



Analysing the Impact of an Elective Research Experience on Medical Students' Research Perceptions

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Abstract

Introduction Physicians are at the centre of bench-to-bedside research, yet the number of physicians engaging in research is declining. One solution to overcome this alarming trend is exposing medical students to research. This study aims to assess the impact of engaging medical students in research, and the feasibility of conducting research solely using online communication.

Methods A pilot elective research opportunity was offered to medical students enrolled to the University of Malta Doctor of Medicine and Surgery course by a resident academic (summer 2021) of the same institute to assess the epidemiology of COVID-19 in Europe. An anonymous survey was distributed to seventy medical students recruited to participate in this elective research project. The data collected was analysed and interpreted.

Results A response rate of 88.73% was achieved. “Career progression” and “lack of time” were the most reported motivating and hindering factors towards conducting research, respectively, before engaging in a research experience. Research experience helped overcome reported barriers ($p < 0.01$), while also challenging students' perceptions towards research. An increase in positive perceptions towards research was observed after conducting research. An overwhelming majority (90.47%) of participants reported that mentorship played an influential role in their overall experience, and 95.24% commented that they would like research opportunities to be made available by their faculty.

Discussion and Conclusion Giving students the opportunity to conduct research demonstrated how research experience improves students' soft skills and the understanding of research. This study also portrayed how remote research opportunities are effective in engaging students and increased the number of students who would consider a career in research.

Keywords Undergraduate student research · Medical education · Skill acquisition · Research education

Introduction

Recent literature has demonstrated the decreasing trend for physicians to undertake research [1–4]. To counteract this trend, institutions across the world have increased their focus on exposing medical students and freshly graduated doctors to biomedical research [5]. Conducting research during physicians' formative years has increasingly gained momentum [6] since engaging in research develops a profound disposition for medical students to critically assess scientific literature, and report data with rigour and accuracy while demonstrating increased use of critical thinking during clinical practice [4, 7, 8].

Notwithstanding, medical students must overcome numerous barriers to obtain research experience, as

demonstrated by multiple studies investigating medical students' perceptions towards conducting research, as well as their publishing practices [3, 6, 9–14]. A significant discrepancy has been noted between interest towards conducting research and research being conducted and published [11, 15]. Studies have demonstrated that this gap can be bridged by involving medical students in research projects [16–22], yet quantitative data comparing before and after research experience perceptions is lacking. This warrants further research to determine the impact conducting research has on medical students' research perceptions. This study aimed to assess the perceptions of medical students towards research before and after actively contributing to an elective research project.

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Methods

Context on Elective Research Opportunity Offered to Students

Participant Recruitment

Medical students studying at the University of Malta follow an internationally recognised 5-year course leading to the medical doctorate, accredited by both the Association of Medical Schools (AMSE) and the German accreditation agency (ASIIN). The first 2 years (pre-clinical years) cover foundational topics such as anatomy, physiology, and embryology while the final 3 years (clinical years) cover clinical medicine and surgical specialities. Throughout their pre-clinical years, medical students are required to conduct two pre-defined literature reviews focused on anatomy and physiology respectively. Since its establishment in 2018, medical students studying at the University of Malta can voluntarily pursue an intercalated year, which reads for “Bachelor of Science (Honours) in Medical Sciences” between their second and third years of study. The objective of the intercalated year is to provide students with the necessary knowledge and research skills by taking up a pre-defined thesis title, generally involving supervised lab-based investigations. Once completed, intercalated students may extend their suspension of studies to pursue a full-time master of science degree or directly re-enter the doctor of medicine and surgery course medical as third-year students.

Students need to sit for a mandatory research study module during their third year; however, this is purely theoretical [23, 24]. Despite limited summer exchange programmes offered by the Malta Medical Students Association (MMSA) under the auspice of the International Federation of Medical Students’ Associations (IFMSA) [25], medical students wishing to conduct extracurricular research must independently seek out potential mentorship in the hope of joining ongoing research projects [26].

At the end of the 2020–2021 academic year, a novel pilot elective research opportunity to be conducted in summer 2021 was offered to students by a resident academic of the University of Malta. This project was initially projected to recruit 14 medical students; however, an unprecedented 70 medical students expressed their interest to participate in the research opportunity. Following significant enthusiasm demonstrated by students, the original project was extended to offer all 70 students the opportunity to conduct research [26].

