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Analysis of the Polish Market Potential for Innovative Medical Products Made of Alginate Fibres, with Special Reference to Alginate Wound Dressings

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Abstract

The article presents an analysis of the market potential in Poland for different applications of medical products made of alginate fibres. Emphasis is especially put on wound dressings; however, such issues as tissue engineering or alginate fibres for other specific medical use are also considered. A SWOT (Strengths-Weaknesses-Opportunities-Threats) analysis of the Polish market for medical products made of alginate fibres, a comparison of prices of different wound dressings produced with the use of such fibres, and predictions for the future for such products in Poland are presented, as well as an analysis of the own research of the authors of the market potential of specialist alginate wound dressings conducted among Polish surgeons during the 65th Congress of the Polish Surgeons' Association.

Key words: medical products, alginate fibres, wound dressings, Polish market.

Introduction

Alginate is a commonly known polysaccharide obtained from seaweed, mainly brown seaweed (*Phaeophyceae*) or produced from some bacteria, such as *Azotobacter vinelandii*, *Pseudomonas aeruginosa* and *Pseudomonas fluorescens*. In pharmaceutical applications macro-particles of alginate are used as carriers for immobilising of cells, enzymes and proteins, as well as for controlled release of medicines, due to their unique properties, such as their natural origin, biocompatibility and relatively low cost. The specific properties of alginate fibres support the process of wound healing, and show high absorption, as well as hemostatic and ion-exchanging properties. All these have led to increased importance of their use in medical applications, mainly in a range of materials for wound dressings (also with additives or nano-additives – for example silver) and materials for tissue engineering – mainly in the regeneration of skin or bone tissue, in the engineering of liver tissue and blood vessels (as foundations) [1 - 5].

Wound dressings and other medical materials and products containing or made of alginate fibres in the world are commonly used, however in Poland there are not many of them on the market so far, and their usage is not widespread. What is more, the production of alginate, its salts and esters is relatively small in the European Union [10]. That is why it was found that an analysis of a possible market potential for innovative medical products made of alginate fibres could be useful for enterprises and organizations

that deal with fields where such products are used, researched and/or produced.

Analysis of potential consumers of medical products made of alginate fibres in Poland

Due to their unique properties, the users of alginate fibres can be, first of all, the producers of innovative wound dressings for hard healing wounds with exudation and bedsores, as well as companies producing materials for tissue engineering (for example, regeneration of skin or bone tissue). The range of such companies includes both large international corporations that have their branches in Poland, for example 3M, and innovative small and medium enterprises. The list of examples of wound dressings made of alginate fibres, or with their share, currently available on the market is given in the latter part of the article.

An interest in final medical products made of alginate fibres, or with their share, by hospitals and private clinics, apart from single customers, can also be shown.

Table 1 shows a significant increasing trend in the number of private hospitals and clinics in Poland. Comparing the years 2008 and 2000, an increase of over 600% can be observed. This trend is connected with the need for better, private medical care (the attitude of a patient: 'I pay for the service therefore I demand'), and what follows is the necessity of ensuring the patients of private hospitals and clinics better healthcare (including wound dressings), enabling faster recovering. It can be vital for producers of wound dressings made of alginate fibres, which fit this segment of the market very well. As it will be presented later in the paper, the analysis performed among the Polish surgeons also showed that private hospitals and clinics should be more willing to invest in innovative alginate wound dressings that facilitate patient healing and decrease her/his pain, even if the price of such wound dressings was higher than that of others currently available on the market.

Another trend that can influence this market is an increasing number of people that have been healed in surgical wards in Poland in recent years, which has resulted in an increased demand for spe-

Table 1. Number of hospitals in Poland [6]; **Source:** Statistical Yearbook of Poland 2009.

