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## Relevant chemistry topics for the clinical practice of a physiotherapist

### Abstract

Physiotherapist is a discipline whose aim is to preserve, restore, and improve the health status of individuals with motor disturbances or at risk of developing and to improve the quality of life of people and community. The aim of this article was to determine which are the most important topics of general organic and biological chemistry courses within the physiotherapist undergraduate career at the University Bernardo O'Higgins. For this purpose we followed a model of qualitative study, applied in two different groups of people: educators of the physiotherapist career (PE) and clinical physiotherapist (CP), who were asked about the importance of topics related to chemistry courses, general, organic and biological (GOB courses). Each participant must choose a category for each topic: "important", "relevant" or "not important" for a physiotherapist clinical activity. Results show that the more frequently topics considered as "important" in both groups were from biological chemical course: proteins and its metabolism. Secondly, none of the interviewed subjects considered any of the topics of the course of organic chemistry as "important" for the clinical activity of a physiotherapist. Thus, the aim of the study is widely fulfilled and it might be concluded that future studies are required involving a larger sample size in these and other universities that will generate results for a good curricular articulation.

**Key words:** Chemistry; clinical education; physiotherapist.

## Tópicos de química relevantes para la práctica clínica de un fisioterapeuta

### Resumen

La fisioterapia es una disciplina cuyo objetivo es conservar, restaurar y mejorar la salud de los individuos que presentan o tienen riesgo de tener alteraciones motoras. El objetivo de este artículo fue determinar cuáles son los tópicos más importantes de química general, orgánica y biológica para la práctica clínica en la carrera de fisioterapia en la Universidad Bernardo O'Higgins. Para lo anterior se siguió un modelo de estudio cualitativo aplicado en dos grupos de personas: educadores de la carrera de fisioterapia (PE) y fisioterapeutas clínicos (CP) que fueron encuestados en relación a los tópicos de los cursos de química general, orgánica y biológica, denominados cursos GOB. Cada participante debía elegir una categoría: "importante", "relevante" y "no importante" de acuerdo a la práctica clínica para cada uno de los tópicos preguntados. Los tópicos que presentaron mayor frecuencia como "importante" en ambos grupos entrevistados fueron tópicos del curso de química biológica: proteínas y su metabolismo. Además, ninguno de los encuestados consideró ninguno de los tópicos del curso de química orgánica como "importante" para la actividad clínica de los fisioterapeutas. El objetivo del estudio se cumplió completamente y se puede concluir que son necesarios estudios a futuro que involucren mayor cantidad de encuestados de esta y otras universidades, de este modo se generarán más resultados para una buena articulación curricular.

**Palabras clave:** química; educación clínica; fisioterapeuta.

## Tópicos químicos relevantes para a prática clínica de um fisioterapeuta

### Resumo

A terapia física é uma disciplina cujo objetivo é conservar, restaurar e melhorar a saúde dos indivíduos que têm um estado de risco de comprometimento motor. O objetivo deste artigo foi determinar quais são os temas mais importantes da química geral, orgânica e biológica para a prática clínica na carreira de fisioterapia na Universidade Bernardo O'Higgins. Para o anterior efetuou-se um estudo qualitativo aplicado a dois grupos de pessoas: educadores da carreira de fisioterapia (PE) e fisioterapeutas clínicos (CP). Eles foram entrevistados em relação aos temas dos cursos de química geral, orgânica e biológica, chamados cursos GOB. Cada participante devia escolher uma categoria: "importante", "relevante" e "sem importância" de acordo com a prática clínica para cada um dos temas questionados. Os temas mais frequentemente apresentados como "importante" em ambos grupos entrevistados foram os temas do curso de química biológica: proteínas e metabolismo. Além disso, nenhum dos inquiridos considerou qualquer dos tópicos do curso em química orgânica como "importante" para a atividade clínica dos fisioterapeutas. O objetivo do estudo foi completamente cumprido, e pode-se concluir que são necessários estudos futuros envolvendo um maior número de entrevistados nesta e em outras universidades, desse jeito se gerarão mais resultados para uma boa articulação curricular.