Elective Research Opportunity Design

The elective-research project aimed to collect and analyse data about the epidemiology of COVID-19 in Europe. Five research groups were created to cover the impact of COVID-19 in (i)

Mediterranean countries, (ii) Balkan countries, (iii) European microstates, (iv) European Union (EU) countries, and (v) non-EU European countries. Kick-start research meetings were held during the first week of July 2021, via ZOOM[®]. Each student was designated to collect quantitative epidemiological data and quantitative data on policies and mitigative measures employed to manage the effects of the COVID-19 pandemic for a respective country. The data collection process was fully explained with live demonstrations of how to access various databases containing relevant COVID-19 epidemiological data. All communication was held virtually [26].

Survey Design

An online self-design questionnaire (supplementary material 1) was developed for this study. The self-designed questionnaire was compiled following a comprehensive literature search. Google Scholar and MEDLINE databases were used with a blend of the following keywords: “Medical Students”, “Perceptions on research”, “Conduct research”, “Medical student research”, “Perspectives on research” and “Medical students’ perceptions” to mirror the objectives of this study. Relevant articles were retrieved [8, 11, 13, 15], and their full text was analysed to identify overlapping themes between studies which should be assessed to obtain empirical data regarding students before and after research perceptions. The questions were divided into five sections to reflect the objectives of this study. The first four sections of the survey collected quantitative data which respectively aimed to collect participants’ demographic characteristics, students’ research experience before contributing to the hands-on research project, students’ perceptions towards research before and after taking part in the elective research project and their perceptions towards research, mentorship received throughout the project and their opinions on elective research opportunities after taking part in the elective research project.

The study protocol and proposal were submitted to the Faculty Research and Ethics Committee (FREC) of the Faculty of Medicine and Surgery at the University and Malta, and permission to carry out the study was obtained. The survey was distributed to the seventy medical students who were actively participating in the elective research project between the 2nd and 15th of August 2021 [26].

Data Collection and Analysis

Standardised data collection tables were used to extract data from the survey. Analyses of quantitative data were conducted using Microsoft[®] Excel 2021[®] for Mac, Version 16.53, for descriptive statistics including percentages, mean, Pearson’s chi-square coefficient, confidence intervals, and generation of figures. Mann–Whitney *U* test was used for categorical comparisons of “before” and “after” participant responses using

Table 1 Participants’ demographic characteristics (*N*=63)

Demographics		%	<i>n</i>
Age group	18–20	41.27	26
	21–23	46.03	29
	≥ 24	12.70	8
Stage of medical education	Year 1	36.51	23
	Year 2	31.75	20
	Year 3	22.22	14
	Year 4	9.52	6
Nationality	Maltese	98.41	62
	Foreign national	1.59	1
Gender	Males	30.16	19
	Females	69.84	44
	Prefer not to say	0.00	0
Completed a degree before studying medicine and surgery	Yes	26.98	17
	No	73.02	46
Completed the intercalated year	Yes	1.59	1
	No	98.41	62

IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp.

Results

Sixty-three responses were collected, achieving a response rate of 88.73%. The participants represent 10.59% (*N*=595) of the total medical student cohort studying at the University of Malta.

Demographic Characteristics

The predominant age group was 21–23 years old, and most respondents were in their pre-clinical years. Seventeen students read for a previous degree before pursuing the doctor

in medicine and surgery course, and one student intercalated before participating in this survey (Table 1). Our analysis did not find any statistically significant differences in the pooled “agree” and “strongly agree” responses regarding personal (Q: 17–25) and career characteristics (Q: 26–30) stratified by gender, age groups, years of study, whether students followed a previous degree and prior research extracurricular research experience (Table 2).

