

Aus der Universitätsklinik für Anästhesiologie und Schmerztherapie, Inselspital Bern

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**Arbeit unter der Leitung von: Dr. med. Joana Berger-Estilita und
Prof. Dr. med Robert Greif**

***Attitudes of Medical Students Towards Interprofessional Education: A mixed
methods study***

**Inaugural-Dissertation zur Erlangung der Doktorwürde der Humanmedizin der
Medizinischen Fakultät der Universität Bern**

vorgelegt von Chiang Hsin

aus Deutschland

akzeptiert zur Publikation in PLOS One

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PLOS ONE

Attitudes of Medical Students towards Interprofessional Education: A Mixed-methods Study --Manuscript Draft--

Manuscript Number:	PONE-D-20-15351R1
Article Type:	Research Article
Full Title:	Attitudes of Medical Students towards Interprofessional Education: A Mixed-methods Study
Short Title:	Attitudes towards IPE
Corresponding Author:	Joana Berger-Estilita Inselspital Universitätsspital Bern Bern, SWITZERLAND
Keywords:	Interprofessional Education, IPE, Medical Student, Undergraduate, Medical Education, Attitudes
Abstract:	<p>Background: Interprofessional Education (IPE) aims to improve students' attitudes towards collaboration, teamwork, and leads to improved patient care upon graduation. However, the best time to introduce IPE into the undergraduate curriculum is still under debate.</p> <p>Methods: We used a mixed-methods design based on a sequential explanatory model. Medical students from all six years at the University of Bern, Switzerland (n=683) completed an online survey about attitudes towards interprofessional learning using a scale validated for German speakers (G-IPAS). Thirty-one medical students participated in nine semi-structured interviews focusing on their experience in interprofessional learning and on the possible impact it might have on their professional development.</p> <p>Results: Women showed better attitudes in the G-IPAS across all years ($p = 0.007$). Pre-clinical students showed more positive attitudes towards IPE [Year 1 to Year 3 ($p = 0.011$)]. Students correctly defined IPE and its core dimensions. They appealed for more organized IPE interventions throughout the curriculum. Students also acknowledged the relevance of IPE for their future professional performance.</p> <p>Conclusions: These findings support an early introduction of IPE into the medical curriculum. Although students realise that interprofessional learning is fundamental to high-quality patient care, there are still obstacles and stereotypes to overcome.</p> <p>Trial registration: ISRCTN 41715934</p>
Order of Authors:	<p>Joana Berger-Estilita</p> <p>Hsin Chiang</p> <p>Daniel Stricker</p> <p>Alexander Fuchs</p> <p>Robert Greif</p> <p>Sean McAleer</p>
Opposed Reviewers:	
Response to Reviewers:	<p>Reply to Reviewers' comments:</p> <p>Reviewer #1: Congratulations on a well-designed and conducted study. Just a few clarifying questions.</p> <p>Comment 1: What is the current IPE curriculum? You wrote: "Most frequent IPEs mentioned were the intravenous cannulation course (n=125), the confidentiality seminar (n=98), and the optional interprofessional rotation (n=43)." This should be better explained earlier in the paper. Which respondents and at which level of matriculating year would they have completed that course work and how might it have affected their responses?</p> <p>Our reply: Thank you for this comment. We have expanded the description of the IP offer at the University of Bern in the Introduction, which now reads (Page 4, Lines 76-</p>

81): "Further interprofessional activities include a compulsory seminar on confidentiality in cooperation with the Bern University of Applied Sciences and the Institute for Medical Education of the University of Bern (UniBe) as well as the compulsory Intravenous Cannulation course, both taught in the first academic year, during which the learning groups and the team of peer tutors are interprofessionally allocated."

Comment 2: What was your exclusion criteria? You wrote: "Six-hundred and seventy-seven students replied to the online survey (response rate: 43,7%). After exclusions (n=115), we included 562 questionnaires in the final analysis."

Our reply: Thank you for this remark. We have described our exclusion criteria in more detail and you can now read (Page 9, lines 167-168): "Incomplete questionnaires (n=111) were excluded and 4 students did not report year of studies. We included 562 completed questionnaires in the final analysis."

Comment 3: A large number of learners had previous healthcare experience. How did this impact your findings?

Our reply: Thank you for your remark. We conducted an independent samples t-test to determine the association between previous healthcare experience and better attitudes towards IP as measured by the G-IPAS. We failed to find a significant difference (Page 14, lines 203-205): "The independent samples t-tests showed no statistically significant difference for previous experience in healthcare and having parents working in the healthcare system." We added a paragraph in the discussion to explain the impact of these findings and you can now read (Page 26, lines 517-525): "Factors contributing to this decline in interprofessional attitudes include being more experienced in the healthcare field (32), having previous interprofessional contact (42), having had less positive experiences in IPE (31, 34, 43) and having parents working in healthcare (44). Although specifically targeted for the Bernese sample, none of these factors showed a significant association with the decline in attitudes. A recent study by Oza et al. (45) applying a regression analysis to a large cohort of medical students, also failed to find such associations with the aforementioned variables. The absence of any association in larger cohorts may be more statistically trustworthy, and the association of these factors in IPE decline should be specifically addressed in higher powered studies."

Comment 4: For clarity's sake for the reader, I recommend that the results section more specifically discuss the tables directly.

Our reply: Thank you. We have introduced subheadings in the results section ("Quantitative analysis" and "Qualitative analysis") and have taken on board the suggestion from Reviewer #2, Comments 7 and 8, and have introduced relevant citations in the results section, significantly reducing the information in Tables 4 and 5. We hope that this will enhance readability of the qualitative analysis results.

Comment 5: Your study is attempting to define when might be the best time to initiate IPE curriculum. Unfortunately, your results do not help clarify that as you do not discuss how stratification by learner level, type, nor prior exposure to IPE curriculum affects that. A sub-analysis of those groups would help elucidate your conclusion that earlier IPE curriculum is better. You mention that earlier learners are more enthusiastic, but do not explore why more advanced students who may or may not have gone through the IPE curriculum did not demonstrate that same enthusiasm.

Our reply: Please refer to the reply to comment 3. Page 26, line 526 to Page 27, line 538 looks at further reasons for a decline in motivation.

Comment 6: The qualitative component (Table 4) exposed novel findings including the loss of professional 'uniqueness'. This would be important to explore further as you mention in your discussion.

Our reply: Thank you for this insightful comment. We have commented on the loss of professional identity in Page 27, lines 539-552.

Reviewer #2: Thank you for the opportunity to review this manuscript.

Comment 1: I have several suggestions listed below. Overall, a spelling and grammar check is needed based on what I presume is the translation to English.

Our reply: Thank you for this comment. We are aware of the translation issues in qualitative, interdisciplinary research. Such translation issues arise more and more frequently, as the most highly ranked international academic journals are mostly published in English. We, as non-English-speaking academics, are confronted with the challenge of translating our research results into English, and such translation processes may come with additional language challenges and issues. Such language and translation issues are particularly important in qualitative interview-based research. Interviews often aim to unveil interviewees' subjective experiences, usually expressed

in their source language – that is, a language other than English. This is what happened in our case. In qualitative, interview-based accounting studies, translation problems primarily materialize in direct quotations used in the manuscripts reporting on research results. For such quotations, researchers need to translate material directly from non-English interviews into the English language. We see direct quotations from interviews as an opportunity to achieve credibility and authenticity in qualitative analysis. Additionally, a proper translation of quotations from non-English interviews may not be easy to achieve, since the original meaning of the quotations needs to be preserved. In order to cope with this limitation, we have used the concept of creating equivalent translational structures, a core task in translation processes (Enzenhofer and Resch, 2011). This concept refers to the establishment of similarity between the source and the target languages at the textual level. This functionalist approach of translation, performed by one of the authors (SM), aims for the achievement of a translation initiator's needs (Schäffner, 2009), which involves ensuring the target text is understandable for an end user. Consequently, the translated text may break away from the original text. We also introduced a paragraph on this topic both in the Methods section and in the limitations section of the manuscript. You can now read:

Methods, Page 7, Line 157 to Page 8, Line 162: "Direct quotations from the interviews were translated into English using a functionalist approach of creation of equivalent translation structures as described by Enzenhofer and Resch (23). One author (HC, German-speaking) translated the citations from German to English *ipsis verbis* with the aid of an online tool (Google Translate®). The second author (SM, English-speaking), performed changes to ensure that the target text could be understood by the reader."

Limitations, Page 29, Lines 578-582: "We also cannot assume that our qualitative data can be translated by the simple translation of words, because words and meanings are not equivalent in different languages and language carries a cultural meaning. Although we have used a known approach to translation of our quotes from German to English by two native speakers, our translation may still suffer from misinterpretation and the translated text may break away from the original."