**Palavras chave:** química, educação clínica, fisioterapeuta.

## Introduction

Physiotherapist is a discipline whose aim is to preserve, restore, and improve the health status of individuals with motor disorders and risk of having a stroke movement, also to improve the quality of life of the people and community (1). Physiotherapist has had a fundamental development in recent years due to increase disabled that people every day are added as a result of increased life expectancy, the increasing number of elderly people, and the grow number of chronic degenerative diseases (2).

This discipline bases its work on the human body motion, where the connection between molecules, cells, tissues, systems and organs, as well as the person in the environment, and the individual in society, are influenced by the movements of a person and, therefore, has a strong link with medicine. There have been great advances in this career, very significant in the development of public health programs in Chile. In this sense, in 1989 the Acute Respiratory Infections (ARI) rooms were created with the intention to decrease in less than ten years the high rates of infant mortality from pneumonia in Chile. Along with this, rooms of Adult Respiratory Diseases (ARD), rehabilitation and community centers were created, further enhancing of the work of physiotherapist in Primary Health Care (PHC) (3). Both examples show the public health physiotherapists importance.

During the formation of a physiotherapist, in the first career years, they have a strong education in basic science courses, centered in chemistry and biological courses, which are taught by experts in this area and not necessarily by physiotherapist. This often has consequences in relation to the contents that must be taught and how deep should be made, which may have an impact on future student performance.

According to our knowledge there are no published studies related to analyze the perception of basic science courses on the physiotherapist career. Thus, regarding the physiotherapist career importance in the health system in Chile, the main objective of the study was to determine which are the most important topics of the general, organic and biological (GOB) courses within the undergraduate of physiotherapist career.

## Materials and methods

### Methodology

This is a qualitative study in two different groups of people: educators of the physiotherapist career (PE) and clinical physiotherapist (CP). Both groups were asked through a semi-structured survey, about the importance of topics related to the chemistry area (general, organic and biological), these courses were call GOB courses. The topics asked in interviews are all topics that currently have the GOB courses at the University Bernardo O'Higgins, where the study was conducted, and the goal was to fairly evaluate the perception of the topics currently being taught.

The participants of the two groups categorized if the topics of the GOB courses that were asked were: "important", "relevant" or "not important" to the formation of a physiotherapist considering that they will work in clinical activity. According to the applied interview, the definition of the three categories is as follows:

- Important: have a direct relationship with clinical practice.
- Relevant: facilitate the understanding of central subjects, but are not directly related to clinical practice.

- Not important: it has no direct or indirect relationship with the clinical practice of a clinical physiotherapist.

The interview applied also included the possibility of each subject to add comments about their perception of each chemistry topic according to their experience, and this also was included in the results.

The list of topics that contained the survey was obtained from current programs of the institution where the study was performed and that also correspond to established topics in chemistry textbooks (4, 5, 6, 7, 8).

### Participants

The study sample consisted a group of PE with an extensive academic career over 10 years ( $n=18$ ) corresponding to 40% of all teachers that participate in the kinesiology school at the University Bernardo O'Higgins. Also were interviewed a second group of CP ( $n=11$ ), within the last three years of graduates from the University of Bernardo O'Higgins, corresponding to 60% of graduates, since this is a relatively new career at the University.

The PE, which participated in this study, have a long academic career with undergraduate students in the following courses: rehabilitation, occupational health, exercise physiology, functional anatomy, cardiovascular therapist, and basic emergency care, among others. It is for this reason that they were an important population to categorize topics, based in their own perception of basic science courses, also because they have an extensive experience, focused on clinical specialty courses.

The CP participants corresponded to graduate students from University Bernardo O'Higgins within the last three years, which allow them to provide the latest vision of how the topics of the GOB courses influence clinical practice.

### Data collection

The data collection was conducted through individual interviews to the participating subjects where a semi-structured survey was applied. This method allows categorizing all the topics of the GOB courses according to individual experience and knowledge of participants (9).

Applied interview had all the topics of the GOB courses, each respondent had to categorize each topic in one of the three possible categories: "important", "relevant" or "not important", choosing only one of these. In addition, each interview had a section for writing comments, which make it a semi-structured interview. The only previous bounding provided to participants was to categorize each topic according to the clinical activity that physiotherapist would perform.

