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Twelve tips for using Pattern Matching in data analysis for qualitative medical education research

Attard Cortis, Petramay; Muir, Fiona

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Title

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Corresponding Author and Contact Details

Petramay Attard Cortis MD, DESA, MMed (Dundee)

Email: petramaycortis@yahoo.com.au

Phone: +356 7970 3674

Author and Contact Details

Fiona Muir Senior Lecturer EdD (Strathclyde), MEd (Strathclyde), PGCertHE (Dundee) SFHEA

Email: f.e.muir@dundee.ac.uk

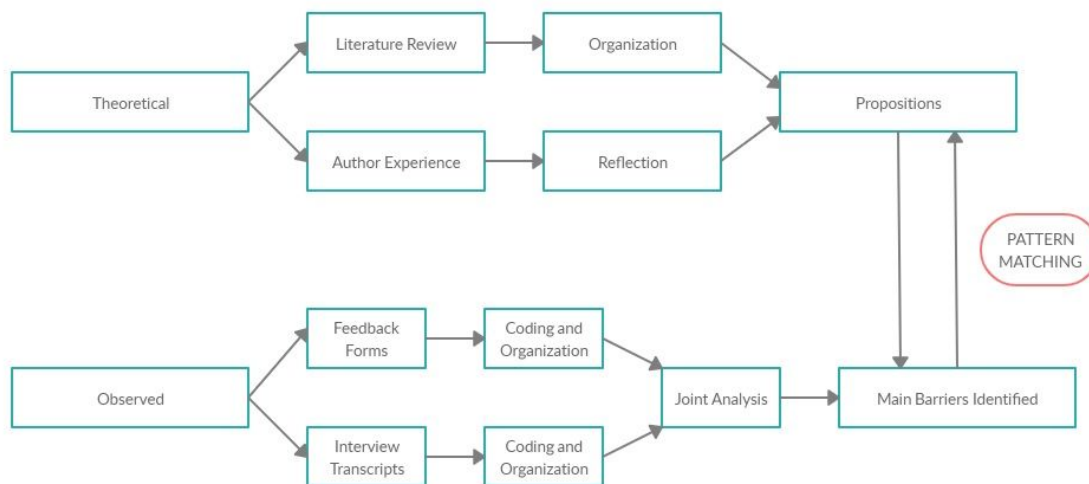


Figure 1. A flow chart of the Pattern Matching process followed for the author’s research.
 Reference: Attard Cortis, P. (2020). *Barriers to Staff Attendance at the Basics in Medical Education (BiME) Course organized by the Faculty of Medicine and Surgery, University of Malta: a case study approach*. MMed Thesis. University of Dundee.

Twelve tips for using Pattern Matching

in data analysis for qualitative medical education research

Abstract

Pattern Matching (PM) is a data analysis method used in qualitative research. This article outlines a step-by-step approach to using PM to analyse qualitative data through the example of the author's experience in its use for a master in medical education dissertation. The recommended twelve tips, outlined as steps to be used sequentially in the PM process are: (1) Assess if PM is a suitable technique for you and your research, (2) Consider alternatives, (3) Decide to proceed with PM, (4) Perform literature review, (5) Reflect about your experiences, (6) Define Propositions, (7) Collect your data, (8) Code data, (9) Match data to propositions, (10) Celebrate congruency, (11) Explain discrepancies and, (12) Discuss relevance and utility of findings in your context. PM, when rigorously applied, can increase the internal validity and transferability of qualitative research in medical education. A clear data analysis protocol enhances reliability and dependability of any research.

(150 words)

Introduction

Pattern Matching (PM) is a method of data analysis recommended for use in qualitative research. It involves the "... comparison of a predicted theoretical pattern with an observed empirical pattern" (Sinkovics, 2018, p.469). It is a technique recommended for case study research in particular (Yin, 2018) and qualitative research in general (Johnson &