Comment 2: Abstracts states that women "scored higher," but I would suggest rewording as this is an attitudinal survey. It currently seems to imply that women did better.

Our reply: Thank you. We reworded as suggested and it reads now: "showed better attitudes" (Page 2, Line 36).

Comment 3: Background: I would suggest removing the statement "How exactly this occurs is not known..." as you have provided details to support your statement.

Our reply: Thank you. We removed the statement as suggested.

Comment 4: In this section, you mention the original development of the IPEC competencies in 2009. There was an important revision in 2016 to note, but I don't know that much information is needed here, as these are common practice currently.

Our reply: Thank you. We have deleted the statement regarding the revision of the IPEC report. You can now read (Page 3, Lines 54-56): "The Interprofessional Collaborative Practice (IPEC) outlines IPE's core competencies that concentrate on four main domains: Ethics & Values, Roles & Responsibilities, IP Communication and Teamwork.(4)". We also updated the reference to the 2016 update of the IPEC report.

Comment 5: In the demographic characteristics, I would suggest including details and descriptions of the classes noted throughout the paper.

Our reply: Thank you for this comment. We are not totally sure what the reviewer means with his/her comment but we guess it is about the different experiences of the students. Therefore, we have expanded the qualitative analysis results section and added student's comments and descriptions of their experiences with specific interprofessional activities. You can now read:

Page 17, Lines 266-270: "However, most students realised that nursing students already had the given competency and were bored/frustrated during the workshop. Some medical students observed other peers having discriminating attitudes towards nursing students. Most were unhappy to be in a workshop where they knew less than their nursing counterparts and could not contribute to any exchange in knowledge."

Page 17-18, Lines 294-307: "However, the absence of follow-up courses or further skills training and having it assessment only in the third year of studies were all reasons to consider the workshop inadequate for the first year curriculum.

Another IPE experience mentioned was the two-hour Confidentiality seminar, occurring

with law students or with nursing students. Participants attended this seminar in their first year of studies. Most students hinted that the course was not well structured and that students did not mix, so the experience was not really IP. The reason for it being interprofessional was the common topic rather than the interaction between groups. Five students had additionally chosen to take part in an interprofessional clerkship offered by the UniBern, consisting of two interprofessional days (first day: nursing students have a shared histology lesson with medical students; second day: nutritional care with student role-play). All students found the IP clerkship very positive. Nursing and clinical clerkships in clinical years, as well as lectures with other professional groups, were also considered IP interventions.”

Comment 6: Page 15 Section C- I would suggest rewording the paragraph. It says several advantages with a colon then only one listed. I would combine the information from the first and second sentences. I would also suggest eliminating the sentence “there is no benefit to starting later.”

Our reply: We are sorry if our description was more dubious than intended. We have corrected the signalled sentence and one can now read (Page 22 , Lines 414 - 419: “Ten students agreed that IPE should start as early as the first year of studies. They mentioned advantages for early IPE introduction which included (1) easier to implementation (as students would have similar backgrounds) and (2) the encouragement of early interaction, shared learning and networking, which would contribute to the building of mutual respect from an early stage. Students suggested starting with basic science and other overlapping topics, which could then evolve to clinical interactions later in the curriculum.”

Comment 7: The results section is somewhat confusing. I would suggest eliminating the data that reiterates what is stated in tables 4&5.

Our reply: Please refer to Comment 4 from Reviewer #1.

Comment 8: Tables 4&5 seem to have a lot of information and make take away from the overall message.

Our reply: Please refer to Comment 4 from Reviewer #1.

Comment 9: Components of the IPEC report on Page 13 does not seem necessary to be included.

Our reply: Thank you. We removed them as suggested.

Reviewer #3: Very interesting article which approaches the topic for IPE with a mixed methods approach in a large number of students across the various years that medicine is taught in their institution. This should be commended.

Minor comments

Comment 1: too many abbreviations - MS, HCP and parts of the G-IPAS are not needing to abbreviated. I appreciate that they are abbreviated because they are used frequently in the manuscript, but they are not common and add to cognitive load. Please unabbreviate throughout the manuscript.

Our reply: We would like to thank the reviewer for this comment. We edited the manuscript as suggested.

Comment 2: Table 5 - consistency - interview # then student # please.

Our reply: Thank you for pointing this out. We corrected the tables accordingly.

Comment 3: Seeing as there is a strong gender difference in the scoring of the G-IPAS was gender considered in the final model predicting the variance of the overall score? I would have thought there would be an interaction at least within the model. Could the final model also be presented to understand which of the components mostly committed to the variance.

Our reply: Thank you for your comment. Gender differences were indeed found across many variables and especially also for the overall G-IPAS mean score. However, we have found gender differences only as main effects and not as interaction effects. Gender plays a role but the variable does not interact with study year in the ANOVA (although the alpha error was 0.068 and barely missed significance) nor does gender interact with the variable clinical years, where we found higher G-IPAS overall scores for students in pre-clinical years (1-3) compared to those in clinical years (4-6). For the latter case, we initially did not take gender into the model since it would not have added additional information. Just to be on the safe side, we expanded the last analysis and did an ANOVA including gender as factor and pre-clinical vs clinical years as second between group factors. We found no interaction between the two factors with regard to the overall G-IPAS score ($p=0.573$), the main effects gender, as reported in the first ANOVA, and clinical years, as reported from the t-test, reached significance. However,

in order to give a better insight into the data, we have added the F-values and the partial Eta-squared for the effects of the ANOVA.

Comment 4: Could the authors comment on the frequency of the quotes in each of the interviews. I think this aspect is unclear and I would like a percentage of the main topics across the group to be identified and discussed.

Our reply: Thank you for this important comment. We have added the frequency of quote themes in the qualitative analysis section (Table 4). One can now read (Page 14, Lines 216-218): Table 4 depicts the overall frequency of the quotes in each of the interviews. There were similar distributions of codes across genders and years of study.

Table 4: Coding frequency across all interviews

Frequency (n)	Percentage (%)
Participant's age	313.33
Participant's year of studies	313.33
Participant's previous work experience	151.61
Participant's ties with healthcare	414.40
Comments on filling the GIPAS form	252.68
Definition of IPE	444.72
Goals of IPE	485.15
Advantages of IPE	11212.02
Disadvantages of IPE	10110.84
Examples of IPE during medical course	9610.30
Attitudes towards IPE	636.76
Attitudes: Absence of IPE	343.65
Examples of wished for interventions	707.51
Desired format of the IPE course	717.62
Desired Year of studies for IPE	929.87
Desired Frequency of IPE	505.36
Ideal group size for IPE interventions	80.86
Total number of coded citations	932100

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<p>disclose any competing interests that could be perceived to bias this work—acknowledging all financial support and any other relevant financial or non-financial competing interests.</p> <p>This statement will appear in the published article if the submission is accepted. Please make sure it is accurate. View published research articles from PLOS ONE for specific examples.</p> <p>NO authors have competing interests</p> <p>Enter: <i>The authors have declared that no competing interests exist.</i></p> <p>Authors with competing interests</p> <p>Enter competing interest details beginning with this statement:</p> <p><i>I have read the journal's policy and the authors of this manuscript have the following competing interests: [insert competing interests here]</i></p> <p>* typeset</p>	<p>Director and Senior Lecturer at the Centre for Medical Education, University of Dundee. This does not alter our adherence to PLOS ONE policies on sharing data and materials. The remaining authors report no competing interests. We confirm that this manuscript is not under consideration by another journal. It is our own work and was not sponsored by the industry.</p>
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Additional data availability information:

Prof. Joerg Heber, Editor-in-Chief
Prof. Elisa Houwink, Academic Editor
Plos One

Bern, 3 September 2020 / jbe

Dear Prof. Houwink, Dear Prof. Heber,

We wish to submit the revised version of our manuscript (**PONE-D-20-15351**) entitled

Attitudes of Medical Students towards Interprofessional Education: A Mixed-methods Study

for further consideration for publication in *Plos One*. In this mixed-methods article, we explored the best time to introduce IPE into the undergraduate curriculum. We thank your reviewers for their comments that have helped us to improve our manuscript, and we provide in attachment our point-by-point replies to their comments and questions. All consequent changes in the manuscript are highlighted in **red text** in the "MarkedChanges" file.

All authors have approved the manuscript and agree with its submission to *Plos One*.

We disclose that some data of this project was used in a dissertation for the conclusion of the Master of Medical Education of the University of Dundee. We also were conceded funding for open access publication charges by a grant from the Suzanne and Hans Biäsch Foundation for Applied Psychology, in case of acceptance.