Year	2000	2005	2007	2008
Hospitals total	716	781	748	732
Public hospitals	686	611	578	546
Private hospitals and clinics	30	170	170	186

cialist wound dressings for hard healing wounds and bedsores. **Table 2** shows that from the year 2000 to 2008 the number of such people increased by over 14%. It is also worth noticing that the percentage of patients who required specialist wound dressings facilitating the healing of wounds was estimated by the surgeons who took part in the research conducted by the authors to be 5 - 10% of patients from each ward. Hence the total size of the market for specialist wound dressings, which can also be supplied with alginate wound dressings, can be estimated to be around 100 – 200 thousand patients yearly in Poland.

What is more, the number of pharmacies where individual customers can purchase medicines and wound dressings in Poland has also increased. In the year 2008 there was almost 28% more of them than in the year 2000 (10628 in 2008 in comparison to 8318 in 2000 [6]).

It is also worth mentioning that wound dressings made of alginate fibres or with their share can be used in curing both people and popular pets, which has increased their target group greatly. Healing pets is very specific and in the case of traditional wound dressings often requires long-lasting and constant care by their owners, which can be troublesome (for example the usage of a special collar for cats and dogs necessary for the complete healing of the pet's wounds may disturb normal functioning of the family and cause damage to furniture and other home items). It is caused by the fact that pets, by licking their wounds, do not let them heal, and in most cases they do not tolerate foreign bodies (in the form of dressings and bandages) on their own body and try to remove it immediately after being placed (that is why there is a necessity of using the special collar). Wound dressings made of alginate fibres shorten the time of healing of hard healing wounds with substantial exudation and may contribute to a lesser engagement of the pet's owner(s) in the healing process, which may cause high interest in wound dressings of this type.

Apart from wound dressing materials, alginate fibres are also used in tissue engineering, for example in the regeneration of skin or bone tissue, or in the engineering of liver tissue and blood vessels (mainly as foundations). It is a field with great prospects and the EU market is opening for such products. Currently the demand of the market only for substitutes

Table 2. Number of people (in thousands) treated yearly in surgical wards in Poland [6]. **Source:** Statistical Yearbook of Poland 2009.

Year	2000	2005	2007	2008
People treated in surgical wards (thousands of people)	1680	1861	1851	1921

Table 3. Wound dressings made of alginate fibres available on the Polish market. **Source:** Own elaboration based on internet data.

Producer	Name of product	Available dimensions, cm	Price, PLN
TZMO Toruń	Medisorb A	6 × 6	From 15 to 20 for 3 pcs.
		10 × 10	From 35 to 45 for 3 pcs.
Hartmann (internet shop: https://www.hartmann24.pl)	Sorbalgon	5 × 5	11 for 3 pcs. 36 for 10 pcs.
		10 × 10	26 for 3 pcs. 87 for 10 pcs
ConvaTec (internet shop: http://www.media-med.pl/)	Kaltostat	5 × 5	2.77 for 1 piece (purchase up to 10 pcs.) 2.67 for 1 piece (purchase of over 10 pcs.)
		7,5 × 12	9.51 for 1 piece (purchase up to 10 pcs.) 9.17 for 1 piece (purchase of over 10 pcs.)
		10 × 20	21.39 for 1 piece (purchase up to 10 pcs.) 20.64 for 1 piece (purchase of over 10 pcs.)
ConvaTec (internet shop: http://www.media-med.pl/)	Algisite Ag	5 × 5	8.65 - 9.06 for 1 piece
		10 × 10	25.93 - 27.17 for 1 piece
		10 × 20	50.42 - 52.83 for 1 piece
		2 × 30	30.61 - 32.07 for 1 piece
ConvaTec (internet shop: http://www.media-med.pl/)	Algisite M	5 × 5	7.56 - 7.87 for 1 piece
		10 × 10	12.86 - 13.39 for 1 piece
		15 × 20	32.89 - 34.25 for 1 piece
		2 × 30	27.76 - 28.90 for 1 piece
Johnson & Johnson (internet shop: http://www.media-med.pl/)	Silvercel	5 × 5	16.61 - 17.33 for 1 piece
		11 × 11	33.23 - 34.67 for 1 piece
		10 × 20	46.73 - 48.75 for 1 piece
		2.5 × 30.5	51.92 - 54.17 for 1 piece

of skin in Europe is estimated at about 400 – 800 million Euro. Current production represents only a few percent of this value. On the other hand the global demand for tissue engineering products is estimated at even 400 billion Euro. The European market is at an early stage of development, but according to the estimates of the European Commission, starting from 2009, it should increase by 10% yearly and in the year 2010 be equal in value to the American market [7].