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3 Onwuegbuzie, 2004), and which can be applied to medical education research. Johnson and
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5 Onwuegbuzie (2004) state that by using PM, qualitative researchers can increase the quality
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7 and rigour of their research by using a data analysis process that is clearly laid out a priori to
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9 the data collection and can therefore be replicated from the data set. This reproducibility is
10
11 a clear benefit of PM as a qualitative data analysis tool.
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15 One of the first educational research papers about PM as a data analysis method for theory-
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17 based research was published by Trochim (1989). PM has not been widely reported in the
18
19 literature since but has been used in case study research looking at the influence of cultural
20
21 diversity in a nursing workforce on quality and safety of patient care (Almutairi, Gardner, &
22
23 McCarthy, 2014) and in business leadership research (Pearse, 2019). Both papers highlight a
24
25 lack of published guidance and application examples of PM. They explain the use of PM as
26
27 applied to their research, but in also reporting the research results concurrently, the process
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29 of PM as a data analysis technique necessarily shares the publication spotlight. PM has also
30
31 been used in phenomenological research looking into the professional identity of
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33 undergraduate medical education leaders (Sundberg, Josephson, Reeves, & Nordquist,
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35 2017).
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42 The author used Pattern Matching (PM) as a data analysis technique for a medical education
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44 qualitative research dissertation, which was an explanatory, holistic, single case study. The
45
46 research question focused on why faculty members at the author's institution were not
47
48 attending a faculty development programme and included data in the form of semi-
49
50 structured interview transcripts and analysis of documentation (programme feedback
51
52 forms).
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55
56 Like the first author, medical education researchers from the clinical specialities are likely to
57
58 be most familiar with quantitative research and look for absolute knowledge in their clinical
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practice. They may be hesitant to delve into the realm of qualitative research and the more commonly used constructivist and interpretivist designs. Pattern Matching balances both positivist and interpretivist approaches. It is therefore most useful to medical education researchers approaching qualitative research from a positivist/ post-positivist perspective and may provide a data analysis method that aligns with their theoretical stance.

Pattern Matching was found to be theoretically, a rigorous and reliable qualitative data analysis method, but finding texts and publications where the process was clearly and concisely explained was a challenge. After reading Yin's (2018) book and a detailed literature search in PubMed®, Google Scholar™, Scopus and ERIC, the following diagram (Figure 1) was developed to summarize the PM data analysis process.

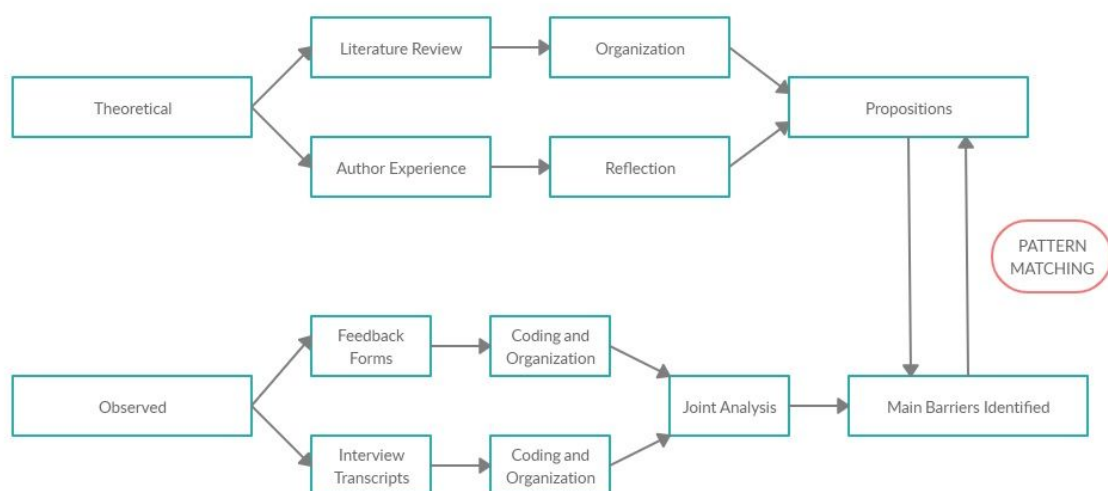


Figure 1. A flow chart of the Pattern Matching process followed for the author's research. Reference: Attard Cortis, P. (2020). *Barriers to Staff Attendance at the Basics in Medical Education (BiME) Course organized by the Faculty of Medicine and Surgery, University of Malta: a case study approach*. MMed Thesis. University of Dundee.