We declare the following competing interests: RG is the Board Director of Training and Education for the European Resuscitation Council, the Task Force Chair Education, Implementation, and Team of ILCOR, and member of the direction of the MME Programme of the University of Bern. SM is the Programme Director and Senior Lecturer at the Centre for Medical Education, University of Dundee. This does not alter our adherence to PLOS ONE policies on sharing data and materials. The remaining authors report no competing interests. We confirm that this manuscript is not under consideration by another journal. It is our own work and was not sponsored by the industry.

We hope that you and your Reviewers will find that our manuscript is now of suitable publication in *Plos One*.

On behalf of all authors,

A handwritten signature in black ink that reads "Joana Berger-Estilita". The signature is written in a cursive, flowing style.

Joana Berger-Estilita, MD, EDAIC, EDIC, MMed (Dundee)
Consultant in Anaesthesia & Intensive Care

Attitudes Towards IPE, Berger et al. V6.0

1 **Title: Attitudes of medical students towards**
2 **interprofessional education: A mixed-methods study**

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13

14 **Availability of data and materials:** All data generated and analysed during this study
15 are included in this published article and its supplementary information files.

16 **Funding:** This article's publication charges are supported by a grant from the Suzanne
17 and Hans Biäsch Foundation for Applied Psychology.

18 **Competing Interests :** RG is the Board Director of Training and Education for the
19 European Resuscitation Council, the Task Force Chair Education, Implementation, and
20 Team of ILCOR, and member of the direction of the MME Programme of the
21 University of Bern. SM is the Programme Director and Senior Lecturer at the Centre for
22 Medical Education, University of Dundee. This does not alter our adherence to PLOS
23 ONE policies on sharing data and materials. The remaining authors report no competing
24 interests.

25 **Abstract**

26 **Background:** Interprofessional Education (IPE) aims to improve students' attitudes
27 towards collaboration, teamwork, and leads to improved patient care upon graduation.
28 However, the best time to introduce IPE into the undergraduate curriculum is still under
29 debate.

30 **Methods:** We used a mixed-methods design based on a sequential explanatory model.
31 Medical students from all six years at the University of Bern, Switzerland (n=683)
32 completed an online survey about attitudes towards interprofessional learning using a
33 scale validated for German speakers (G-IPAS). Thirty-one medical students participated
34 in nine semi-structured interviews focusing on their experience in interprofessional
35 learning and on the possible impact it might have on their professional development.

36 **Results:** Women showed better attitudes in the G-IPAS across all years ($p=0,007$). Pre-
37 clinical students showed more positive attitudes towards IPE [Year 1 to Year 3
38 ($p=0.011$)]. Students correctly defined IPE and its core dimensions. They appealed for
39 more organized IPE interventions throughout the curriculum. Students also
40 acknowledged the relevance of IPE for their future professional performance.

41 **Conclusions:** These findings support an early introduction of IPE into the medical
42 curriculum. Although students realise that interprofessional learning is fundamental to
43 high-quality patient care, there are still obstacles and stereotypes to overcome.

44

45 Trial registration: ISRCTN 41715934

46 **Introduction**

47 The World Health Organization (WHO) defines Interprofessional Education (IPE) as,
48 when “students from two or more professions learn about, from, and with each other to
49 enable effective collaboration and improve the quality of care” (1). Evidence shows that
50 interprofessional (IP) healthcare interventions improve patient outcomes, such as higher
51 medication safety or reduced length of hospital stay (2) by enhancing the
52 communication and interpersonal skills of healthcare professionals, as well as their
53 collaboration and teamwork skills (3). The Interprofessional Collaborative Practice
54 (IPEC) outlines IPE’s core competencies which concentrate on four main domains:
55 Ethics & Values, Roles & Responsibilities, IP Communication and Teamwork (4).
56 Nevertheless, the complexity of teaching for different healthcare disciplines, logistical
57 problems and busy timetables raise issues concerning the introduction of IPE
58 interventions. Current undergraduate literature shows a trend for earlier IPE
59 introduction (5, 6), but the optimal timing for the IPE intervention is unclear (7).
60 IPE interventions can be measured by using validated attitudes scales based on IPE
61 domains. Until recently, only a few conceptual tools for assessing attitudes towards IPE
62 existed (8). The Readiness for Interprofessional Learning Scale (RIPLS) (9) and the
63 extended RIPLS (10) are common examples. Unfortunately, many scales were
64 developed before the IPEC report, and do not integrate all four recommended core
65 competencies(11). The Interprofessional Attitudes Scale (IPAS) (12) – developed and
66 validated in 2015 - uses items from the extended RIPLS and new items to embody all
67 four IPEC domains. This scale has been validated for German speakers (13).
68 The Medical Faculty of the University of Bern (UniBe) is one of the largest in
69 Switzerland with about 1500 students. The study of Medicine starts with a 3-year

70 bachelors programme focusing on basic science (e.g. physics, chemistry, biology,
71 physiology, biochemistry and anatomy) followed by a 3-year masters programme with
72 a strong practical focus, composed mostly of small group interactions (problem-based
73 learning) and clinical clerkships (14). Since 2010 the medical faculty and nursing
74 schools have been offering optional two half-day interprofessional internships for their
75 students in the first and third semesters. Further interprofessional activities include a
76 compulsory seminar on confidentiality in cooperation with the Bern University of
77 Applied Sciences and the Institute for Medical Education of the University of Bern
78 (UniBe) as well as the compulsory Intravenous Cannulation course, both taught in the
79 first academic year, during which the learning groups and the team of peer tutors are
80 interprofessionally allocated.

81 The aims of this study are: (1) to determine whether there are changes in attitudes
82 towards interprofessionality between the bachelors (pre-clinical) and masters (clinical)
83 programme of the curriculum by using a validated attitudes scale, and (2) to ascertain
84 the ideal time in the medical curriculum to introduce IPE interventions.

85 **Materials and methods**

86 We used a sequential qualitative-quantitative mixed methods design(15). The quantitative
87 cross-sectional survey collected students' demographic data and included all 24 items of the
88 German Interprofessional Attitudes Scale G-IPAS (13) using an online platform
89 (SurveyMonkey Inc, San Mateo, California, USA). Semi-structured interviews explored
90 individual students' experiences with IPE interventions, and the impact they had on their
91 professional development. All medical students actively enrolled in the Faculty of Medicine
92 of the University of Bern, Switzerland, during the academic year 2019/2020 were eligible for
93 inclusion in the study. The study was conducted in German.

94 **Ethical Considerations**

95 The participants gave written informed consent and the Bern Cantonal Ethics Committee
96 (Req-2019-00743, 23.08.2019) waived the need for ethics approval. The survey link included
97 a covering letter reiterating the goals of the study and "consent by participation" was
98 obtained (16). We used ID numbers to code students and requested no identifying data. Data
99 was stored in a secure repository accessible to the investigators only. All procedures from this
100 investigation followed the Helsinki Declaration (17). All researchers complied with the Data
101 Protection Act (18) and the Swiss Law for Human Research (19). This study was registered
102 with the number ISRCTN41715934.

103 **Procedure**

104 Students received an e-mail from the Medical Faculty deanery in October 2019 with the link
105 to the online G-IPAS survey via the online platform. The survey was open from 7th October
106 to 15th December 2019, and two reminders were sent.

107 The German Interprofessional Attitudes Scale is a 24-item questionnaire with 3 subscales
108 ("*Teamwork, Roles and Responsibilities*", "*Patient-centeredness*" and "*Healthcare*

109 *Provision*”). Participants had to answer the questions using a Likert scale with 1 representing
110 “Strongly Disagree”, 2 “Disagree”, 3 “Neutral”, 4 “Agree” and 5 “Strongly Agree”. The G-
111 IPAS has been shown to be a reliable instrument, representative of the original American
112 IPAS dimensions [38] and it has been translated, culturally adapted and validated in German-
113 speaking countries for the assessment of interprofessional attitudes (13).
114 After completion of the online G-IPAS questionnaire, students were invited to participate in
115 nine semi-structured interviews, which took place at the Department of Anaesthesiology and
116 Pain Therapy, Inselspital, Bern, Switzerland in November 2019. An interview guide was used
117 to conduct the one-hour session. Students provided demographic data (e.g. age, year of
118 studies) and were asked about their understanding of IPE and the (dis)advantages of this type
119 of teaching strategy. We discussed the survey results and asked their opinion on optimal IPE
120 interventions (duration, format and content). Data was audio- and video recorded.

121 **Sampling**

122 For the quantitative phase, we used a non-probability convenience sample and included all
123 medical students from the Bern Faculty of Medicine enrolled in the academic year 2019/2020
124 (n=1550). We aimed to include 100 students for each year, and at least 600 students overall,
125 following recommendations for sample size survey research (20). As the study was sequential
126 in nature, it was impossible to pre-emptively select participants for the qualitative phase. We
127 used purposive sampling for the nine semi-structured interview groups.