An increase in the global market connected with tissue engineering and regenerative medicine is estimated at 16% yearly, up to the year 2013, according to the report 'Worldwide Markets and Emerging Technologies for Tissue Engineering and Regenerative Medicine' elaborated by the Life Science Intelligence organisation, which delivers high quality and credibility data and information concerning the medical technologies' market [8]. These estimations show the huge poten-

tial for the future of medical products produced with the use of alginate fibres.

In Europe there are about 113 companies dealing with tissue engineering, but in Poland currently the production of materials in this field is undertaken by only one company – Euroimplant S.A.. This enterprise is the only Polish company that was invited to be part of a consortium created for the needs of the EU project in the 7FP (Framework Programme) of the European Commission. This consortium will be dealing with researching new, 'intelligent' biomaterials for tissue engineering used, apart from other applications, in the regenerative surgery and orthopaedics. The consortium will be constituted by academic institutions and world leaders among pharmaceutical companies. The European Commission estimates the value of the whole project to be 105 million Euro [9]. What is more, this company has also received several other subsidies, which shows that

Table 4. Examples of wound dressings made of alginate fibres available on the international market. **Source:** Own elaboration based on internet data.

Producer	Product
Dumex Medical	AlgiCell
Bard	AlgiDERM
Swiss-American	Askina Sorg
Carrington	CarraSorb H, CarraGinate
Kendall/Tyco	Curasorb, Curasorb Zinc
Sherwood – Davis & Geck	Dermacea
DermaRite	DermaGinate, DermaGinate AG
B. Braun	FyBron
Gentell	Gentell
Hyperion Medical	Hyperion Advanced Alginate Dressing
DeRoyal	Kalginate, Algidex
Medline	Maxorb
Molnlycke Health Care	Melgisorb
Ferris Mfg.	PolyMem
Hollister	Restore CalciCare
Mylan Bertek	Sorbsan
Poloplast Corp.	SeaSorb
3M Health Care	Tegagen

the field in which it acts is seen as highly promising by the EU and governmental institutions. In 2008 the company also had its IPO (initial public offering) on the alternative market of the Warsaw Stock Exchange – the NewConnect. It gained over 11 million PLN from going public. In March 2011 the company moved to the main market of the Warsaw Stock Exchange, which also shows that financial investors see the potential of this kind of business.

Alginate wound dressings available on the Polish market

On the Polish market currently there are wound dressings produced from alginate fibres mainly by big international companies. Among Polish producers the only one that can be mentioned is TZMO Toruń. The precise list of those products that can be bought in Poland is given in **Table 3** (products available as of the 1st May 2010).

Alginate wound dressings available on the international market

On the international market there is a much greater choice of wound dressings made of alginate fibres, examples of which are given in **Table 4**.

SWOT analysis for alginate wound dressings on the Polish market

The SWOT analysis (Strengths-Weaknesses-Opportunities-Threats) is a simple tool for estimating the potential on a given market of a company, technology or a product. In this case it was decided to use it in order to assess the potential of the Polish market with respect to wound dressings made from alginate fibres.

Strengths

- High innovativeness of the technology on the Polish scale;
- Very good properties in the process of wound healing;
- Relatively low production costs;
- The biodegradability of alginate fibres is in compliance with current world trends, which are based on ecology and the smallest interference in the natural environment (the so called 'green revolution' and sustainable growth in all fields of the economy). This can be significant from the point of view of applying for the financing of investments in a technology connected with alginate fibres from EU programmes.

Weaknesses

- Possible differences in the properties and colour of the fibres, depending on the region of the world from which the alginate originates;
- Risk of changing exchange rates of the Euro currency, which may result in price variations of the raw material.

