A Study for the Production of Containers Used in the Diagnosis and Prevention of Infection

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Objectives: *1. To study the need of containers used in the diagnosis and prevention of infection.*
2. To produce the containers,
3. To test the practicability of the product.

Material and Method : *- The study on the need of the containers was done by questionnaires answered by nurses and microbiology laboratory technicians in 56 hospitals.*
- The containers were produced by the researchers who later had them tested for their practicability by nurses and technicians in the same hospitals.
- The study was done during 2002-2004.

Results : *Fifty-six hospitals were enrolled by stratified random sampling. Questionnaires were responded by 424 nurses and 35 microbiology laboratory technicians. Sputum trap, body fluid and feces containers and needle disposal box were studied and the need for commercial products was 31.1%, 31.1%, 32.3% and 99.5% respectively. Sixteen percent to 58.5% of these containers were bought and 14.3% to 68.6% were home-made. Sputum trap, body fluid and feces containers, and needle disposal boxes were produced and tested by 400 nurses and 32 laboratory technicians. The products were evaluated as satisfactory in 59.4% to 80.0%. The lid of the needle disposal box designed as saw tooth was not convenient for use and was later modified to various slits. The costs of the containers produced were 1.3% to 29.8% of available commercial products.*

Conclusion : *Sputum trap, body fluid and feces containers and needle disposal boxes of reasonable prices were needed in Thailand. These containers could be produced locally and were much cheaper than available commercial ones.*

Keywords : *Containers, Diagnosis, Prevention, Infection*

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Containers used in clinical medicine are for collection of specimens for laboratory tests and for disposal of hazardous wastes especially sharps. These containers should be convenient for use, safe, disposable by burning and at affordable prices especially for less privileged countries[1,2]. These containers should be leak proof, screw-capped, unbreakable and preferably made of thin plastic to avoid reaction with clinical specimens. Occupational exposure to blood and body fluid is common and could result in fatal infection[3-5]. The less-experienced working in emergency wards are more prone to these accidents[3,6-8]. Needlestick and sharp injuries are as common as one accident for every registered nurse in the United States[3]. Safety needles, needless injection devices have been marketed to reduce the risk of needlestick[1,3,6]. As recapping and disposal of used needles are major causes of needlesticks[9], safe needle disposal containers have been produced. These disposal boxes are hardly affordable in developing countries. Laboratory personnel are at high risk of exposure to infection[10-12] and of

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whom a significant number have died. Safe containers for clinical specimens can reduce the risk of spillage on non-intact skin, mucous membranes of the persons who collect and transport the specimens as well as laboratory workers.

Containers for sputum, urine, body fluids, feces and needle disposable boxes have been produced commercially and used in developed countries. These products are considered too expensive for developing nations. Healthcare workers in these countries have to make the containers with available materials, for example, medicine bins, intravenous fluid bottles etc. The risks of leakage, spillage and breakage of these substandard containers are high. A study on the problems in using, need and the possibility of mass production of the containers was done in Thailand during 2002-2004.

Material and Method

The sources of supply, problems and the need of sputum traps, containers for urine, body fluids and feces and needle disposal boxes were studied by a set of questionnaires to head nurses or nurses, microbiology laboratory technicians in 56 hospitals. They were enrolled by stratified random sampling. After obtaining the results of high demand for finished products, the researchers produced the containers, mainly on the advice of nurses and laboratory technicians. The containers were test-used in the same hospitals. Evaluation of the products regarding size, color, convenience for use, leak proof, tight lids, unbreakability, and overall preference were also reported. Major defects of the products, if there were any, were later corrected. Cost of the products were compared with commercial ones.

Descriptive statistics were used in the analysis of the data.

Results

The hospitals in the present study were enrolled by stratified random sampling. As shown in Table 1, there were 3, 10, 15, 25 and 3 university, regional, provincial, district and private hospitals. They represented hospitals of different sizes, and in different regions of Thailand. A set of questionnaires on the sources of supply, problems in practice and the need for commercial products at a reasonable price were sent to head nurses/nurses in various clinical departments as well as microbiology laboratory technicians. With the help of coordinating infection control nurses, all questionnaires were responded. As shown in Tables 2, 4 head nurses/nurses and 35 laboratory technicians

Table 1. Hospitals enrolled

Hospitals	No	%
University	3	5.4
Regional	10	17.9
Provincial	15	26.8
District	25	44.6
Private	3	5.4
Total	56	100

Table 2. Persons answered the questionnaires

Hospitals	Nurses		Technicians	
	No	%	No	%
University	56	13.2	3	8.6
Regional	138	32.5	14	40.0
Provincial	150	35.4	15	42.8
District	50	11.8	-	-
Private	30	7.1	3	8.6
Total	424	100	35	100

Table 3. Supply of sputum traps (%)

Supply	Nurses	Technicians
Commercial	52.4	48.6
Home-made	34.9	14.3
Other	12.7	37.1

Table 4. Supply of body fluid containers (%)

Supply	Nurses	Technicians
Commercial	47.4	20.0
Home-made	52.4	28.6
Other	0.2	51.4

Table 5. Supply of feces containers (%)

Supply	Nurses	Technicians
Commercial	58.5	37.1
Home-made	35.8	40.0
Other	5.7	22.9

answered the questionnaires. The sources of supply of the containers are presented in Tables 3-5 and of needle disposable boxes in Table 6. About one-half of the sputum traps, containers for urine and body fluid and feces were commercial products and about one-third were made in the hospitals. Two-thirds of the personnel made needle disposal boxes with available materials, for example, medicine bins, intravenous bottles and in a few hospitals, soft drink cans.