Research Experience, Motivators, and Barriers Towards Conducting Research

Eighteen students reported having extracurricular research experience, before taking part in the research project (25.35%). Most students with prior extracurricular research experience were between the ages of 21 and 23 (66.67%, *n* = 12) with half being in their pre-clinical years and clinical years respectively. Of note, most of these students had read for a degree before medicine and surgery (55.56%, *n* = 10, *p* = 0.048). Eight published their work in peer-reviewed journals. Interestingly, students who published research were predominantly in their pre-clinical years (62.5%, *n* = 5, *p* = 0.29) and did not read for prior degrees (62.5%, *n* = 5, *p* = 0.60). Career progression was reported as the greatest motivating factor for conducting extracurricular research (Fig. 1A). Students who did not have prior research experience reported a lack of opportunity as the major hindering barrier for not conducting extracurricular research (Fig. 1B). The major reason students decided to participate in this research project was the fact that this research opportunity was the first chance offered to participants (Fig. 1C).

Effect of Research Experience on Students’ Research Perceptions

An overall positive experience was noted following participation in hands-on research, as visually represented in Fig. 2. Actively contributing to research improved students’

Table 2 Chi-square analysis between personal and career characteristics stratified by gender, age groups, years of study, whether students followed a previous degree and prior extracurricular research experience

	<i>p</i> value
Personal characteristics before and after research experience vs gender	0.99
Career characteristics before and after research experience vs gender	0.99
Personal characteristics before and after research experience vs level of education	0.99
Career characteristics before and after research experience vs level of education	0.98
Personal characteristics before and after research experience vs age	0.51
Career characteristics before and after research experience vs age	0.99
Personal characteristics before and after research experience vs followed a degree before studying medicine and surgery	0.91
Career characteristics before and after research experience vs followed a degree before studying medicine and surgery	0.99
Personal characteristics before and after research experience vs previous extracurricular research experience	0.99
Career characteristics before and after research experience vs previous extracurricular research experience	0.99

perceptions towards research and confidence in research skills (Table 3). While students' responses indicated that research experience has given them a more positive outlook towards research and given them more research skills, we were unable to account for respondent bias. Hence, these results should be interpreted with caution. Participants (88.88%) reported that contributing to research helped them better understand the research process ($n=56$) and changed participants' perceptions regarding their definition of research ($p < 0.01$) (Fig. 3). Participants (47.60%) agreed that their active participation in a research project helped mitigate some of the reported institutional barriers hindering their conduction of research ($n=30$). Participants (39.02%) who had previously reported experiencing barriers in conducting research noted that actively contributing to a research project helped them diminish their perceived hindering stumbling blocks to conducting research ($n=16$, $p < 0.01$). Mentorship received throughout the research project was an important contributing factor to the participants' experience, with students (90.47%) reporting receiving good mentorship throughout the project ($n=57$). Moreover, participants (85.71%) reported that mentorship positively influenced their future choices for conducting research ($n=54$, 95% CI [74.61–93.25]).

Perceptions of Future Research Opportunities

Participants (95.25%) wished that elective research opportunities would be made available by their faculty ($n=60$)

and reported (93.65%) they would be willing to participate ($n=59$). Students reported "Topic of study" being the most important factor governing their willingness to participate in future research opportunities (83.05%, $n=49$). Respondents agreed (66.67%) that having the option to create their research proposal and conduct research based on their proposal would motivate them to conduct research more than conducting research using a predefined research title ($n=42$).

Discussion

Research Interest and Hindering Barriers

Our results parallel those of numerous international studies, with career progression being reported as the foremost motivator in medical student research [11, 27–31]. These results attempt to explain why the number of physician-scientists is declining, while student interest in research increased over the past four decades [1–4, 11]. Medical students often perceive conducting research as another box to check in the list of requirements they need to be able to graduate successfully [8, 32]; thus, interest in conducting research is expected to be exponential. However, students are often disheartened from pursuing a career in research as they perceive it to diminish patient contact [12]. Despite the high enthusiasm to conduct research, participants of our study, alongside those of international studies, reported several barriers hindering