Opportunities

- The higher and higher interest of people in modern and innovative technologies connected with health;
- Utilisation of the internet in advertising products with alginate;
- Due to the high innovativeness of the technology, it is possible to apply for the financing of investments connected with it from EU programmes (for example the POIG – Operational Programme Innovative Economy);
- The export of wound dressings from alginate fibres produced in Poland to highly developed countries of the EU can be an opportunity due to the fact that Polish labour costs are still competitive in relation to those countries.

Threats

- Low awareness of products containing alginates among Polish society;
- Competition from other materials with similar properties;
- Currently on the Polish market there is only one importer of alginate, which results in the high dependence of production costs on its price; however, from the point of view of the repeatability of the properties of the raw material it is a positive aspect;

The SWOT analysis presented above illustrates very well the potential that is hiding in alginate wound dressings for the Polish market. The strengths identified in the analysis in relation to the opportunities definitely exceed the threats from the market and should give some suggestions concerning the probable manufacturing of these products, especially as one of the weaknesses that was found while performing the analysis was paradoxically eliminated by one of the threats emerging from the Polish market; however, the second one should not be a problem when Poland enters the Euro zone.

Research of the market potential of specialist alginate wound dressings conducted among Polish surgeons during the 65th Congress of the Polish Surgeons' Association

Market potential research was conducted for three new types of alginate wound dressings that are currently being developed within the project entitled: 'Manufacturing of biodegradable, hybrid composites based on lactide nano-fibres and alginate nanocomposite fibres for medical use' financed by the National Centre for Research and Development (NCB&R), realised at the Department of Man-Made Fibres, the Department of Material and Commodity Sciences and Textile Metrology at the Lodz University of Technology and at the Department of Biomaterials of the AGH University of Science and Technology in Cracow. The three types of specialist wound dressings that will be developed by the end of the project are:

- Wound dressings made of copper, calcium and sodium alginate fibres, with their different shares, containing nano-silver, which apart from the specific action of alginates – supporting the process of wound healing – will

also ensure the antibacterial properties of the wound dressing. The fact that the wound dressings will be made of fibres from all of the above-mentioned alginates will ensure that the wound dressings will have the beneficial properties of all of them (sodium alginate will ensure that the wound dressing is soluble in physiological fluids, which will enable painless removing of the wound dressing; calcium alginate will ensure high sorption properties and will cause the absorbing of secretion from the wound, and the fibers of copper alginate during contact with skin show the ability to generate a negative static electric charge). This will be beneficial for the wound surrounding, while causing a decrease in pain for the patients.

- B) Wound dressings intended for skin lesions without exudation, for example bedsores or wounds in the period of granulation. The ingredients of such multifunctional nonwoven wound dressings will also be fibres of calcium alginate containing nano-silver.
- C) Nonwovens made of nano-composite fibres of sodium and calcium alginates (containing nano-silver) intended for infected or hard healing wounds at an early stage of healing.

The research was conducted on a sample of 47 surgeons during the 65th Congress of the Polish Surgeons' Association that took place in Łódź from 14th to 17th September 2011. The total number of surgeons that took part in the Congress was over 2300. It is the biggest event of this type organised for surgeons in Poland. The respondents were selected randomly, and the entities in which they work are located in most of the regions of Poland, which enables to state that the sample of the research is representative for the whole of Poland. The percentage distribution of the regions in which the respondents work is shown in **Figure 1**.

The surgeons surveyed work in public hospitals (more than 70% of respondents), private hospitals or clinics (61.7%) and in non-public health care centres (NZOZ – 27.66%). Some of them work in 2 or more of the entities mentioned. A detailed distribution is shown in **Figure 2**.