128 **Data analysis**

129 We performed a descriptive analysis of the survey data with sub-group analysis per year of
130 studies. Global scale, dimensions, and individual items were assessed for normal distribution
131 with the Shapiro-Wilks test and visual assessment of residuals and Q-Q Plots. Two-way
132 analysis of variance (ANOVA) with gender and the stratified study years (year 1 to 6) as
133 between subjects’ factors were conducted separately for the means of all subscores as well as

134 the mean overall G-IPAS score as dependent variables. Separate independent samples t-tests
135 were conducted for the between subjects' factor previous experience in healthcare and having
136 parents working in the healthcare system for the overall G-IPAS score, with correction for
137 multiple testing. Additionally, an independent samples t-test was conducted to compare the
138 overall G-IPAS score in pre-clinical (years 1-3) and clinical years (years 4-6). Quantitative
139 data was analysed with SPSS v26 (IBM, New York, USA).

140 Because the G-IPAS has only recently been introduced, we decided to perform an additional
141 confirmatory analysis of its validity and reliability. For survey validity, we used a factor
142 analysis using the Scree test for factor extraction and Varimax rotation with Kaiser-
143 normalization. Data was assessed for factorability with Bartlett's test of sphericity, and the
144 Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. For reliability, Cronbach's alpha
145 was determined. Cronbach's alpha should be at least of 0.7 for the instrument to be
146 considered reliable (21).

147 Data from the semi-structured interviews was processed according to the Miles and
148 Huberman (22) framework for data analysis: data segmenting, editing and summarizing,
149 followed by data display, and finally conclusion verification. HC transcribed all interviews.
150 JBE and HC corrected and verified transcriptions of the interviews and we sent summaries of
151 the interview to each participant as a form of respondent validation (23). JBE and HC both
152 coded the first group interview independently using the software MaxQDA2020® (Verbi,
153 Berlin, Germany) and agreed on the coding scheme for the remaining interviews. Memoing
154 was performed parallel to coding. All interviews were coded in a phased fashion, with
155 interim analysis, to check for saturation.

156 Direct quotations from the interviews were translated into English using a functionalist
157 approach of *creation of equivalent translation structures* as described by Enzenhofer and
158 Resch (24). One author (HC, German-speaking) translated the citations from German to

159 English *ipsis verbis* with the aid of an online tool (Google Translate®). The second author
160 (SM, English-speaking), performed changes to ensure that the target text could be understood
161 by the reader.

162

163 Results

164 *Quantitative analysis*

165 Six-hundred and seventy-seven students replied to the online survey (response rate: 43,7%).
 166 Incomplete questionnaires (n=111) were excluded and 4 students did not report year of
 167 studies. We included 562 completed questionnaires in the final analysis.

168 **Confirmatory analysis of the instrument's validity and reliability**

169 The initial three-factor model (Teamwork, Roles & Responsibilities, Patient-centeredness and
 170 Healthcare Provision) explained 48% of the total variance. After rotation, a simple structure
 171 with loadings on to the three components emerged. This is consistent with previous research
 172 (13). The calculated Cronbach's alpha for G-IPAS was 0.855.

173 **Demographic characteristics**

174 Participants' demographics are shown in Table 1. 54% of the students reported previous
 175 experience as healthcare providers and over 80% of participants were Swiss German. Most
 176 frequent IPEs mentioned were the Intravenous Cannulation course (n=125), the
 177 Confidentiality seminar (n=98), and the optional interprofessional rotation (n=43).

178

179 **Table 1. Participant's demographics for the quantitative data.**

Year of studies	Year 1 (n=74)	Year 2 (n=84)	Year 3 (n=108)	Year 4 (n=93)	Year 5 (n=103)	Year 6 (n=100)	Total (n=562)
Women [n(%)]	50 (68)	56 (67)	71 (66)	68 (66)	71 (69)	63 (63)	379 (67)
Age (mean \pm SD)	20.5 \pm 2.4	21.1 \pm 2.0	22.6 \pm 3.4	23.4 \pm 2.6	24.1 \pm 2.0	25.6 \pm 2.0	23.1 \pm 3.0
Previous IPE interventions [n (%)]							
None	69 (95)	38 (45)	38 (35)	25 (27)	57 (55)	60 (60)	287 (51)
\leq 2 courses	2 (3)	44 (52)	64 (59)	55 (60)	40 (39)	31(31)	236 (42)
> 2 courses	2 (3)	2 (2)	6 (6)	12 (13)	6 (6)	8 (8)	36 (6)
Previous experience in healthcare [n (%)]							
yes	31(42)	51 (61)	62 (56)	37 (40)	60 (58)	60 (60)	301 (54)
Parents working in the healthcare system [n(%)]							
yes	25 (34)	26 (31)	32 (30)	41 (44)	44 (43)	34 (34)	202 (36)

180 **German interprofessional attitudes scale questionnaire**

181 Table 2 shows the mean scores of each G-IPAS item. Five of the nine items in the subscale
182 “Teamwork, Roles and Responsibilities”, six of the eight in “Patient-Centeredness” and one
183 in “Health Provision” were significantly higher in females. In the subscale analysis, only
184 “Teamwork, Roles and Responsibilities” decreased significantly with an increase in study
185 years ($p < 0.001$). Males showed lower mean scores in the subscale “Teamwork, Roles and
186 Responsibilities” ($p = 0.002$) and “Patient-centeredness” ($p < 0.001$) but not in the subscale
187 “Health Provision” (Table 3).

188

189

190 **Table 2. Mean values for G-IPAS individual components.**

Item ^a	German Interprofessional Attitudes Scale (G-IPAS) (n=562)	Women	Men	Total	p value
Teamwork, roles and responsibilities [Mean(SD)]					
TFV1	<i>Shared learning before graduation will help me become a better team worker</i>	3.79 (1.01)	3.55 (1.13)	3.71 (1.05)	0.015
TFV2	<i>Shared learning will help me think positively about other professionals</i>	3.33 (1.09)	3.14 (1.18)	3.27 (1.12)	0.059
TFV3	<i>Learning with other students will help me become a more effective member of a health care team.</i>	3.91 (1.01)	3.58 (1.20)	3.81 (1.08)	0.001
TFV4	<i>Shared learning with other health sciences students will increase my ability to understand clinical problems.</i>	3.30 (1.05)	3.12 (1.09)	3.24 (1.06)	0.061
TFV5	<i>Patients would ultimately benefit if health sciences students worked together to solve patient problems.</i>	4.20 (0.93)	3.96 (0.92)	4.12 (0.93)	0.004
TFV6	<i>Shared learning with other health sciences students will help me communicate better with patients and other professionals.</i>	4.03 (0.10)	3.69 (1.11)	3.92 (1.05)	0.000
TFV7	<i>I would welcome the opportunity to work on small group projects with other health sciences students.</i>	3.48 (1.18)	3.43 (1.23)	3.47 (1.19)	0.644
TFV8 ^c	<i>It is not necessary for health sciences students to learn together</i>	3.72 (1.07)	3.34 (1.28)	2.4 (1.15)	0.001
TFV9	<i>Shared learning will help me understand my own limitations</i>	3.23 (1.11)	3.29 (1.14)	3.25 (1.12)	0.550
Patient-centeredness [Mean(SD)]					
PZ1	<i>Establishing trust with my patients is important to me</i>	4.90 (0.31)	4.81 (0.40)	4.88 (0.34)	0.008
PZ2	<i>It is important for me to communicate compassion to my patients</i>	4.87 (0.39)	4.71 (0.50)	4.81 (0.43)	0.000
PZ3	<i>Thinking about the patient as a person is important in getting treatment right</i>	4.75 (0.50)	4.59 (0.59)	4.70 (0.53)	0.002