Table 6. Supply of needle disposal boxes (%)

Supply	Nurses	Technicians
Commercial	16.0	17.1
Home-made	63.2	68.6
Other	20.8	14.3

Table 7. Problems in using containers (%)

Containers	Nurses	Technicians
Sputum trap	60.6	85.7
Body fluid	58.9	88.6
Feces	56.8	62.9
Needle disposal	19.1	45.7

Table 8. The need of commercial products by nurses (%)

Containers	Need
Sputum traps	31.1
Body fluid containers	31.1
Feces containers	32.3
Needle disposal boxes	99.5

Problems in using containers and needle disposal boxes are shown in Table 7. Difficulty to operate,and leakage were the main problems in using sputum traps. Leakage and different sizes, shapes of body fluid containers were experienced by over one half of the nurses and laboratory technicians. The main problems in using feces containers were difficulty in collecting specimens, breakage of containers and leakage of the specimens. Difficulty in dislodging used needles was the most common problem for needle disposable boxes. The need of commercial products is

Table 10. Evaluation of the sputum trap

Items	%
Proper size	66.4
Proper color	76.4
Convenience	62.5
Leak proof	65.3
Tight lid	79.6
Unbreakability	80.8
Ward preference	66.3
Laboratory preference	62.5

Table 11. Evaluation of the urine and body fluid container

Items	%
Proper size	80.3
Proper color	61.8
Convenience	82.9
Leak proof	62.3
Tight lid	88.2
Unbreakability	91.0
Ward preference	79.8
Laboratory preference	59.4

Table 9. Persons evaluated the products developed by researchers

Hospitals	Nurses	%	Technicians	%	Total	%
University	57	14.3	3	9.4	60	13.9
Regional	132	33.0	8	25.0	140	32.4
Provincial	142	35.5	12	37.5	154	35.6
District	39	9.8	6	18.8	45	10.4
Private	30	7.5	3	9.4	33	7.6
Total	400	100	32	100	432	100

shown in Table 8, about one-third of the nurses wished to have commercial sputum traps, urine and body fluid and feces containers and almost all nurses preferred commercial needle disposal boxes.

The researchers produced sputum traps, containers for urine and body fluid and feces and needle disposal boxes (Fig. 1-3). These products were sent to the above hospitals for test-use. Evaluation of the products was done by 400 nurses and 32 laboratory technicians (Table 9). The results of evaluation are given in Tables 10-13. Over one-half of the evaluators were satisfied with the different characters of the products except the lid of the needle disposal box. The first produced lid had a saw-tooth opening in the middle and it was difficult to dislodge the needles.It was later changed to slits in the lid for disconnecting the needles from syringes.

The costs of the products by the researchers were much less accounting for 1.25% to 29.8% of the prices of commercial body fluid containers and feces containers respectively (Table 14).

Table 12. Evaluation of the feces container

Items	%
Proper size	64.4
Proper color	71.5
Convenience	77.8
Leak proof	67.1
Tight lid	87.0
Unbreakability	88.7
Ward preference	80.0
Laboratory preference	59.4

Table 13. Evaluation of the needle disposal box

Items	%
Proper size	70.4
Proper color	99.8
Convenience	47.5
Leak proof	68.3
Tight lid	80.8
Puncture resistance	90.3

Table 14. Cost of the containers (baht)

Containers	In Use	Researcher's
Sputum trap	0.7-95	10.7
Body fluid container	0.7-200	2.5
Feces container	0.5-8.4	2.5
Needle disposal box	50-300	28

Discussion

Containers for collecting clinical specimens and needle disposal boxes of good quality were not affordable in developing countries. The study in 56 hospitals (Tables 1-2) across Thailand demonstrated that about one-half of the sputum traps, urine, body fluid, and feces containers were home-made (Tables 3-5) as were two-thirds of needle disposal boxes (Table 6). The containers were made by healthcare workers, mainly nurses, from available materials. Medicine bins, boxes, fragile plastic containers, intravenous fluid bottles were modified and used in most hospitals. In some, soft drink cans were used and found to be practical in dislodging needles from syringes. The hole in the lid was covered with an adhesive tape before discarding. This was local wisdom but problems encountered were too small in size and the adhesive tape might peel off the lid and the needles fell off the containers.