1
2
3 Yin (2018) states that if the empirical (observed) and predicted (theoretical) patterns appear
4
5 congruent, then this can provide data analysis evidence to strengthen the research's
6
7 internal validity. PM requires the development of theoretical propositions, or predicted
8
9 research findings, prior to the commencement of data collection. These propositions should
10
11 be developed from a literature search and/or from the researcher's experience (Almutairi,
12
13 Gardner, & McCarthy, 2014). They are then compared to the research findings, either
14
15 manually or using computer software.
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19
20 PM can be used to enhance the quality of case study research. Internal validity is challenging
21
22 in case study research due to the fact that inferences need to be made from data that may
23
24 be collected using non-observational methods. As part of the author's research, data was
25
26 collected from semi-structured interviews and documents, and so, inferences had to be
27
28 made. This concern with internal validity was identified early in the research process and
29
30 mitigated through the use of PM as the data analysis process, as recommended by Yin
31
32 (2018).
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36
37 To ensure dependability, peer **debriefing can also be used within the PM data analysis**
38
39 **process**. Peer debriefing enhances the research's quality and rigour (Houghton, Casey,
40
41 Shaw, & Murphy, 2013) by providing "*... an external evaluation of the research process...*"
42
43 (Onwuegbuzie & Leech, 2007, p.244). It increases research validity through legitimacy and
44
45 trustworthiness (Starks & Brown Trinidad, 2007). The peer debriefing process was used to
46
47 demonstrate agreement between the author and the peer debriefer using PM for data
48
49 analysis.
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55 This article outlines a step-by-step approach to using PM to analyse qualitative data **in**
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57 **medical education research**. The recommended twelve tips, outlined as steps to be used in
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1
2
3 succession, will be explained by using **examples from the author's experience** in its use for a
4
5 master's degree dissertation. **While some tips may be familiar from other forms of research**
6
7 **methodology and methods, the steps in common are features of quality and rigorous**
8
9 **research design and data analysis techniques, and so are also a part of the PM data analysis**
10
11 **process.**
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18 **Tip 1**

20 **Assess if PM is a suitable technique for you and your research**

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22 Similar to other data analysis methods, it is important that PM is assessed by the researcher
23
24 to determine whether it is a good fit for the researcher and the research being undertaken.
25
26 The choice of PM needs to be aligned with the researcher's theoretical lens, ontology, and
27
28 epistemology, as well as with the chosen research methodology. **Such alignment is a**
29
30 **necessary quality marker in qualitative research (Boaz & Ashby, 2003).** If the medical
31
32 education qualitative research is approached from the theoretical lens of positivism and
33
34 post-positivism, then PM is an aligned data analysis method. PM may be less suitable for
35
36 research performed using a critical theory or constructivist theoretical **lens as these may**
37
38 **require a constructivist or interpretivist stance.** A more detailed discussion of ontology and
39
40 epistemology is provided by Al-Saadi (2014).
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49 When considering alignment between methodology and data analysis techniques, PM has
50
51 been particularly recommended for case study research (Yin, 2018). However, it has also
52
53 been suggested as a strategy to reduce subjectivity and increase rigour in qualitative
54
55 research in general (Johnson & Onwuegbuzie, 2004). A YouTube^{MT} lecture explaining the
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1
2
3 use of PM in qualitative medical education research can be found at this link:
4

5 <https://www.youtube.com/watch?v=lxrtmCnwjiM>
6
7

8 PM has been used as a data analysis method in qualitative medical education research with
9
10 interesting results (Almutairi, Gardner, & McCarthy, 2014; Sundberg, Josephson, Reeves, &
11
12 Nordquist, 2017).
13
14

15 16 17 18 **Tip 2**

19 20 **Consider alternatives**

21
22 There are numerous methods of data analysis that can be used in qualitative medical
23
24 education research - two commonly used methods are framework analysis and grounded
25
26 theory analysis. Grounded theory looks for themes that emerge from the data and
27
28 compares these to each other. This method of data analysis requires that the analysis be
29
30 conducted using an open mind, with no preconceptions as to what the data will show. In
31
32 contrast, PM dictates the development of theoretical propositions before starting data
33
34 collection which adds rigour to the data analysis process by allowing other researchers to
35
36 understand the data analysis process in detail (Yazan, 2015).
37
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40
41 Framework analysis has also been proposed as a method for thematic (qualitative content)
42
43 analysis, particularly for use with large amounts of data from interview transcripts being
44
45 worked on by multidisciplinary researchers (Gale, Heath, Cameron, Rashid, & Redwood,
46
47 2013). It is however a time-consuming process and should be led by a researcher
48
49 experienced in this method of data analysis (Gale et al., 2013).
50
51