PZ4	<i>In my profession, one needs skills in interacting and cooperating with patients</i>	4.88 (0.39)	4.83 (0.45)	4.86 (0.41)	0.166
PZ5	<i>It is important for me to understand the patient's side of the problem</i>	4.80 (0.46)	4.68 (0.56)	4.76 (0.50)	0.018
PZ6	<i>It is important for health professionals to understand what it takes to effectively communicate across cultures</i>	4.66 (0.53)	4.52 (0.68)	4.62 (0.59)	0.017
PZ7	<i>It is important for health professionals to respect the dignity and privacy of patients while maintaining confidentiality in the delivery of team-based care</i>	4.81 (0.42)	4.75 (0.53)	4.79 (0.46)	0.172
PZ8	<i>It is important for health professionals to provide excellent treatment to patients regardless of their background (e.g., race, ethnicity, gender, sexual orientation, religion, class, national origin, immigration status, or ability)</i>	4.95 (0.22)	4.89 (0.38)	4.93 (0.28)	0.035
Healthcare Provision [Mean(SD)]					
GHV1	<i>It is important for health professionals to work with public health administrators and policy makers to improve delivery of health care</i>	4.07 (0.78)	4.20 (0.88)	4.11 (0.82)	0.069
GHV2	<i>It is important for health professionals to work on projects to promote community and public health</i>	4.14 (0.80)	4.17 (0.86)	4.15 (0.82)	0.684
GHV3	<i>It is important for health professionals to work with the legislators to develop laws, regulations, and policies that improve health care</i>	4.07 (0.82)	4.28 (0.76)	4.14 (0.80)	0.002
GHV4	<i>It is important for health professionals to work with non-clinicians to deliver more effective health care.</i>	4.06 (0.84)	4.09 (0.97)	4.07 (0.88)	0.737
GHV5	<i>It is important for health professionals to focus on populations and communities, in addition to individual patients, to deliver effective health care</i>	4.02 (0.87)	4.18 (0.86)	4.07 (0.87)	0.052
GHV6	<i>It is important for health professionals to be advocates for the health of patients and communities</i>	4.16 (0.85)	4.23 (0.90)	4.19 (0.87)	0.343
GHV7	<i>It is important for health professionals to respect the unique cultures, values, roles/responsibilities, and expertise of other health professions</i>	4.65 (0.56)	4.56 (0.59)	4.62 (0.57)	0.071

191 ^aThe items have been translated from the German language. TFV = Teamwork, roles and responsibilities, PZ = Patient-centredness, GHV =
 192 Health Provision.

193

194 **Table 3. Mean Scores for the G-IPAS Score and Subscale Scores, stratified by gender and year of studies.**

	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Overall average		<i>P</i> value
Overall Scores	Women (n=50)	Men (n=24)	Women (n=56)	Men (n=28)	Women (n=71)	Men (n=37)	Women (n=68)	Men (n=25)	Women (n=71)	Men (n=32)	Women (n=63)	Men (n=37)	Women (n=379)	Men (n=183)	
Teamwork, roles and responsibilities	3.95 (0.59)	3.70 (0.63)	3.63 (0.80)	3.74 (0.81)	3.73 (0.52)	3.57 (0.61)	3.61 (0.74)	3.08 (0.90)	3.60 (0.75)	3.47 (0.82)	3.5 (0.83)	3.20 (1.05)	3.67 (0.72)	3.46 (0.84)	0.002
[Mean(SD)]	3.87 (0.61)		3.67 (0.81)		3.68 (0.56)		3.47 (0.81)		3.56 (0.77)		3.39 (0.92)		3.60 (0.77)		
Patient-centeredness	4.85 (0.2)	4.58 (0.40)	4.76 (0.31)	4.78 (0.33)	4.82 (0.24)	4.75 (0.34)	4.83 (0.2)	4.70 (0.26)	4.85 (0.22)	4.76 (0.32)	4.83 (0.22)	4.72 (0.35)	4.83 (0.23)	4.72 (0.33)	0.000
[Mean(SD)]	4.76 (0.31)		4.76 (0.32)		4.80 (0.28)		4.79 (0.23)		4.82 (0.25)		4.79 (0.29)		4.79 (0.28)		
Healthcare Provision	4.33 (0.54)	3.99 (0.70)	4.08 (0.70)	4.31 (0.56)	4.20 (0.48)	4.26 (0.57)	4.08 (0.53)	4.34 (0.49)	4.18 (0.55)	4.23 (0.61)	4.14 (0.59)	4.28 (0.55)	4.17 (0.57)	4.24 (0.58)	0.207
[Mean(SD)]	4.22 (0.61)		4.16 (0.67)		4.22 (0.52)		4.16 (0.54)		4.02 (0.57)		4.19 (0.57)		4.19 (0.57)		
Overall G-IPAS	4.36 (0.35)	4.08 (0.48)	4.14 (0.48)	4.25 (0.46)	4.23 (0.29)	4.16 (0.39)	4.16 (0.38)	3.99 (0.38)	4.19 (0.36)	4.13 (0.36)	4.07 (0.35)	4.01 (0.38)	4.11 (0.44)	4.20 (0.40)	0.008
[Mean(SD)]	4.27 (0.41)		4.17 (0.48)		4.12 (0.32)		4.11 (0.38)		4.11 (0.38)		4.05 (0.36)		4.12 (0.36)		

195 P-values indicate the significance of the main effect gender for the overall average Scores obtained from the separate ANOVAs.

196

197

198 The two-way ANOVA of the G-IPAS mean score showed a statistically significant main
199 effect for gender ($F(1, 550)=7.129, p=0.008, \eta^2_p=0.013$), with women achieving overall
200 higher mean GIPAS scores. The main effect of study year ($F(5, 550)=2.109, p=0.063,$
201 $\eta^2_p=0.019$) and the interaction effect between gender and study year ($F(5, 550)=1.927,$
202 $p=0.088, \eta^2_p=0.017$) was not statistically significant. The independent samples t-tests showed
203 no statistically significant differences for previous experience in healthcare and having
204 parents working in the healthcare system.

205 An independent samples t-test revealed a significant difference in the means of the overall G-
206 IPAS score between pre-clinical ($M=4.22, SD=0.40$) and clinical years ($M=4.13, SD=0.40$)
207 ($p=0.007$).

208

209 *Qualitative Analysis*

210 We performed nine group interviews (maximum of 4 students each), 31 participants in total.
211 All study years were represented [Year 1: $n=5$ (16%), Year 2: $n=8$ (26%), Year 3: $n=2$ (7%),
212 Year 4: $n=8$ (26%), Year 5: $n=7$ (23%), Year 6: $n=1$ (3%)]. There were 20 female students
213 (64.5%), 16 (51.6%) students had previous experience in healthcare work, 24 students
214 (77.4%) had at least one parent working in healthcare, and 19 students (61.3%) had
215 healthcare professionals as close friends. Table 4 depicts the overall frequency of the quotes
216 in each of the interviews. There were similar distributions of codes across genders and years
217 of study.

218

219

220

221 **Table 4. Coding frequency across all interviews.**

	Frequency (n)	Percentage (%)
Participant's age	31	3.33
Participant's year of studies	31	3.33
Participant's previous work experience	15	1.61
Participant's ties with healthcare	41	4.40
Comments on filling the GIPAS form	25	2.68
Definition of IPE	44	4.72
Goals of IPE	48	5.15
Advantages of IPE	112	12.02
Disadvantages of IPE	101	10.84
Examples of IPE during medical course	96	10.30
Attitudes towards IPE	63	6.76
Attitudes: Absence of IPE	34	3.65
Examples of wished for interventions	70	7.51
Desired format of the IPE course	71	7.62
Desired Year of studies for IPE	92	9.87
Desired Frequency of IPE	50	5.36
Ideal group size for IPE interventions	8	0.86
Total number of coded citations	932	100

222

223 Three main categories emerged from the focus groups: a) *awareness of IPE*, b) *barriers to*
 224 *IPE*, and c) *expectations of IPE*.

225 a) *Awareness of IPE*

226 **Definition of interprofessional education**

227 The interviews demonstrated that students could correctly define IPE, as per the WHO
 228 definition [7] (Table 5, Quote 1). Learning opportunities appeared when topics overlap and
 229 are relevant for the healthcare groups involved. Such interventions allow for exchange of
 230 knowledge or skills and sharing of different experiences, which improves understanding and
 231 communication between groups, and builds trust. IPE can refer to learning about the roles,
 232 responsibilities, competencies and duties of other healthcare professionals (Table 5, Quotes 2
 233 and 3). It was also noted that IPE benefits patient care and helps build a social network of
 234 people within the working environment (Table 5, Quote 4).

235 **Table 5: Subcategory "Definition of IPE" elements and representative cites**

Subtheme with explanation	Representative cites (exemplary) from semi-structured interviews
<p>Definition of IPE</p> <p>Learning that occurs with 2 or more different health professionals or healthcare students</p> <ul style="list-style-type: none"> • about each other’s professions • with other professions about a common topic • to enable effective collaboration • to improve patient outcomes 	<p>Quote 1, Interview 8, Student 3: “(...) at least 1 person from a different professional group is present as a medical student.”</p> <p>Quote 2, Interview 1, Student 2: “I can only agree with the keyword “more efficient cooperation”. I think it is all about having the knowledge and understanding, what are the tasks, the competencies of another team member and how can you support and benefit from each other.”</p> <p>Quote 3, Interview 1, Student 3: “Who does which tasks – it is important that you learn that, so that you focus on the patient.”</p> <p>Quote 4, Interview 6, Student 3: (...) so that people who work in the health sector optimally form a network with each other and work effectively together.”</p>

236

237 **Recognition of interprofessional education in the medical curriculum**

238 The most vividly recalled experience was the intravenous cannulation workshop, currently
 239 being taught during the first year of studies. The course was considered interprofessional
 240 because it was taught by a registered nurse and held in a small-group workshop, with groups
 241 of up to six students (including nurses, midwives and sometimes pre-hospital technicians).
 242 All participants mentioned that it was a positive experience and that they profited from the
 243 course. Main positive aspects mentioned included: (1) the teaching and then the practice with
 244 a skilled nursing student; (2) the relaxed, informal interaction; and (3) the exchange of
 245 information and guidance from the nursing students, with tips from daily practice.