In order to examine the market potential for new types of specialist wound dressings the respondents were asked if the entities in which they work already use some kind of specialist wound dressings that facilitate healing. As it was possible

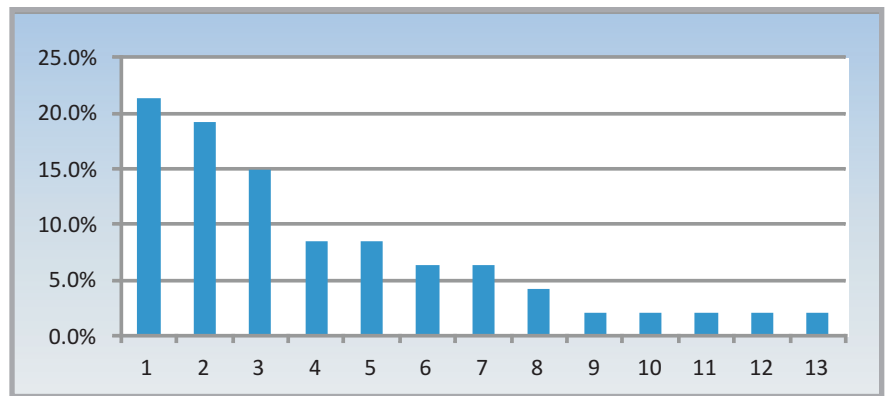


Figure 1. Regional distribution of the workplace of respondents (districts of Poland); 1 – Greater Poland; 2 – Łódź province; 3 – Masovian; 4 – Lesser Poland; 5 – Pomeranian; 6 – Silesian; 7 – West Pomeranian; 8 – Lower Silesian; 9 – Subcarpathian; 10 – Warmian-Masurian; 11 – Kuyavian-Pomeranian; 12 – Lubuskie province; 13 – Podlaskie province. **Source:** Own calculations based on the results of survey research.

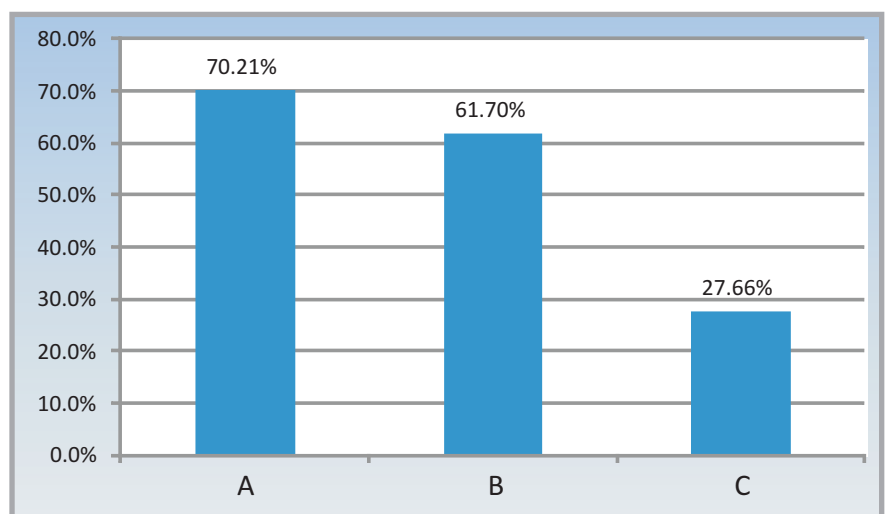


Figure 2. Types of medical entities in which the respondents work; A) Public hospital, B) Private hospital/clinic, c) NZOZ (Non-public health care centres). **Source:** Own calculations based on the results of survey research.

