing the risk of a terrorist attack. Attack using biological weapons seems to be likely as they are relatively cheap to develop and produce, easy to spread, a small dose causes infection which develops into a lethal disease. Thus preparedness for a bioterrorist attack of rescue services

including medical personnel is of vital importance. In emergency services, nurses are the most numerous professional group. They work in all kinds of medical care units so they should be trained in emergency procedures during a bioterrorist attack. Education and training for this group are necessary. Knowledge of behaviour algorithms increases safety of population and enables further public education.

Use of biological weapons is not a new phenomenon. Biological agents for military purposes were used centuries ago; the records date as far back as ancient times e.g., Scythians poisoned arrows, in ancient China poisonous snakes were used to fight the enemy. Drinking wells were poisoned with rye ergot by the Assyrians in the 6<sup>th</sup> century B.C. In the Middle Ages the use of bioweapons was practised by the catapulting of plague victims over the walls of a besieged city e.g., in 1346 Tatars practiced it in Kaffa fortress in Crimea; then when running away from the fortress the Genoese infected with plague spread the disease over Europe, which resulted in pandemics of black plague on all continent. At the battle of Carolstein in 1422 plague-stricken soldiers were hurled into the ranks of enemy troops.

Another example of using pathogens for military purposes was contamination of French wine with the blood of leprosy patients in Naples in 1495 [1]. The second World War and the Cold War era was the period of development of weapons of mass destruction including biological agents. Facing the threat of using these weapons, in the late 1960s measures to arms limitation were undertaken. In 1972 "Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction" was signed; it was a multilateral disarmament treaty banning the development, production, stockpiling and purchase of biological weapons. One of the definitions describes "bioterrorism" as a kind of terrorism based on illegal use of biological agents against humans to force them to do something or terrorise governments, the public to achieve personal, political or religious goals [2]. Biological warfare is mass destruction weapon BMW with the capacity to inflict death and destruction on a massive scale. Thus biological warfare may also be called "mass victim weapon".

Biological warfare includes microbiological and other biological agents or toxins irrespective of

their origin, way of production, type or amount, whose use is not justified by prophylaxis, defence or other peacekeeping aims. It comprises bacteria, viruses of the selected infectious diseases, some fungi, rickettsia, bacterial, animal or plant toxins or they are produced by chemical synthesis [3].

National and homeland security is closely related to preparedness for detection and monitoring of a potential bioterrorist attack as well as professional competence in minimising the effects. Health care providers are among the first lines of defence. They should be well prepared, aware of the threat ready to act according to procedures and algorithms. Under threat the task of all medical teams is to analyse and transfer the obtained data to superior centres. Professional and well trained nurses should be an important chain link. The aim of the paper was to assess the nurses awareness of the bioterrorism threat in Poland and evaluate the need for further education in this field.

## 2. MATERIALS AND METHODS

The study was carried out on professionally active nurses from Łódź region using the method of diagnostic poll.

## 3. RESULTS

**Table 1.** Group characteristics.

Number of investigated nurses	100
Sex: (F/M)	F: 99; M: 1
Age: Mean (min-max)	45,0 (37-57) years
Dwelling place: town	82
countryside	18
Workplace: hospital	77
outpatient clinic	18
Healthcare Facility	1
Social Welfare House	2
Work place	2
Work experience: Mean (min-max)	23,2 (10 -36)



Analysis of the questionnaire results:

1. In your opinion, is the threat of bioterrorism in Poland real?

- a. yes
- b. no
- c. no opinion

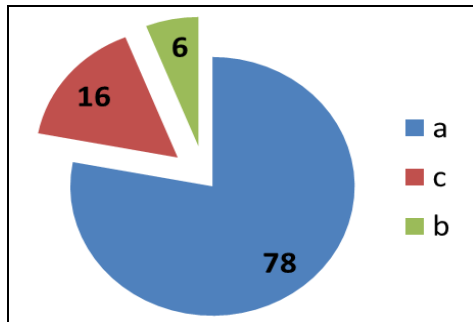


Fig. 1. Opinions on the threat of using biological weapons in Poland.