246 *"I could even benefit a lot from the nursing students or the midwives. You really*
 247 *noticed that they already did it on real people when we were still practicing on the*
 248 *models. And they already had routine and could give us good practical advice."*
 249 (Interview 2, Student 2)

250
 251 *"The intravenous cannulation (...) was shown by the nursing student and not by the*
 252 *course instructor, who was a medical student in the higher year because he simply*
 253 *said that the nurse could do it better and had more experience. I thought that was*
 254 *extremely good, that he then said that she could do better and should show it."*
 255 (Interview 7, Student 2)

256
 257 *"(...) we were deliberately divided into my group, that you were always with*
 258 *someone who was not a medical student, which I found very exciting."* (Interview 5,
 259 Student 3)

260

261 *“I could benefit [from the intravenous cannulation course] because we had a*
262 *qualified nurse (...), who could actually show me how it worked, better than the*
263 *instructor. And otherwise, it was a relaxed atmosphere.” (Interview 8, Student 2)*

264
265 However, most students realised that nursing students already had the given competency and
266 were bored/frustrated during the workshop. Some medical students observed other peers
267 having discriminating attitudes towards nursing students. Most were unhappy to be in a
268 workshop where they knew less than their nursing counterparts and could not contribute to
269 any exchange in knowledge.

270 *“[During the intravenous cannulation course] I heard from many nursing students*
271 *that they didn't understand that they were doing there. They could already do it and*
272 *had clinical experience. It was therefore unnecessary for them to take the course*
273 *and a waste of time” (Interview 5, Student 1)*

274
275 *“I noticed that a colleague of mine got upset about the teaching at the intravenous*
276 *cannulation course and mentioned that "she is just a nurse anyway". I then asked*
277 *him directly, "that means that she can do less?" And he answered “yes” and stood*
278 *by it. He really meant it, and only because the nurse had other competencies. And he*
279 *was a first-year student.” (Interview 7, Student 1)*

280
281 *“I don't know what the others should learn from us. We can't do anything! Maybe we*
282 *know more, but that doesn't interest them that deeply either.” (Interview 2, Student*
283 *2)*

284
285 It was also noted that if groups were not deliberately mixed, students from the same
286 profession tended to group together and quality learning was impacted. A medical student
287 who had a nursing background added:

288 *“(…) I have been doing the VP course as a tutor. (...) I personally make sure that I*
289 *do not have a group of doctors in the groups and that the nurses are separate, but*
290 *that I mix them up a bit (...). [It is important that] they work side by side (...)”*
291 *(Interview 8, Student 1)*

292
293 However, the absence of follow-up courses or further skills training and having it assessment
294 only in the third year of studies were all reasons to consider the workshop inadequate for the
295 first year curriculum.

296 Another IPE experience mentioned was the two-hour Confidentiality seminar, occurring with
297 law students or with nursing students. Participants attended this seminar in their first year of

298 studies. Most students hinted that the course was not well structured and that students did not
299 mix, so the experience was not really IP. The reason for it being interprofessional was the
300 common topic rather than the interaction between groups.

301 Five students had additionally chosen to take part in an interprofessional clerkship offered by
302 the University of Bern, consisting of two interprofessional days (first day: nursing students
303 have a shared histology lesson with medical students; second day: nutritional care with
304 student role-play). All students found the IP clerkship very positive. Nursing and clinical
305 clerkships in clinical years, as well as lectures with other professional groups, were also
306 considered IP interventions.

307 *“I found it so important in my nursing internship that I saw what they actually do,*
308 *what their tasks are. Because I also noticed from myself that I have a completely*
309 *wrong picture of what this profession actually is. Because I just thought, a qualified*
310 *nurse, well ... and then I saw what they actually do.” (Interview 2, Student 2)*

311
312 *“We went to lectures for six months with law students. As it was about health law,*
313 *medical students were also invited. It was very interesting, the law students asked a*
314 *lot of medical questions which were clear to us, but we didn't know anything about*
315 *when they mentioned court issues.” (Interview 3, Student 1)*

316
317 Overall, students welcomed IP courses but were disappointed because of the lack of actual IP
318 (i.e., inadequate setting, disorganized interventions). Medical students felt they had
319 significantly less experience than their IP counterparts.

320 *“I actually thought [the IPE] was good in the beginning, but in the end we never*
321 *worked together. (...)I think we medical doctors had a lot less experience and it was*
322 *actually the wrong setting to somehow mix us.” (Interview 8, Student 2)*

323 *“In the intravenous cannulation course, nurses could perform the skill already,*
324 *because they already had patient contact. And I had zero experience. I profited a lot*
325 *from them, but I couldn't give them anything in return.” (Interview 5, Student 1)*

326 The IP offer during the Medical course was insufficient: medical students were aware that
327 doctors deal with many other health care professions, and for medical students it would be
328 important to know about other professions' training, roles and responsibilities during the
329 medical curriculum. Most students did not experience IPE, except for the Intravenous

330 Cannulation course, and one student interviewed had no recollection of any IP interactions
331 during training.

332 *“We had a couple of IP courses with nursing students during our studies. I thought*
333 *it was cool, but I think it shouldn't stop there. We will have to deal with so many*
334 *healthcare groups in the future that it is important to get to know these people*
335 *during medical studies: what they learn, what they can do and where their limits*
336 *are. So that we can understand them a little better.” (Interview 5, Student 2)*
337

338 **Overarching goals of IPE**

339 Table 6 summarises all the mentioned goals of IPE with the respective quotations. Students
340 named several goals of IPE, segmented into 5 main subcategories:

341 (1) *Profession-linked perspectives, and work-oriented learning*: Students were aware
342 that to achieve these goals for application in future daily practice, interactive learning
343 between professional groups was necessary (Table 6, Quote 5).

344 (2) *Improvement of teamwork*: IPE leads to better understanding of the daily routine,
345 work distribution, and duties of other healthcare groups, thus preventing
346 misunderstandings and miscommunication. Enhanced communication through IPE
347 was pointed out as a contributing factor for improved interaction between different
348 professional groups (Table 6, Quote 5).

349 (3) *Reduction of prejudices in the workplace*: Early contact with other healthcare groups
350 could “prevent” the endorsement of stereotypes, and lead to a workplace environment
351 that is open-minded and where there is mutual respect (Table 6, Quote 8).

352 (4) *Enhancement of a patient-centred approach*: IPE implies that patient care is
353 performed collectively, and the patient lies in the centre of care.

354 (5) *Support of workplace wellbeing*: Several students mentioned IPE could create
355 *workplace wellbeing*, particularly by improving social relationships both in and
356 outside work, and by reducing miscommunication, and therefore frustration levels
357 (Table 6, Quote 10).

358 A frequently visited component of IPE was the *enhancement of workplace well-being*.
 359 Students were regardful that finding commonalities in different healthcare professions
 360 intensifies social relations both inside and outside the workplace, leading to a social benefit.
 361 Some students mentioned a financial advantage of IPE, as satisfied staff are more likely to
 362 remain in post thus reducing overall costings. Finally, all of the above lead to less medical
 363 mistakes, which can increase patient safety.