The objective of interviewing two groups of people was to understand the diverse perceptions and interpretations of the chemical topics for the clinical practice of a physiotherapist. The results of the interviews were digitally transferred for further analysis.

### Data analysis

The first result analyzed was the frequency of the categorization for each topic of the GOB courses according to the applied interview. Subsequently, those topics that were chosen as "important" for PE and CP in a frequency equal to or greater than fifteen (half of the sample) were selected to generate a final list of the most important topics of chemical area (GOB courses) for clinical practice of physiotherapists.

## Results

The frequencies obtained per topics in each GOB course are presented in tables 1, 2 and 3, together some comments of certain topics are presented. Finally table 4 presents the list of the most “important” topics of the GOB courses, this list is constructed according to the methodology previously explained. For each GOB course the results details are presented.

## General Chemistry

The results obtained for the topics of the general chemistry course are shown in Table 1. According to PE the most important topic is “Acids, Bases and Salts” (n=10). On the other hand, according to the CP, the most important topics in general chemistry topics are: “Basic Topics”, “Covalent Bonds” and “Gas, Liquid and Solid” (n=7). some educator emphasizes the concept of basic topics and one teacher (PE 03) states:

**Table 1.** Distribution of the categorization of the general chemistry topics according to the teachers and clinical physiotherapist.

Topic	Expert	Important	Relevant	Not Important
Basic Topics	PE	8	5	5
	CP	7	4	0
Chemistry Measurements	PE	2	6	10
	CP	3	4	4
Atomic Structure and Periodic Table	PE	2	7	9
	CP	2	4	5
Ionic Bonds	PE	4	5	9
	CP	4	5	2
Covalent Bonds	PE	4	5	9
	CP	7	3	1
Chemistry Calculation	PE	4	5	9
	CP	1	4	6
Gas, Liquids and Solids	PE	9	5	4
	CP	7	3	1
Solutions	PE	4	5	9
	CP	2	5	4
Chemistry Reactions	PE	6	5	7
	CP	3	5	3
Acids, Bases and Salts	PE	10	3	5
	CP	6	4	1
Nuclear Chemistry	PE	0	7	11
	CP	0	6	5

**Table 2.** Distribution of the importance of Organic Chemistry topics according to experts

Topic	Expert	Important	Relevant	Not Important
Saturated Hydrocarbons	PE	4	6	8
	CP	2	5	4
Unsaturated Hydrocarbons	PE	3	7	8
	CP	2	5	4
Alcohols, Phenols, Ethers	PE	3	7	8
	CP	2	4	5
Aldehydes and Ketones	PE	3	8	7
	CP	1	5	5
Carboxylic Acids, Esters	PE	3	8	7
	CP	2	5	4
Amines and Amides	PE	5	3	10
	CP	3	3	5

**Table 3.** Distribution of the importance of biological chemistry topics according to experts

Topic	Expert	Important	Relevant	Not Important
Carbohydrates	PE	14	4	0
	CP	10	1	0
Lipids	PE	15	3	0
	CP	9	2	0
Proteins	PE	15	3	0
	CP	10	1	0
Enzymes and Vitamins	PE	14	4	0
	CP	10	1	0
Nucleic Acids	PE	12	3	3
	CP	8	1	2
Biochemical Energetics	PE	13	4	1
	CP	11	0	0
Carbohydrates Metabolism	PE	14	4	0
	CP	11	0	0
Lipids Metabolism	PE	14	4	0
	CP	10	1	0

**Table 4.** Most important topics of the GOB courses in the physiotherapist practice

Topics	Total Frequency
Basic aspects of matter	15
Gas, liquids solids	16
Acid, bases, salts	16
Carbohydrates	24
Lipids	24
Proteins	25
Enzymes and vitamins	24
Nucleic acids	20
Biological chemistry and energy production	24
Carbohydrates metabolism	24
Lipids metabolism	24
Proteins metabolism	25

“The relevance is in the appropriate management of basic topics related to chemistry and biology”.