2. Biological weapons include:

- a. bacteria
- b. viruses
- c. biologically active substances produced by a living organism
- d. biologically active substances obtained by chemical synthesis

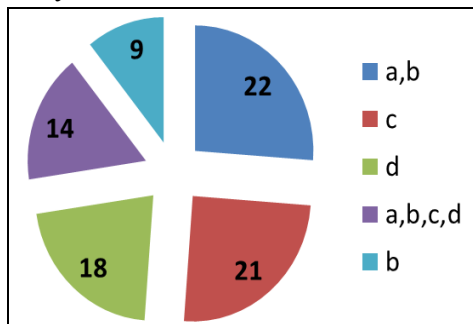


Fig. 2. Knowledge of biological warfare agents.

3. In your opinion, the most likely targets for bioterrorism are:

- a. people
- b. farm animals
- c. crops
- d. food
- e. environment

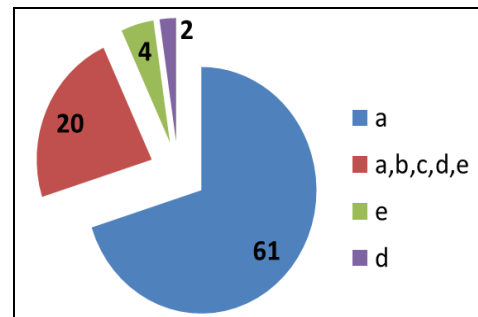


Fig. 3. Awareness of the most likely targets for bioterrorism.

4. In your opinion, infection with biological warfare agents spreads mainly through:

- a. respiratory tract
- b. digestive tract
- c. open wounds

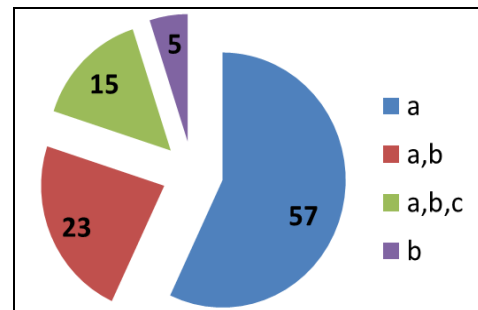


Fig. 4. Knowledge of the routes of infection.

5. In your opinion, which groups of pathogens are used as biological warfare agents?

- a. anthrax, plague, smallpox, tularemia, botulinum toxin, hemorrhagic fevers
- b. brucellosis, glanders, staphylococcal enterotoxin, ricin
- c. yellow fever virus, Nipah virus, Hanta virus, multi-drug-resistant Mycobacterium tuberculosis
- d. bacteria: Salmonella, Shigella, Escherichia coli

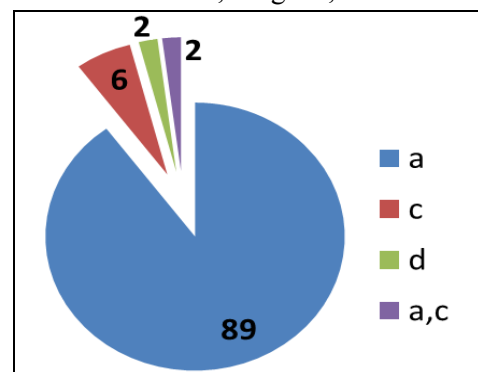


Fig. 5. Knowledge of pathogen groups used as biological agents.

6. Epidemiological guidelines showing bioterrorist attack are:

- a. high number of patients with similar symptoms
- b. high number of patients or mortality of unknown etiology
- c. incidence of atypical diseases in a population or diseases caused by a microorganism non-existent on this territory

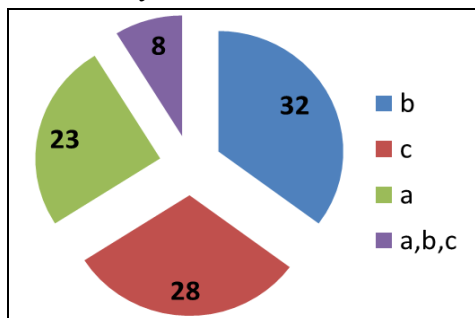


Fig. 6. Awareness of factors proving a bioterrorist attack.