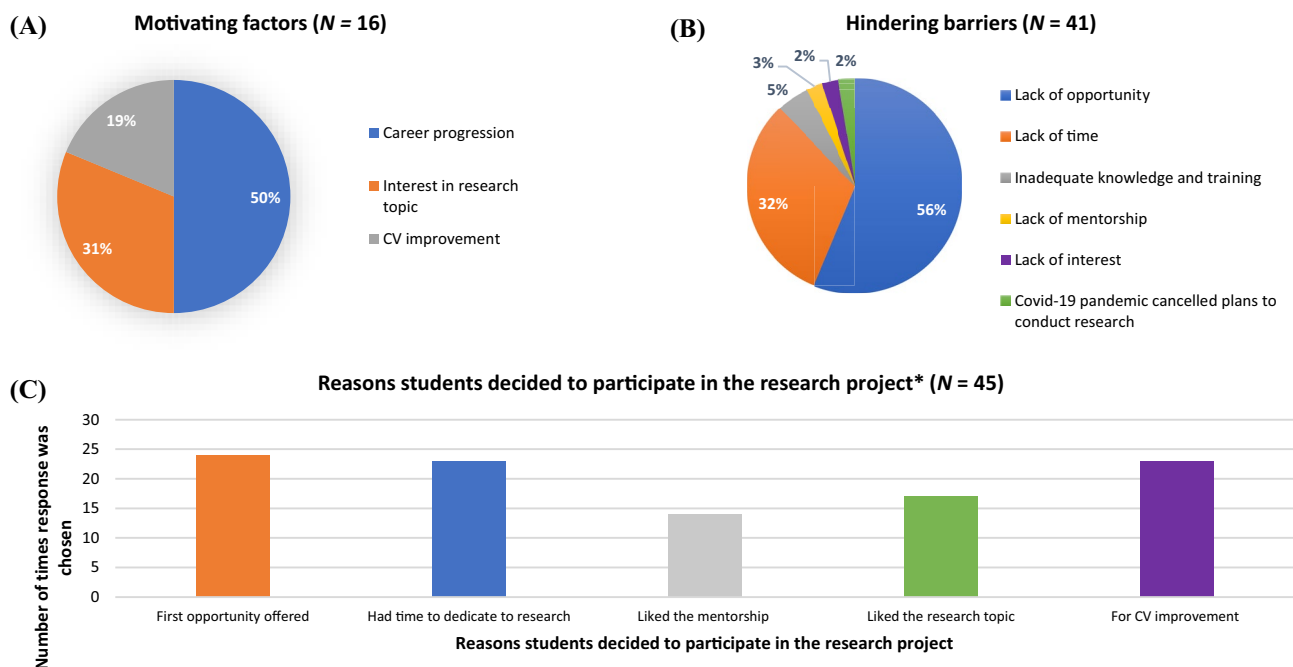


Fig. 1 A Reported motivating factors for conducting prior research, B reported hindering barriers preventing participants from conducting, C reported reasons as to why students with no prior research experi-

ence decided to take part in a hands-on research project (*more than one response may have been chosen by each participant)