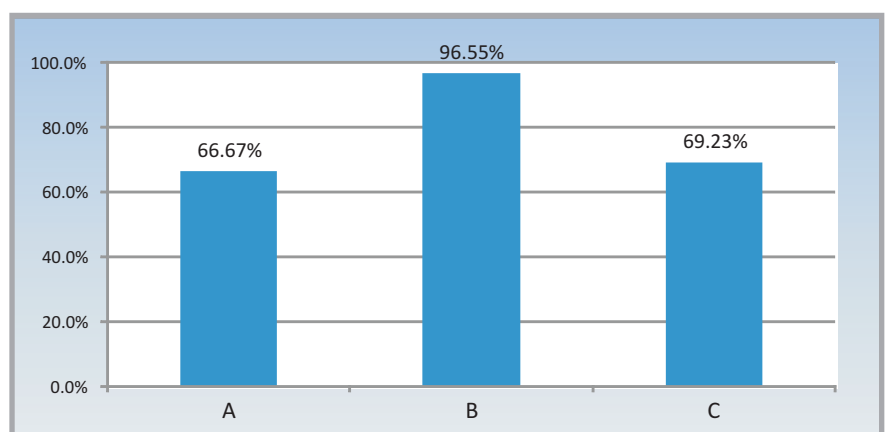


Figure 3. Utilisation of specialist wound dressings in medical entities in which the respondents work; A) Utilisation in public hospitals, B) Utilisation in private hospitals, C) Utilisation in NZOZ (Non-public health care centres). **Source:** Own calculations based on the results of survey research.

to predict the highest level of utilisation of such wound dressings was recorded for private hospitals and clinics and was equal to almost 97%. Thus one can say

that specialist wound dressings are utilised in almost every private medical facility of such type in Poland. The utilisation in NZOZ and public hospitals was at

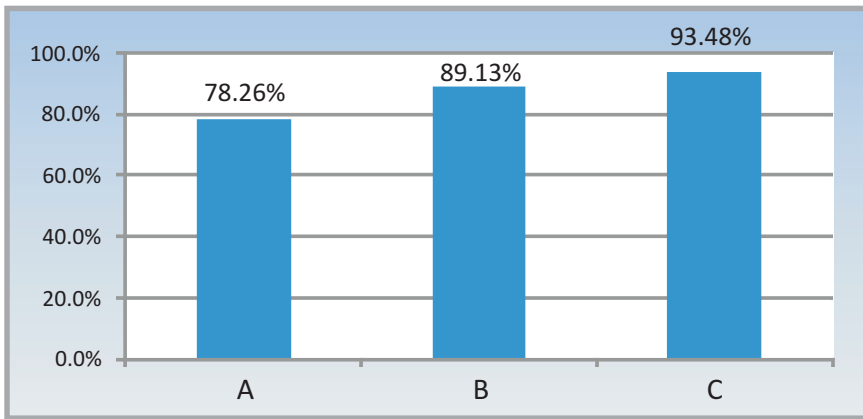


Figure 4. Interest of the respondents in the respective types of new wound dressings (A – wound dressings made of copper; calcium and sodium alginate fibres, with different shares thereof, containing nano-silver; B – multifunctional nonwoven wound dressings made of fibres of calcium alginate containing nano-silver intended for skin lesions without exudation, C – nonwovens made of nano-composite fibres of sodium and calcium alginates containing nano-silver, intended for infected or hard healing wounds at an early stage of healing). **Source:** Own calculations based on the results of survey research.

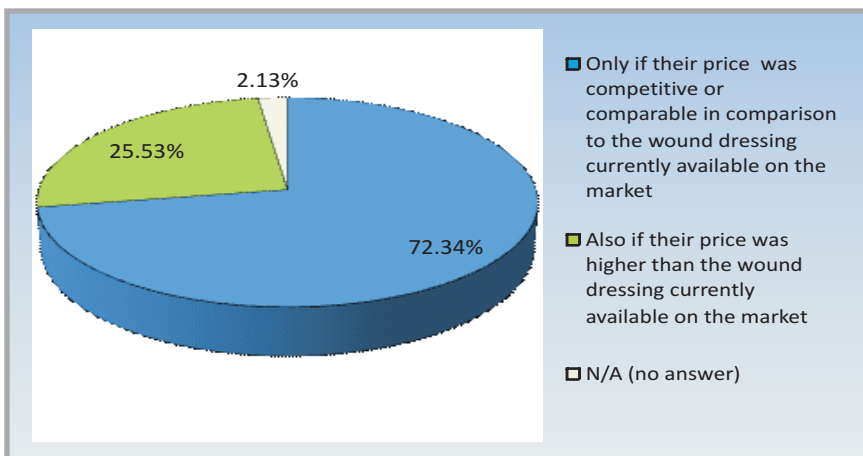


Figure 5. Willingness to purchase the new types of wound dressings with reference to their price. **Source:** Own calculations based on the results of survey research.