7. In your opinion, who should be a social educator on bioterrorism:

- a. rescue services (police, fire service)
- b. medical personnel (a physician, a nurse)
- c. specialized military units
- d. media

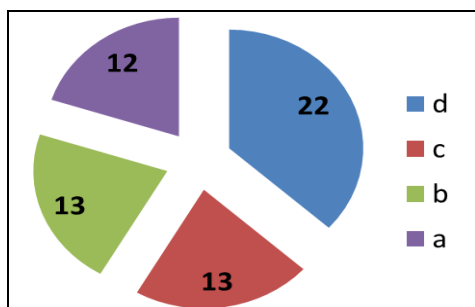


Fig. 7. Opinion on bioterrorism education.

8. In your opinion, should the problem of bioterrorism be widely presented to the public?

- a. yes
- b. no
- c. no opinion

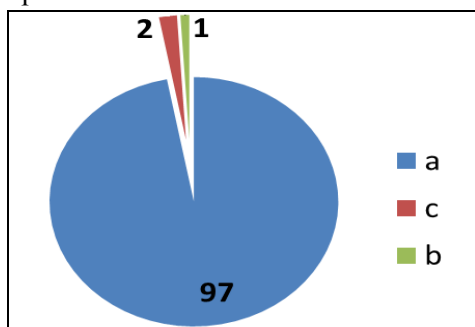


Fig. 8. Opinion on bioterrorism education.

9. Have you ever been exposed, in your professional life, to the threat of using bacteria, viruses, toxins?

- a. no
- b. yes
- c. if so, please present the situation

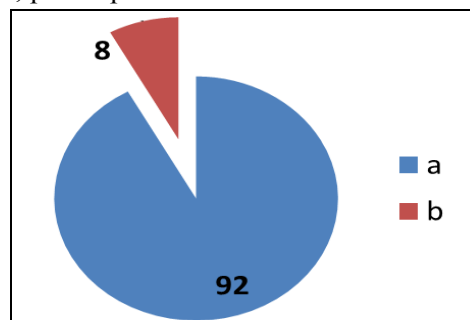


Fig. 9. Opinion on bioterrorist threat in the professional career.

10. Have you ever participated in the training on the risk of using biological warfare in Poland and regulations in case of a bioterrorist attack?

- a. yes
- b. no
- c. if so where

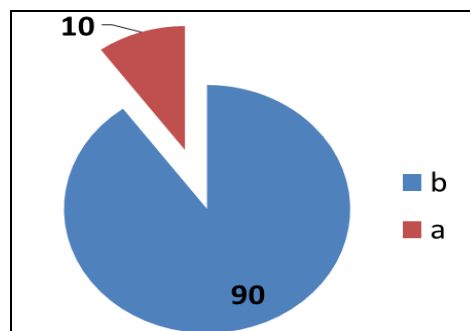


Fig. 10. Opinion on participation in trainings on the threat of bioterrorist attack.

11. Is your knowledge on procedures for a patient with a particularly dangerous disease, e.g., after bioterrorist attack, sufficient?

- a. yes
- b. no

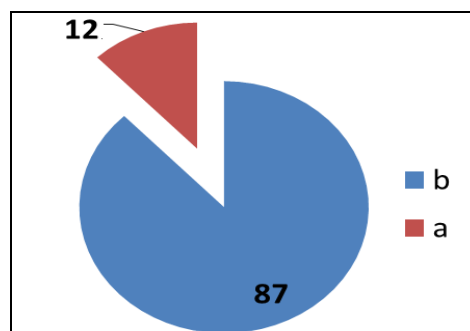
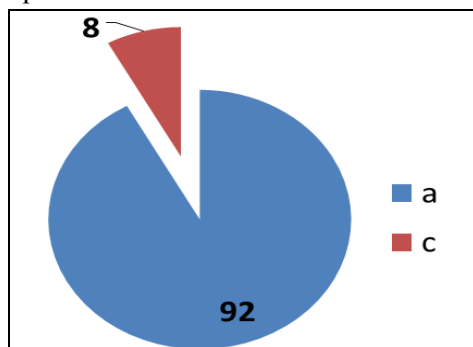


Fig. 11. Assessment of knowledge of procedures for a patient after a bioterrorist attack.