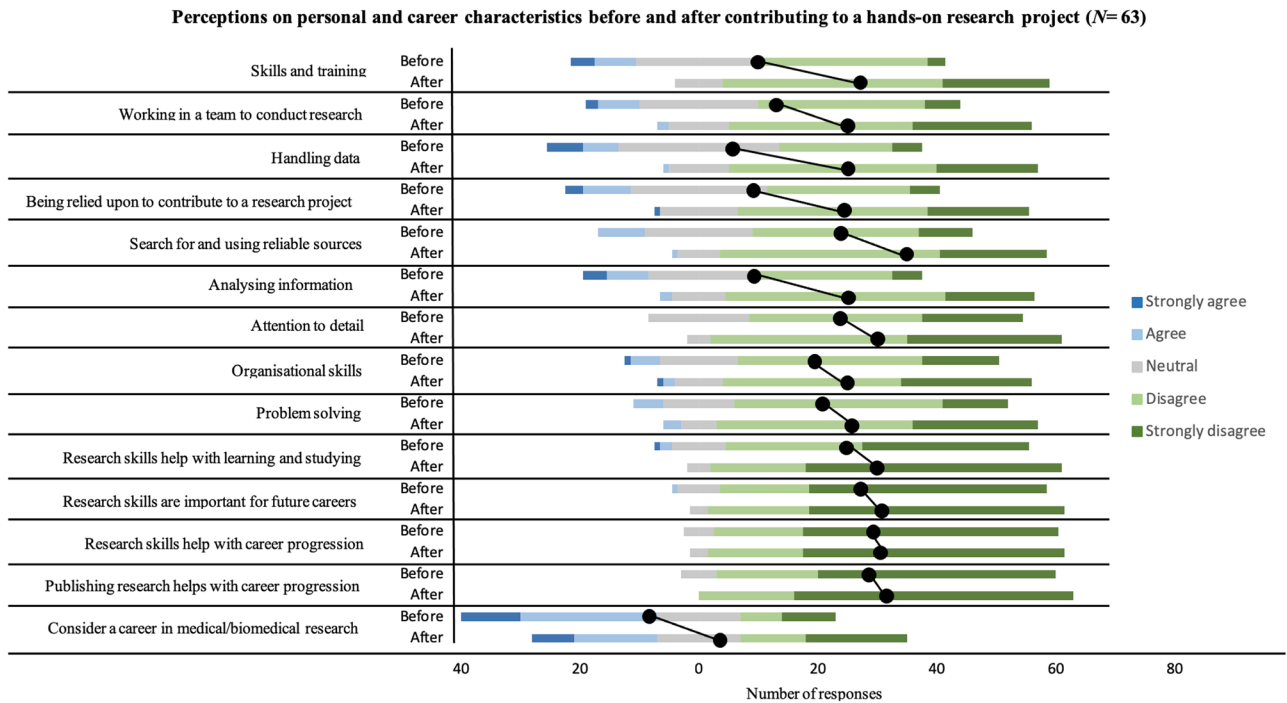


Fig. 2 Modified divergent bar graph for 5-point Likert scales comparing students’ perceptions of personal and career characteristics relating to research before and after hands-on research experience. Ball-and-stick plots represent a median response

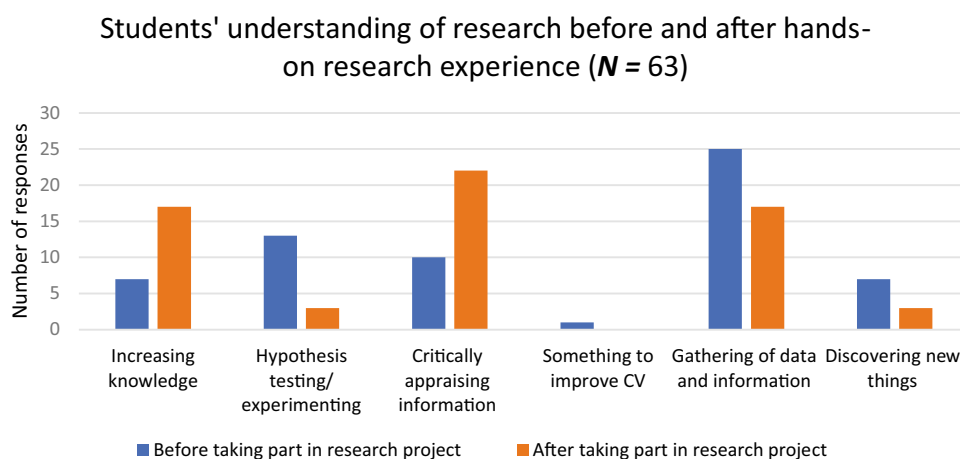
them from engaging in research, making the removal of barriers hindering medical student research a global challenge [10–12, 14, 28, 33–44].

Our study consolidates findings by Ho et al. [22] and Brousseau et al. [18] which elucidated that providing research opportunities does indeed overcome medical

Table 3 Distribution of students’ pre- and post-positive responses regarding personal and career characteristics relating to research before and after contributing to a hands-on research project

	Positive responses before and after research experience		p value
	Before % (n) [N = 63]	After % (n) [N = 63]	
Personal characteristics			
Research skills and training	47.62 (30)	87.30 (55)	<0.01
Working in a team to conduct research	53.97 (34)	82.54 (51)	<0.01
Handling data	38.10 (24)	82.54 (52)	<0.01
Being relied upon to contribute to a research project	46.03 (29)	77.78 (49)	<0.01
Search for and use reliable sources	58.73 (37)	87.30 (55)	<0.01
Analysing information	55.56 (35)	82.54 (52)	<0.01
Attention to detail	73.02 (46)	93.65 (59)	<0.01
Organisational skills	69.84 (44)	82.54 (52)	0.10
Problem-solving skills	73.02 (46)	85.71 (54)	0.08
Career characteristics			
Research skills help with learning and studying	80.95 (51)	93.65 (59)	0.03
Research skills important in future careers	87.30 (55)	95.24 (60)	0.12
Research skills are important for future careers	92.06 (58)	95.24 (60)	0.47
Publishing research help with career progression	90.58 (57)	100.00 (63)	0.01
Consider a career in medical/biomedical research	23.40 (16)	44.44 (28)	0.03