52
53 Even when working from a positivist or post-positivist theoretical lens in case study
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55 qualitative medical education research, the literature provides an array of data analysis
56
57 options. These include explanation building, time series analysis, logic models, and cross
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1
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3 case synthesis (Baxter & Jack, 2008). However, these methods may require familiarity in
4
5 their use and often require computer software to implement. These may be barriers to
6
7 utilisation in comparison to PM, which is a straightforward, step-by-step, data analysis
8
9 process. In the author's experience, PM can be applied by a novice researcher to qualitative
10
11 research by performing a thorough literature review, followed by an in-depth reflexive
12
13 process of the research question and by working with a great attention to detail and rigor.
14
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20 Tip 3

21 **Decide to proceed with PM**

22
23 Once the PM process has been adequately understood and alternatives considered, then a
24
25 decision can be made to proceed with this data analysis approach. Developing a
26
27 personalised flow chart for the PM process to be followed for the particular research **should**
28
29 **be** developed at this stage and then strictly adhered to. **An example can be found in Figure**
30
31 **1.**
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36

37 The author used Flowchart Maker and Online Diagram Software at www.draw.io This is a
38
39 free software that can be used by logging in using a Google account and integrated within
40
41 the user's Google Drive.
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47 Tip 4

48 **Perform literature review**

49
50 Prior to starting the data collection, the theoretical Propositions for use in the PM process
51
52 need to be developed (Yin, 2018). The first step is an in-depth literature review about the
53
54 research topic. This is important for the researcher to learn what is currently known about
55
56 the research question.
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3 For example, the author's research question was: "Why are staff members at the Faculty of
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For example, the author's research question was: "Why are staff members at the Faculty of Medicine and Surgery, University of Malta not attending the Basics in Medical Education Course?" A literature search demonstrated that commonly reported barriers to faculty development were multifactorial and included both individual (such as time), and institutional hurdles (such as the lack of positive or negative incentives).

Tip 5

Reflect about your experiences

In PM, the researcher's view and understanding of the situation under study is important.

As part of the preparation process for developing the theoretical Propositions, considerations related to the researcher's experience need to be included.

For example, the author found through a literature review that funding was a common barrier to attendance to faculty development initiatives. However, this was deemed not relevant to the research question as the particular course being studied was offered free of charge. Additionally, while the author believed that a lack of awareness about this faculty development course was a barrier to attendance in the case under study, little was found in the literature relating to this. The lack of awareness as a barrier to course attendance was included as a Proposition from researcher experience.

Tip 6

Define Propositions

Combining the knowledge gained from the literature search and the reflection on the researcher's own experience allows the development of theoretical Propositions. It is

1
2
3 important that these are clearly and succinctly defined, so that the later steps in the PM
4
5 process can be smoothly performed.
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7

8 Examples of the Propositions developed for the author's research question focusing on
9
10 barriers to attendance to a **faculty development programme in Malta, Europe** as informed
11
12 by the literature and author experience included:
13
14

- 15 • Time is a significant barrier to attendance (Caffarella & Zinn, 1999; Swanwick &
16
17 McKimm, 2010; Brownell & Tanner, 2012; Aziz, Jet, & Rahman, 2013; Ikenwilo &
18
19 Skåtun, 2014)
- 20 • The idea of separate professional and teaching identities (Brownell & Tanner, 2012)
21
22 is poorly developed locally and this lack of awareness acts as a barrier to attendance
23
24 (author experience)
- 25 • A lack of awareness of the existence of the BiME course is a barrier to attendance
26
27 (author experience)
- 28 • Funding (Aziz et al., 2013; Ikenwilo & Skåtun, 2014) is not a barrier to attendance
29
30 (author experience)
- 31
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41 **Having well-defined Propositions for the PM data analysis process before the start of data**
42
43 **collection is essential (Yin, 2018).**
44
45

46 47 **Tip 7**

48 49 **Collect your data**

50
51 Once your theoretical Propositions are developed and finalised, these should not be
52
53 changed to maintain rigor in the PM process. The data collection stage of the research can
54
55 now be started as per the defined methodology and methods.
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Tip 8

Code data

The next step in the PM process is coding of the obtained data and formulation of the empirical (observed) findings.

Data coding and organisation can be done manually or using computer software such as NVivo®. Computer software provides the advantage of speed and accuracy in data coding and organization but is usually expensive to use and requires training.