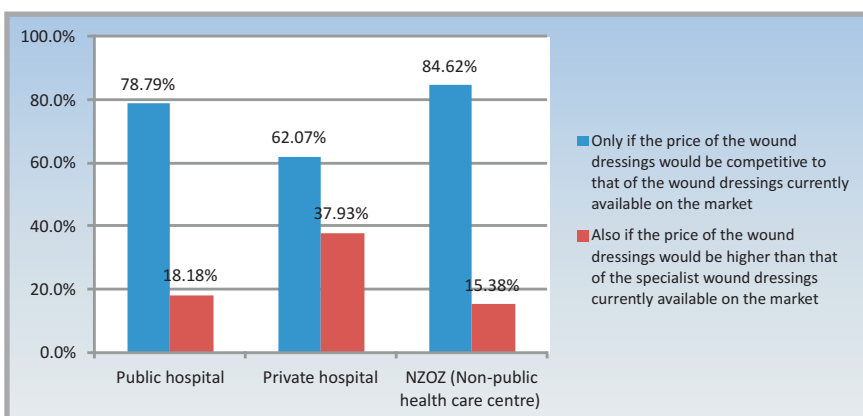


Figure 6. Willingness to purchase the new types of wound dressings with reference to their price, the comparative analysis for 3 types of medical entities. **Source:** Own calculations based on the results of survey research.

a lower and comparable level, as can be seen in **Figure 3**.

At the same time it is worth noticing that out of all the surgeons (47) that took part

in the research only 1 declared that he would not be interested in the new types of wound dressings described above. This was caused by the fact that specialist wound dressings are simply too ex-

pensive for the public hospital in which he works, as was stated. The others were greatly interested in the new types of wound dressings presented earlier in the analysis, which can be seen in **Figure 4**.

The respondents were also asked if interest in the new wound dressings would be dependent on their price. It appeared that 25.5% of them would be willing to buy the new types of wound dressings for their entities even if the price was higher than that of wound dressings that are currently available on the market; however, a great majority (72.34%) would recommend purchasing those wound dressings only if the price was comparable or competitive with wound dressings currently available on the market, which can be seen in **Figure 5**.

A comparative analysis of the price dependence in comparison to the entity in which the respondents work was also performed. As could be predicted, and can be seen in **Figure 6**, the entities that are most willing to pay more for innovative wound dressings are private hospitals or clinics. This is most likely caused by the fact that those institutions care a lot more about the patients than the public hospitals, and as the numbers of such entities increases in Poland, which was shown earlier in the article, it also gives a basis for promising predictions of possible good margins for companies that would be willing to produce such types of wound dressings.

To sum up the analysis of market potential based on the research performed among Polish surgeons and on the macroeconomic factors presented earlier in the paper, it should be stated that the three types of innovative alginate wound dressings are very promising from the point of view of their implementation on the Polish market. There is high interest from surgeons, which was shown by the survey, the reason for which is that the number of private hospitals and clinics (which are mostly interested in new types of specialist wound dressings) is growing significantly in Poland, with the other determinants presented also being positive.

Conclusions

From the research and analyses performed for the purpose of this article it results that medical products manufactured from alginate fibres, or with their share, especially specialist alginate wound dressings, are highly promising with reference to the Polish market, due to the higher and high-

er interest of Polish society and Polish specialists in modern and innovative medical materials and products. Another reason are the possibilities of financing projects connected with biomedical technologies offered by the European Union. Macroeconomic trends that are currently visible in the Polish medical market, presented in the article - an increasing number of private hospitals and clinics, an increasing number of patients in surgical wards, etc. – also give a basis for promising predictions for the future for medical products containing and made of alginate fibres. However, in order to get a full view of this market it would be recommended to perform another research in society, this time among consumers, to check the demand for such products in households and among veterinarians to estimate the possible demand for wound dressings for pets.

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