On the other side, it was mentioned by one teacher (PE 10) respect to “acid, base and salts” topic the following: “It is important and depends directly on the area of practice, since in the respiratory area these concepts are relevant compared to the esthetics features”. Among the interviewed group, any of them considered the nuclear chemistry as an important topic.

### Organic Chemistry Courses

In the organic chemistry courses the results are shown in Table 2, where the most frequencies are in the “relevant” or “not important” to clinical activity. In fact none of the topics have a frequency of 15 or higher for the “important” category.

### Biological Chemistry Topics

The results for topics of the biological chemistry are showed in Table 3.

The topics “Lipids”, “Proteins” and “Proteins metabolism” were considered as “important” (n= 15) for the clinical practice according to PE. Together and with a frequency of 14 the topics: “Carbohydrates”, “Enzymes and Vitamins”, “Carbohydrates metabolism” and “Lipid metabolism” were considered as “important” in the PE group.

On the other hand, all the subjects in the CP group (n= 11) consider the topic “Carbohydrates metabolism” as “important” for clinical practice. In general all topics of the biological chemistry course were considered “important” for clinical practice in both groups interviewed PE and CP. It is observed that many of those topics are related between each other; for instance, in the carbohydrates metabolism field, which is important to understand the expenditure and energy generation directly

related to muscle function and clinical activity of a physiotherapist. The latter obviously is associated with physical exercise; this aspect is emphasized by one of the physiotherapist educator (PE 09), which stands: “biological chemistry knowledge is fundamental to understand many of the benefits of controlled physical exercise”.

### Important GOB topics for clinical practice

According to the results in tables 1, 2 and 3, it was generated the table 4, which shows the topics considered “important” more frequently for the clinical practice, according to the study participants. Importantly, the topics listed in Table 4 corresponds to all the topics of the GOB courses that had 15 or more frequency responses adding the two groups of participants (PE and CP).

It is shown that among total of topics incorporated into the interview (n=26), 12 are considered as “important” to the clinical practice of physiotherapists. Of these 12, nine (75%) are topics of biological chemistry; the other three (25%) correspond to general chemistry topics, however none of the topics of organic chemistry exceeded the frequency of 15 to be considered in the final list.

## Discussion

This is the first study that evaluates the perception of teachers and physiotherapist on the importance of topics of chemistry courses in the physiotherapist career, which had been studied before in other health careers such as nursing (10).

In relation to general chemistry course any of the participants considered nuclear chemistry topic as “important”, however this course is essential to understand the radiation and radioactivity, which are used to comprehend radiology aspects, it is relevant in respiratory clinic and cardiac areas. These relationships are demonstrated in some CIU (Critical Illness Unit) patients whose muscle membrane excitability is reduced, as observed in critical illness myopathy (CIM) patients (1). Nevertheless, most of the participants considered nuclear chemistry as “not important”.

Additionally, the biggest difference between the PE and CP groups in general chemistry was on the acids, bases and salts topic, where PE considered as “important” topic with a difference of 4 points over CP group. The acids, bases and salts topics are essential to understand the pH regulation and buffers in the organism, which could be related to muscle function. Here the main issue is to understand the respiratory system and its pH regulation, what it becomes very important considering the places, on public health, where a physical therapist can work, as was mentioned in the ARI and ARD rooms. On the other hand, draws attention that any topic of organic chemistry course was considered as “important” at a high frequency, in fact the majority of the participants in both groups considered the organic chemistry topics as “not important”. This is rare because these topics are central to acquire knowledge of biological chemistry, thus the function of a molecule cannot be fully understood if its structure is not known. This shows, as was mentioned above, that the topics of organic chemistry are not directly considered important for physiotherapist clinical practice and its relevance would rather be indirect, as it helps to acquire knowledge of biological chemistry, according to interviewed perceptions.

Relative to biological chemistry topics is interesting how all the listed topics are considered as “important” in both groups. Which was expected, if we think that glucose is one of the energetic sources for the organism and the glycolysis process is related with the generation of energy, and that knowledge could be relevant for clinical practice, especially in areas as rehabilitation, and even in other actions not directly

related with clinical activity as sports. Therefore, the ability of the muscle cell to sense, process, and respond to mechanical stimuli is an important regulator of gene expression and protein synthesis (1). Moreover, the energy production is highly related to ATP production and ATP hydrolysis, which is directly related with motion process.