While a manual process may be more laborious, the author found that performing data coding and organisation in this manner allowed for a deeper understanding and increased familiarisation with the research findings. An explanation of what codes are and how to use them is found in this YouTube^{MT} video: <https://www.youtube.com/watch?v=opp5tH4uD-w>

Tip 9

Match data to propositions

The exciting step in the PM approach is comparing the previously defined theoretical Propositions (Tip 6) to the empirical (observed) research findings. At this point, the researcher must analyse the data to see if the observed findings are congruent with the predicted theoretical Propositions.

For example, the author compared the coded data obtained from Tip 8 to the Propositions outlined in Tip 6 which could be outlined as follows:

- Proposition: Time is a significant barrier to attendance
 - Coded data showed that nine out of thirteen interviewees confirmed that time would be a significant barrier to attendance. Supported by transcript quotations, for example, *“I was busy... I did not have the time.”*

- Proposition: A lack of awareness of the existence of the BiME course is a barrier to attendance
 - Coded data showed that five interviewees had never heard of the BiME course prior to the study participation email.

This matching needs to be performed for all the Propositions defined before the start of data collection.

Tip 10

Celebrate congruency

Congruency between theoretical and observed patterns is a positive outcome. If the observed patterns are similar to the predicted ones, then the use of PM enhances the internal validity of the research (Yin, 2018).

For example,

- Proposition: The idea of separate professional and teaching identities is poorly developed locally and this lack of awareness acts as a barrier to attendance
 - Coded data showed that the majority of interviewees agreed with the Proposition above and that this could be due to a number of factors, as supported by transcript quotations:
 - Lack of concept awareness, *“I think it is still a bit muddled... when we graduated, we were expected to teach your peers or teach medical students... and I don’t think that was fair... because although you just graduated, you graduated as a doctor not as a teacher.”*
 - Limited local acceptance of idea, *“We do not have... an understanding - generally - of the importance of medical education. Many educators*

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3 *believe that once they have become specialists, they are therefore*
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5 *qualified to be educators.”*
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- 24 ■ Lack of institutional feedback, *“If nobody's ever told you... that there is*
25 *a better way and you've never been exposed to alternatives, then yes*
26 *of course it's a barrier... they don't know what they don't know, and*
27 *that does not make them bad people, it just makes them ignorant in*
28 *relation to this.”*

29 **Tip 11**

30 **Explain discrepancies**

31 If the researcher identifies differences between the theoretical Propositions and the
32 empirical findings, then these need to be considered and discussed. Therefore, if the coded
33 data obtained in Tip 8 provides evidence that refutes one or more Propositions outlined in
34 Tip 6, then the medical education researcher needs to provide an explanation for this (Yin,
35 2018). A reflexive stance is important in these situations to explain what could have been
36 the reasons and conditions for the lack of pattern matching.
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46 **Tip 12**

47 **Discuss relevance and utility of findings in your context**

48 Finally, the PM data analysis process and its conclusions – congruency and/or discrepancies
49 – need to be viewed in the light of the research question and the qualitative research
50 context. The relevance and utility of the data analysis and findings should be explored and
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3 discussed. An outline of the strengths and weakness of the applied PM data analysis process
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5 ought to be reflected upon and reported in the research report.
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10 **Conclusions**

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12 Pattern Matching as a **qualitative** data analysis tool **for medical education research** has been
13
14 described in an easy-to-follow, step-by-step manner. A clear data analysis protocol
15
16 enhances reliability and dependability of any research. When rigorously applied, PM can
17
18 increase the internal validity, **reproducibility**, and transferability of qualitative medical
19
20 education research.
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28 **Declaration of Interest**

29
30 This work is derived from a dissertation in part-fulfilment of a Master in Medical Education
31
32 degree at the University of Dundee completed by Petramay Attard Cortis, under the
33
34 supervision of Fiona Muir.
35
36

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38
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40
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42
43
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45 **Notes on contributors**

46 **Petramay Attard Cortis** MD (Melit.), DESA, MMed (Dundee) is an anaesthetist with an
47
48 interest in medical education. She is a Visiting Lecturer at the Faculty of Medicine and
49
50 Surgery, University of Malta; and is a European Resuscitation Council Full Instructor on GIC,
51
52 ILS, ALS and EPALS courses.
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56 **Fiona Muir** PgCert Higher Education, MMed (Dundee), PhD Education (Strathclyde) is a
57
58 Senior Lecturer, Centre for Medical Education, Medical School University of Dundee.
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