364 **Table 6:** Subcategory “Overarching Goals of IPE” elements and representative quotations

Subtheme with explanation	Representative cites (exemplary) from semi-structured interviews
<p><i>Overarching goals of IPE</i></p> <ul style="list-style-type: none"> • learning together and gaining a more work-oriented perspective • improvement of teamwork • reduction of prejudices • increase in patient-centeredness • improvement of wellbeing in the workplace 	<p>Quote 5, Interview 5, Student 1: “(...) you have the exchange between different professions very early [during medical school] so you don't come clueless to the hospital later.”</p> <p>Quote 6, Interview 1, Student 2: “<i>You (...) become aware of the [roles of team members] and focus on working together.</i>”</p> <p>Quote 7, Interview 6, Student 3: “<i>If you have IP communication beforehand, future work with other healthcare groups will be simplified.</i>”</p> <p>Quote 8, Interview 7, Student 2: “<i>not letting doctors feel superior to the nurses and correct the stereotype that “nurses only do what we do not want to do cause it’s not good enough or not challenging enough for us“</i>”</p> <p>Quote 9, Interview 2, Student 3: “<i>I think it is important to learn to appreciate what others do for the patient. During medical school we do not see the whole spectrum [of health care]. Especially the care or the physiotherapy or ergotherapy, too, contribute a lot - and we do not learn about that“</i>”</p> <p>Quote 10, Interview 5, Student 3: “<i>Also to reduce frustration in the hospital - nurses are frustrated with doctors and the other way around; [IPE] may help“</i>”</p>

365

366 *b) Barriers to IPE implementation*

367 Issues regarding the *competition with the current medical curriculum, the risk of unbalanced*
 368 *learning and other dangers* were explored. Students feel they already have an overloaded
 369 schedule, so additional IPE interventions could be difficult to implement. They were
 370 uncomfortable with being taught by non-doctors because they feared other health care
 371 professionals would not be aware of their training or be knowledgeable about their
 372 curriculum. The lack of assessment of such activities labels IPE interventions as secondary,

373 superfluous or less relevant. There was an outspoken fear of loss of medical identity, loss of
374 medical specialization (because knowledge is shared), and fear of being less thorough in their
375 own medical curriculum.

376 *"You may not get to the level you would need in medical studies if you work with*
377 *professional groups that are in a specific area that does not have to reach such a*
378 *high level. And that you may be slowed down a lot in areas."* (Interview 8, Student
379 1)

380 *"It depends on the topic. (...) you may have extreme differences in knowledge and*
381 *personally, I don't think it's so great when I'm somewhere and then I realize that,*
382 *compared to the others, I don't know anything. I somehow feel stupid and*
383 *superfluous. I can benefit from the others, but (...) it is uncomfortable if you do not*
384 *participate."* (Interview 8, Student 4)

385 On a *course level*, the use of IPE interventions *per se* does not guarantee student interaction.
386 If the IPE experience is not perceived as good by all students, there is a risk that they will
387 consider it unnecessary. The implementation of such activities may be challenging because
388 the content, format and frequency rarely accommodate all students involved. There was a
389 frequently mentioned fear that students would not benefit from the topics due to their diverse
390 backgrounds or varying levels of knowledge on a given subject. Medical students were
391 concerned that topics would be approached too superficially. This could lead to boredom and
392 frustration or create a feeling of unworthiness.

393 The teaching of competencies outside a given role can lead to a false sense of ability and may
394 have legal consequences (by performing skills outside of set competencies). Additionally, it
395 may enhance prejudices against other health care professions because of single participant's
396 characteristics from each group.

397 *"Simply the basic requirements for the [IPE] course were so different that it did not*
398 *really contribute to bringing these two professional groups closer together, but*
399 *rather the opposite."* (Interview 1, Student 2)

400 *It is difficult to bring the shared content across at a common level so that it is*
401 *adequate for both groups"* (Interview 6, Student 4)

402 *"It is a tightrope walk. IPE is necessary, but it can also be too much."* (Interview 3,
403 Student 4)

404 Finally, several barriers were mentioned on an *institutional level*: bureaucratic obstacles of
405 combining curricula from different faculties, organizational aspects e.g. lack of
406 infrastructures to accommodate all students, difficulty in coordinating rotations, time
407 constraints, monetary constraints and deanery or political barriers (resistance to change).

408 *"[Barriers include] organization and also coordination with the various training*
409 *plans. Because we are not learning the same things completely in parallel."*
410 (Interview 6, Student 4)

411

412 c) Expectations of IPE

413 Ten students agreed that IPE should start as early as the first year of studies. They mentioned
414 several advantages for early IPE introduction which included (1) easier implementation (as
415 students would have similar backgrounds) and (2) the encouragement of early interaction,
416 shared learning and networking, which would contribute to the building of mutual respect
417 from an early stage. Students suggested starting with basic science and other overlapping
418 topics, which could then evolve to clinical interactions later in the curriculum.

419 *"And if you start early, you are more sensitive, then you get used to the*
420 *interprofessional and working together. I think that makes a big difference, even if*
421 *you are snobbish in the beginning (...)." (Interview 7, Student 3)*

422

423 Reasons opposed to an early IPE introduction included students being overwhelmed by an
424 overloaded, integrative year; the role of "doctor" not being yet clearly defined and prejudices
425 against other health care professions existing before medical school. On the other hand,
426 eleven students pointed out that the IPE introduction should occur just before or during
427 clinical years (from the third year onwards). For them, it meant a better integration of the IPE
428 content with clinical practice, the previous acquisition of basic clinical knowledge which
429 would facilitate the focus on the IP component, and the broader diversity of activities that
430 could be offered. One student was concerned that such an approach would be too late to

431 prevent the development of prejudices. Five students mentioned it was important to have IPE
432 on a frequent, recurrent basis.

433 *“I have the feeling that it is worthwhile, especially later, the more practical it*
434 *becomes and the more practical things you do, the more it makes sense to integrate*
435 *IPL. Because the first few years are so theoretical, integration doesn't bring you*
436 *much.” (Interview 3, Student 3)*

437 *“But I think that you will probably benefit more from the exchange when you get*
438 *closer to the clinical semesters. Because [in pre-clinical years] the roles are not yet*
439 *clearly distributed. Later on the interprofessionalism is more noticeable.” (Interview*
440 *9, Student 1)*

441 *“If you just look, whether only earlier or only late, I don't know which would be*
442 *better. But repeatedly would be good.” (Interview 5, Student 2)*

443 For pre-clinical years, students preferred IPE courses on overlapping topics from basic
444 sciences (e.g., anatomy, physiology, pharmacology. Potential healthcare students to be
445 included were nurses, physiotherapists, midwives and operating room technicians. Courses
446 should be practical (tutorials, case studies, clinical skills trainings, problem-based learning
447 groups, case-based learning) and lectures should be avoided. Other options mentioned
448 included seminars or course days about topics which are relevant to more than one profession
449 or the use of simulation for soft skill and clinical skill training. Some students recommended
450 that such courses should occur during clinical rotations and include other healthcare students.
451 The IP groups should, when possible, be maintained throughout the year to allow for a deeper
452 social interaction.

453 Students would rather have IPE in smaller groups (4-6 participants, mixed ratio 1:1 or 1:2) to
454 allow for a better interpersonal experience and communication. As for the preferred duration,
455 they felt these should be course blocks of approximately 1-4 hours, entailing a full morning
456 or afternoon. IP courses should have an optional character.

457 *“If they are smaller groups, if you really have to communicate and interact, then*
458 *you get to know each other on a more human level and there are many prejudices*
459 *that can be eliminated.” (Interview 3, Student 2)*

460 *“IPE courses not too often, twice a semester, then increase frequency to once per*
461 *month towards the end of medical school”* (Interview 6, Student 2)

462 Students favored regular IPE interventions, with course repetitions. Participants did not agree
463 on an adequate frequency: while some wished for IPE to occur on a weekly, fortnightly or
464 monthly basis, others preferred only once or twice every semester. Some students were
465 concerned about the time it would take to prepare for weekly IPE (e.g., communication)
466 trainings.

467 Regarding the topic of the IPE intervention, students chose basic science topics for pre-
468 clinical years (including anatomy, biology and patient confidentiality). For clinical years, the
469 main desired interventions included topics like basic life support training, clinical skills
470 training (mostly regarding history and physical examination of organs and systems),
471 handover and rounds, non-technical skills and communication training. Trial (taster) days and
472 areas of shared responsibility (medication errors, hospital hygiene, ethics) were also
473 acknowledged as being useful.

474 *“I think the focus for IPE is a little bit different. When we are with among medical*
475 *students, it is often about acquiring knowledge and when it is interdisciplinary, it is*
476 *more about learning soft skills and how to use them in everyday life.”* (Interview 4,
477 Student 1)
478

479 **Discussion**

480 This study explored medical students' attitudes and perceptions towards the main
481 components of IPE in Bern University. The students displayed positive attitudes towards IPE
482 across all study years in individual items, subscales averages and in the global G-IPAS score.
483 This supports findings from a previous Bernese cohort using another interprofessional
484 attitudes scale (25) and reflects similar findings from other countries (26, 27). Such positive
485 attitudes may be due to a ceiling effect caused by the early exposure to IPE interventions in
486 the Faculty of Medicine of the University of Bern.