Fig. 3 Comparison between students' understanding of research before and after contributing to a hands-on research project ($p < 0.01$)



students' perceived barriers towards conducting research. However, to successfully overcome stumbling blocks and attract students towards research, research opportunities should be made available when their academic workload is not highly demanding and on an elective basis [8, 15, 45].

Impact of Research Experience on Students' Perceptions

Participation in an elective research experience had a profound positive impact across all personal and career characteristics assessed, coinciding with the findings of previous studies [19, 22]. Our study affirms how providing research opportunities not only attracts more medical students towards academia but also forms part of their educational and personal growth. Allowing students to conduct research has made an impact on their overall education, as it not only enabled participants to learn a myriad of skills, which may be transferred to clinical practice later on and also aided them to better develop their problem-solving and critical thinking skills [4, 7, 8].

Four scholarly publications successfully were published targeting COVID-19 epidemiology across the Balkan countries [46], across microstates in Europe [47], across European countries [48], and the COVID-19 situation in Europe following the EURO2020 football tournament [49]. Another scholarly article was produced assessing the COVID-19 epidemiology across the Mediterranean region which has been accepted (but not yet published at the time of writing) in the journal *African Health Sciences*. Hence, providing research opportunities culminating in published research promotes career progression and furthers professional development [50, 51].

Numerous studies have acknowledged the necessity and influence mentorship has on medical student research [5, 41, 52, 53]. Over 90% of this study's participants reported that the mentorship they received throughout the research project was an important contributing factor to their overall

experience, which would influence their future research-related decisions. Previously published literature identified mentorship as a crucial factor which should not be overlooked when assessing students' perceptions towards research as well as when planning research opportunities for medical students [6, 21, 41].

Proposals for Engaging Medical Students in Research

Engaging students in research is still a difficult task with numerous institutional and non-institutional hurdles which must be overcome. This is a global problem, and solutions to overcome such barriers should be feasible enough to be implemented in both developing and developed countries [6]. Universities can incorporate elective research opportunities into their academic calendars, covering a diverse range of research topics. Conferences are other effective methods to expose students to research, especially student-led research conferences which offer opportunities wherein students may equip themselves with presenting and debating skills [54, 55].

Strengths and Limitations

To our knowledge, no other studies have assessed the before and after the impact of conducting research remotely on students' perceptions towards conducting research. Survey questions were not validated, which might have impacted the outcome of this study. A limited study population size was utilised; hence, this study may be liable to type 2 errors. Moreover, participants were recruited from a single institution with a research project focused on a single topic, COVID-19 epidemiology, warranting the conduction of similar studies with cohorts from different countries, larger sample sizes, and if possible, diverse research opportunities.

This study has also demonstrated how medical student research can be conducted remotely. Thus, institutions could consider organising virtual research projects and inviting medical students with fewer opportunities to participate. Hence, virtual research can still have a profound impact on improving medical education by allowing students to engage in hands-on research with an element of self-directed learning.

Conclusion

Declining physician involvement in research is a trend which must be confronted. One way to do so is by allowing medical students to expose themselves and engage in research. This study has demonstrated that students respond positively to research opportunities. Yet, they need to be equipped with the necessary skills to be able to conduct future research and helped in mitigating perceived barriers hindering them in conducting research. Elective research opportunities should become more widespread, and future studies assessing the impact of elective research on students' perceptions should be conducted.

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Author Contribution AC was responsible for data collection, data analysis and writing the first draft of the manuscript. SC was responsible for the conceptualisation of the research project, editing, and supervising the project.

Availability of Data and Material None.

Declarations

Ethics Approval and Consent to Participate Ethical approval was obtained from the Faculty Research Ethics Committee (FREC) of the Faculty of Medicine and Surgery, University of Malta.

Consent for Publication All of the authors consented to the publication of this article.

Competing Interests The authors declare no competing interests.

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