In addition the high choice of the biological chemistry topics as “important” in both groups, could be explained, in part, because it is important for physiotherapist formation the knowledge about some metabolic frequent pathologies such as diabetes, hypertension and obesity, particularly for those professionals that would work at primary health centers. (11).

The fact that this study has found that most PE and CP interviewed did not consider the topics of organic chemistry as “important”, does not mean it is actually so, because it remains a small sample. In this sense the Brown’s study performed in nursing career found among the most important topics, those that belong to organic chemistry course like: alcohols, phenols, ethers, carboxylic acids, esters, amines and amides, that in our study were classified as “important”. That variance could be related to the difference in the clinical activity that each professionals do.

Another important fact to consider is that all the choices that every participant made to rank each GOB course topic were determined by individual experiences of each subject, which reinforces, even more, the idea that we cannot extrapolate or generalize the results obtained in this study.

However the results obtained represent the first report to analyze the relationship between topics of basic science and clinical activity according to individual perception of school physiotherapy members.

## Conclusion

This study showed that: the topics chosen most often as “important” considering both groups were proteins and its metabolism, generally all topics of biological chemistry course were listed as important. Furthermore, it was found that none of the topics of the course of organic chemistry were listed as “important” by any of all interviewed. Thus the aim of the study is widely fulfilled, however is important to consider that this work corresponds to an exploratory study. Thus establishing that the results obtained in this study, although are preliminary, are a first attempt to analyze how the people that work in physiotherapist school perceived these courses.

In this study we included evaluation of topics of chemistry courses in one career at University Bernardo O’Higgins, therefore we cannot extrapolate the obtained results to the rest of the health careers of our university or other physiotherapist career in some other university. Future studies are required involving a larger sample size in this and other universities that will generate results for a good curricular articulation.

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## References

1. Llano-Diez, M.; Renaud, G.; Andersson, M.; Gonzales Marrero, H.; Cacciani, N.; Engquist et al. Mechanisms underlying intensive care unit muscle wasting and effects of passive mechanical loading. *Crit. Care.* **2012**, *16*, 1-16.
2. Von Kondratowitz, H.-J. The Futures of Old Age. *IJAL.* **2007**, *2*, 7-11. DOI: <http://dx.doi.org/10.3384/ijal.1652-8670.0721119>.

3. Ministry of Health. Chile 2015. Available from: [www.minsal.cl](http://www.minsal.cl). [Accessed on January 11th 2015].
4. Chang, R.; Goldsby, K. *Chemistry*, 11<sup>th</sup> ed.; McGraw-Hill Education: New York, 2013; pp 38-328.
5. McMurry, J. *Organic Chemistry*, 8<sup>th</sup> ed.; Brooks/Cole: Massachusetts, 2011; pp 74-344, 620-1088.
6. Klein D. *Química orgánica*, 1<sup>st</sup> ed.; Editorial Medica Panamericana: Madrid, 2013; pp 120-173.
7. Timberlake, K. *Química general, orgánica y biológica*, 10<sup>th</sup> ed.; Prentice-Hall: Madrid, 2011; pp 209-382, 513-591.
8. Karp, G. *Biología celular y molecular: conceptos y experimentos*, 2<sup>d</sup> ed.; McGraw-Hill Interamericana: México, D. F., 2014; pp 86-120.
9. Merriam, S. B. *Qualitative research and case study applications in education*: Revised and expanded from case study research. Jossey Bass Education Series: San Francisco, CA., 2001; pp 69-150.
10. Brown, C. E.; Henry, M. L. M.; Barbera, J.; Hyslop, R. M. A bridge between two cultures: uncovering the chemistry concepts relevant to the nursing clinical practice. *J. Chem. Educ.* **2012**, 89, 1114-1121. DOI: <http://dx.doi.org/10.1021/ed200041x>.
11. Di Fabio, R. P. Efficacy of manual therapy. *PTJ*. **1992**, 72, 853-864.

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