487 Females had significantly more positive attitudes towards interprofessionality in the overall
488 G-IPAS and for the subscales of "teamwork, roles and responsibilities" and "patient-
489 centeredness". Selected studies from Sweden (28, 29), using either the RIPLS or the Jefferson
490 Scale also showed more positive attitudes towards teamwork in females. Others (30) reported
491 a significant effect of gender in the IEPS empathy subscale. No other studies seem to report
492 such a gender effect. Females from these countries (Sweden, Northern Italy, and now
493 Switzerland) may be acculturating in more democratic societies that have a strong egalitarian
494 view of women's position in the workforce. The feeling of being equal to males and having
495 equal work expectations can make such differences more visible. Although many healthcare
496 systems still maintain traditional hierarchical structures and gender roles, they may be
497 transitioning into a more gender-neutral teamwork and patient-centred culture, particularly in
498 central and northern Europe. This is an issue worth exploring in further studies.

499 Students in pre-clinical years had significantly higher G-IPAS scores. Other studies showed a
500 similar positive attitudes score, both for the healthcare student population in general (6, 31-
501 34) and medicine in particular (6, 35).

502 One third of students mentioned the importance of the early introduction of IPE in the
503 curriculum, as it facilitated an early interaction and network, contributing to mutual respect
504 and reducing stereotypes. Thus, students can join an interprofessional team without bringing
505 a well-developed “doctor professional identity”(34) . Social Identity Theory (36) supports
506 this: stronger definitions of individual professional roles may lead to intergroup
507 discrimination. Introducing IPE early in the curriculum is likely to have an impact on
508 students’ ability to assume their given roles and responsibilities, which is a basic principle of
509 professionalism (37). Finally, having to learn interprofessional teamwork skills in the
510 workplace in addition to clinical responsibilities and patient care, may increase extraneous
511 cognitive load (38, 39). Learning these skills may be better served within basic sciences
512 courses, as they provide a more favourable framework for the initiation of IPE (40). Early
513 introduction of IPE would also tackle lower levels of prejudice, promoting more positive
514 attitudes (41).

515 Factors contributing to this decline in interprofessional attitudes include being more
516 experienced in the healthcare field (32), having previous interprofessional contact (42),
517 having had less positive experiences in IPE (31, 34, 43) and having parents working in
518 healthcare (44). Although specifically targeted for the Bernese sample, none of these factors
519 showed a significant association with the decline in attitudes. A recent study by Oza et al.
520 (45) applying a regression analysis to a large cohort of medical students, also failed to find
521 such associations with the aforementioned variables. The absence of any association in larger
522 cohorts may be more statistically trustworthy, and the association of these factors in IPE
523 decline should be specifically addressed in higher powered studies.

524 The decline in students’ attitudes towards IPE observed in the quantitative analysis, coupled
525 with 30% of the participants mentioning clear disadvantages of early IPE implementation is
526 worrisome. This is of concern because good relationships with colleagues and patients –

527 likely fostered by IPE – increase patient satisfaction, promote treatment compliance and
528 protect against malpractice claims (46). Hudson et al.(34) suggested this may be due to the
529 nature of the intervention and how negatively students experienced it. Being taught by non-
530 doctors also reduces medical students’ motivation to participate in IPE interventions(34). The
531 arguments above, coupled with an underdeveloped professional identity, may have been the
532 reason for the decline. On-going team training may tackle this, as it has been shown to be
533 central in the sustainability of a shared understanding of professional roles (47, 48). In the
534 present study, students favoured regular IPE to maintain interprofessional proficiency. Both
535 findings reinforce the need to offer health care professional students enough opportunities to
536 interact and learn together from the first year of studies and throughout their careers.

537 Students had an outspoken fear of loss of medical identity and some showed no positive
538 attitudes towards interprofessionalism. Others, despite being at the beginning of their
539 professional career, showed a stereotypical view and regarded interaction between health
540 professions as difficult, which is similar to previous findings (49-52). Although medical
541 students may lack professional maturity to project the benefits of such IPE experiences, it
542 takes time for a true change in mindset to occur, particularly among professions that have for
543 so long operated independently (53). Unfortunately, stereotypes formed by professional
544 interaction and societal views on professional roles are not easily modified by educational
545 interactions alone (54). The introduction of small-group reflections, facilitated by adequate
546 role models, may allow students to remodel their own professional and personal attitude
547 towards patients, to express their moral judgements from their observations of other
548 healthcare professionals’ interactions and to share these experiences within a safe learning
549 environment (48). Such experiences throughout training programmes may reduce anxieties
550 and fears about future professional collaboration(34).

551 Students mentioned barriers similar to those noted previously (5, 55), particularly regarding
552 resistance to IPE by students or faculty, difficulty in coordinating coursework and lack of an
553 established framework. Such barriers are able to influence both the outcome as well as the
554 sustainability of an IPE programme (55). Lawlis (2014) also recommends a way to overcome
555 these barriers by means of faculty development plans. Faculty development encourages staff
556 commitment and buy-in, and eases a professional and institutional culture change, in a
557 “bottom up” approach.

558 The social component of IPE was mentioned as a goal and as an advantage. Students
559 considered the networking beneficial, and by engaging on interprofessional relationships on a
560 personal level, they could learn about each other’s curricula in informal settings and even
561 foster friendships. This is a point not frequently explored in the literature. The social aspect
562 repeatedly mentioned in the interviews mirrors many of the components of Social Learning
563 Theory (56). Learning is also a social and relational process, frequently occurring around
564 authentic and meaningful patient cases (45, 49). Such findings show that “formal” or planned
565 educational IPE experiences also create “informal” opportunities to socialise and be
566 acquainted on a personal level. These “informal arenas can, therefore, stimulate and set a
567 solid basis for interprofessional collaboration” (54).

568 All of these observations should be considered in order to offer more authentic
569 interdisciplinary experiences, with the healthcare team and the patient engaging in
570 interprofessional problem-solving activities. Such significant learning interactions have a
571 clear impact on how medical students internalise and approach patient-centeredness (57).

572 There are limitations to this study: first, the cross-sectional design did not allow for the
573 observation of cohort evolution within their studies and further pre-post analysis. The single-

574 centre design limits the generalization of its conclusions. We tried to overcome this limitation
575 by targeting an adequate sample size, which is one of the largest in IPE literature.
576 We also cannot assume that our qualitative data can be translated by the simple translation of
577 words, because words and meanings are not equivalent in different languages and language
578 carries a cultural meaning. Although we have used a known approach to translation of our
579 quotes from German to English by two native speakers, our translation may still suffer from
580 misinterpretation and the translated text may break away from the original.
581 Additionally, we had concerns about the first use of a new scale. Although the G-IPAS was
582 translated and acculturated into German and has shown very solid reliability data and
583 factorial structure, it may not be the appropriate tool for the study's context. Social
584 desirability bias was also a threat, considering that the G-IPAS was self-reported. Finally,
585 measuring beliefs and attitudes does not indicate true skill proficiency in interprofessional
586 work, and future research should include more ability-oriented measures, aiming for
587 outcomes in levels 3 and 4 of Kirkpatrick's hierarchy (58).

588 **Conclusions**

589 Although IPE has only recently been introduced in many healthcare training settings, medical
590 schools and other health professional training institutions have the means to provide
591 opportunities to encourage collaborative interactions early in training. This study's findings,
592 collected directly from the students, provide valuable insights for the faculty at the University
593 of Bern and for similarly structured universities into the state of IPE in the current
594 programme and potential areas suitable for IPE. They also promote a greater understanding of
595 the difficulties educators and organizations face and encourage discussion about when and
596 how medical schools should address interprofessional learning. The results from this mixed-

597 methods study demonstrate that medical students are ready for IPE experiences early in their
598 studies.

599 **Acknowledgements**

600 We would like to thank the Dean's office of the Medical Faculty of the University of Bern,
601 particularly Dr. Peter Frey, MME for facilitating the distribution of the G-IPAS survey within
602 the University of Bern student's contacts. Additionally, we thank Dr. Sabine Nabecker for her
603 invaluable help with the first coding of the group interviews. We also thank all the students of
604 the medical faculty who participated in the study. We would like to thank the Suzanne and Hans
605 Biäsch Foundation for Applied Psychology for supporting the publication charges.

606 **Authors' contributions**

607 JBE and RG were responsible for the idea and design of the study. JBE and RG implemented
608 the questionnaire. JBE and DS conducted the statistical analysis. JBE and HC prepared,
609 facilitated, transcribed and coded the interviews. SM did the translation according to the
610 equivalent translation structures. SM and AF contributed significantly to the writing, revision
611 and proof-reading of the manuscript. All authors contributed important intellectual content to
612 the paper and approved the final version. All authors agree to be accountable for all aspects of
613 the work in ensuring that questions related to the accuracy or integrity of any part of the work
614 are appropriately investigated and resolved.

615

616

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