The problems in using home-made, low quality containers, as shown in Table 7, were discouraging. Leakage, spillage and difficulty in collecting specimens and opening the containers in the clinical laboratories were the main problems encountered. The leakage of specimens from the containers can contaminate mucous membranes or non-intact skin of persons who handle the specimens. They include doctors, nurses who are responsible for collecting clinical specimens, workers for carrying the specimens from wards to laboratories and laboratory personnel for handling the containers for processing. Needlestick and sharp injuries were common among healthcare workers[3-9]. Nurses and the less-experienced clinical students were the most vulnerable to exposure to infectious agents. The incidents occurred during blood-drawing, placing intravenous catheters, administration of medication, during recapping needles and during needle disposal[9]. The exposure could result in fatal infection, for example, human immuno deficiency virus infection and others[10-12]. Modification of human behavior at work to reduce the risk of exposure can be done by education and supervison[1]. Engineering control by producing safe equipment, for example, safe needles, needleless injection can decrease needlestick and sharp injures[1,3]. These products, unfortunately, are expensive and in

Fig. 1 Sputum traps

Fig. 2 Container for urine, body fluid and feces

Fig. 3 Needle disposal box

most developing countries, are not affordable[9]. Locally produced containers with good quality at reasonable price can be a solution to this problem.

The researchers produced a sputum trap, a container for urine, body fluid and feces and a needle disposal box on the advice of healthcare workers (Figures 1-3). These products were sent to the same hospitals for evaluation by 400 nurses and 32 laboratory technicians (Table 9). Properties of the products to be evaluated included : size, color, convenience, leakproof, tightness of the lid, and unbreakability. An overall assessment was also requested. Results of evaluation of the sputum trap, container for urine, body fluid and feces were satisfactory (Table 10-12). The needle disposal box, however,was criticized about the hole in the lid for dislodging needles. The original product had a saw-tooth hole in the lid resulting in difficulty in disconnecting needles from syringes. The lid was later modified with slits of various sizes for dislodging needles. The cost of the products was much lower than the commercial products (Table 14) accounting for 1.3% of the latter for body fluid containers and 29.8% for feces containers.

Conclusion

The need for containers used for the diagnosis and prevention of infection was high. Production of a sputum trap, container for urine, body fluid and feces and needle disposal box can be done locally and at affordable costs.

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การศึกษาเพื่อผลิตภาชนะที่ใช้ในกระบวนการตรวจและป้องกันการติดเชื้อ

สมหวัง ด่านชัยวิจิตร, ไพโรจน์ สุวรรณสุทธิ, ศิริพร ศรีพลากิจ, เทพนิมิตร จุแดง

วัตถุประสงค์ : *1. ศึกษาความต้องการของภาชนะที่ใช้ในกระบวนการตรวจและป้องกันการติดเชื้อ 2. ผลิตภาชนะ 3. ทดสอบคุณภาพของภาชนะที่ผลิต*

วัสดุและวิธีการ : *ศึกษาความต้องการของภาชนะโดยใช้แบบสอบถามพยาบาลและนักวิทยาศาสตร์ห้องปฏิบัติการจุลชีววิทยาในโรงพยาบาล 56 แห่ง ผลิตภาชนะข้างต้นขึ้นและนำไปทดสอบใช้และประเมินในโรงพยาบาลข้างต้น*

ผลการศึกษา : *การศึกษานี้ระหว่าง พ.ศ. 2545-2547 กระทำในโรงพยาบาลที่สุ่มศึกษา 56 แห่ง ผู้ตอบคำถามปัญหาการใช้แหล่งของผลิตภัณฑ์ และความต้องการภาชนะเหล่านี้ได้แก่ พยาบาล 424 คนและนักวิทยาศาสตร์ 35 คน ความต้องการซื้อภาชนะเก็บเสมหะ, ภาชนะบรรจุสารน้ำร่างกายและอุจจาระ และกล่องทิ้งเข็มที่ใช้แล้วเท่ากับร้อยละ 31.1, 31.1, 32.3 และ 99.5 ตามลำดับ ร้อยละ 16 ถึง 58.5 ของผู้ตอบซื้อภาชนะเหล่านี้ และร้อยละ 14.3 ถึง 68.6 ผลิตขึ้นใช้เองโดยใช้วัสดุที่หาได้ คณะผู้วิจัยได้ผลิตภาชนะข้างต้นขึ้นและทดสอบใช้ในโรงพยาบาลเดิมโดยมีผู้ประเมินเป็นพยาบาล 400 คน และนักวิทยาศาสตร์ 32 คน ภาชนะที่ผลิตได้รับความพึงพอใจ ร้อยละ 59.4 ถึง 80.0 ฝาของกล่องทิ้งเข็มใช้แล้วเดิมทำเป็นแบบฟันเลื่อย ไม่สะดวกต่อการใช้จึงดัดแปลงทำเป็นช่องขนาดต่าง ๆ กัน ต้นทุนของภาชนะที่ผลิตเท่ากับ 1.3% ถึง 29.8% ของราคาจำหน่ายในท้องตลาด*

สรุป : *ความต้องการซื้อมีมากสำหรับภาชนะเก็บเสมหะ ภาชนะเก็บสารน้ำร่างกายและอุจจาระ กล่องทิ้งเข็มใช้แล้วที่มีราคาพอสมควร ภาชนะเหล่านี้ผลิตได้เอง และมีต้นทุนต่ำกว่าราคาที่จำหน่ายในท้องตลาดอย่างมาก*