12. In your opinion, is training on bioterrorism for nurses needed?

- a. yes
- b. no
- c. no opinion



**Fig. 12.** Opinion on necessity of training on bioterrorism for nurse.

#### 4. DISCUSSION

Bioterrorist attack may be aimed at humans, farm animals, crops, food or environment. It is motivated by revenge, protest against government policy, gaining control over a society, eco-terrorism and other.

Biological weapon properties predispose to their use. They are characterised by:

1. low cost of production for military use, the weapons are also known as "the poor man's atomic bomb";
2. easy to make, easy to use
3. easy for long distance transport;
4. very effective (big-area striking power);
5. difficult for quick diagnosis due to atypical symptoms;
6. invisible, odourless, colourless;
7. resistant to treatment;
8. easy to spread and able to survive in unfavourable environment [4].

The risk of autoinfection is a big disadvantage particularly if used in big areas.

The respondents were aware of bioterrorism and features of biological agents. Seventy eight percent of the questioned nurses thought that the threat of bioterrorism was real. According to 22% respondents biological warfare consists mainly of bacteria and viruses, biologically active agents produced by living organisms and agents obtained by chemical synthesis. According to 61% nurses the aim of the bioterrorist attack are humans while 22%

respondents indicated humans, animals, plants and environment. Fifty seven percent nurses thought that pathogens enter a human body through the respiratory system. Most respondents (89%) indicated anthrax, plague, smallpox, tularemia, botulin toxin, hemorrhagic fever as main groups of pathogens to be used in bioterrorist attack. According to 32% respondents a large number of patients with diseases or mortality of unknown etiology indicate a bioterrorist attack, 28% nurses thought it was occurrence of atypical diseases or diseases caused by pathogens not native in the area while 23% nurses thought it was a big number of patients with similar symptoms. According to 23% respondents mainly media are responsible for informing public opinion about bioterrorist attack, then specialized military units (13%), and medical personnel (12%). Only 8% respondents admitted to dealing with threat of epidemics, mainly food poisoning or patients with bird flu in their professional career. Ninety seven percent of those polled thought that issues surrounding threat of bioterrorist attack should be propagated and the nurses themselves felt deficit of knowledge of procedures in case of bioterrorist attack and suggest trainings for this professional group.

In case of suspected or confirmed use of biological weapons all activities should be undertaken according to coherent procedures, which apart from efficient communication, should specify range of competence and tasks for all rescue services. The management of bioterrorist attack, irrespective whether it is a single incident or a bioterrorist attack on a large scale, requires effective rescue activities often under high pressure. Each person exposed to biological attack should be considered infectious. Thus it is necessary to introduce epidemiological regime on each stage of both medical procedures and evacuation and transport to hospital. Medical personnel play an important role in combating bioterrorism; they should be prepared to diagnose and properly react to rare or atypical symptoms caused by biological agents. Thus professional training for this professional group is necessary [5, 6]. Most respondents (87%) admitted that their knowledge of biological attack and management of an infectious patient was not satisfactory, 92% nurses confirmed the need for education and training on bioterrorism and management in case of

an attack. This opinion was shared by 96% of the questioned students from the 5<sup>th</sup> year of Public Health, Medical University in Łódź [7]. The interviewed nurses (97%) indicated the need to educate the public and shape public opinion on bioterrorism to limit effects and consequences of a potential attack. Educated nurses may become excellent "educators for safety". Education on public safety and prophylaxis is an important part of teaching process aiming at teaching civic duties, healthy lifestyle and ecology. National educational system is to shape proper attitudes and behaviour which results in public awareness and increases national security [8, 9].

## 5. CONCLUSIONS

1. In the present political situation of Poland, the nurses consider a bioterrorist attack a real threat.
2. The respondents are aware of bioterrorism, can name risk factors, targets, and epidemiological clues suggesting the use of biological agents.
3. Majority of the respondents find their knowledge of bioterrorism not satisfactory and indicate the need for education of both medical personnel and the public.

## AUTHORS' CONTRIBUTION

All authors contributed equally to this work, read and approved the final manuscript.

## TRANSPARENCY DECLARATION

The authors declare no conflicts of interest.

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