

2015-10-09

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<http://hdl.handle.net/10026.1/4808>

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10.1007/s12687-015-0255-z

Journal of community genetics

Springer Science and Business Media LLC

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**This is an accepted manuscript of an article published by the Journal of Community Genetics (2015) available at:**  
**<http://link.springer.com/article/10.1007%2Fs12687-015-0255-z>.**

Components of Genetic Counsellor Education: A Systematic Review Of The Peer-Reviewed Literature

Ingvoldstad C, Seven M, Taris N, Cordier C, Paneque M and Skirton H

## **ABSTRACT**

The need for appropriately trained genetic counsellors to support genetic healthcare is now acknowledged. However, while programs for education of genetic counsellors exist in a number of countries, these do not conform to any specific international standards. This systematic review was conducted to evaluate the components of educational programmes for genetic counsellors worldwide. Databases were searched for studies published in English from 2000-2014 related to the topic. We identified 406 potential papers, , of these 11 studies met the inclusion criteria. The findings indicate that, in general, the theoretical components of genetic counsellor programs conform to the recommendations and requirements of relevant professional bodies. However, clinical preparation of genetic counsellors in real-life professional practice settings seems to be less well addressed as this is essential to ensure genetic counsellors are able to provide safe patient care after graduation. Further work to gain agreement internationally on genetic counsellor education is needed.

Key words: genetic counsellor, education, clinical practice, program content



## INTRODUCTION

The rapid advancement of genetics has resulted in an increase in the application of genetics to many aspects of healthcare.<sup>1</sup> In parallel with the higher demand on genetic services, an increasing number of health professionals working in the field is required.<sup>2,3</sup> Genetic services, including diagnosis of genetic conditions, genetic counselling and genetic testing, have been provided by a multidisciplinary specialist genetic healthcare team, including allied health professionals such as genetic nurses and genetic counsellors.<sup>3,4</sup>

Genetic counselling, which is an integral part of genetic services, is defined by the National Society of Genetic Counsellors (NSGC) as "the process of helping people understand and adapt to the medical, psychological and familial implications of genetic contributions to disease".<sup>5</sup> Genetic counsellors are health professionals with specific specialist training in this field.<sup>5,6</sup>

The first training program for non-medically trained genetic counsellors was founded in 1969 by Melissa Richter at the Sarah Lawrence College in Bronxville, New York (USA).<sup>2,7</sup> It was established in response to the advances in human genetics knowledge and technologies, which coincided with the decriminalization of abortion and the growing importance of the bioethical issues in the United States (US).<sup>2,7</sup> This first training programme served as the model for the education in genetic counselling throughout North America. Over the next decades, additional programmes were established in both the US and Canada.<sup>8</sup> Currently, there are more than 30 training programmes accredited by the American Board of Genetic Counselling.<sup>9</sup> In the late 1980s, educators in South Africa established an MSc level training programme for genetic counsellors<sup>10</sup> and in Australia, a diploma level programme was developed: this was later converted to two-year Master's program in

2008.<sup>11</sup> In Europe, Master's degree programmes for genetic counsellors started in the United Kingdom (UK), in 1992 at the University of Manchester and in 2000 at Cardiff University.<sup>12</sup> More recently, in the last decade, professionals in other nations in Europe and worldwide followed in the footsteps of those inaugural models in creating specific educational programmes for genetic counsellors.<sup>13</sup> The European Board of Medical Genetics has approved seven specific university-based programmes offered in Europe as appropriate for the training of genetic counsellors<sup>14</sup>, these are in the UK (Manchester and Cardiff), France, Spain, Portugal and Romania.

As scientific knowledge and application of genetic technology continues to develop, creating more diagnostic and management options in clinical medicine, genetic counselling must continue to evolve to meet the needs of populations.<sup>2,3</sup> In order to ensure quality of patient care, genetic counselling training should include the knowledge, skills and attitudes required to perform appropriately as a genetic counsellor.<sup>5, 12</sup> Core competencies for the genetic counselling profession have been established in several regions.<sup>2, 4, 5</sup> Using a Delphi study, Skirton *et al*<sup>4</sup> determined the first core curriculum for genetic counsellors in Europe that includes: (1) counselling skills; (2) psychological aspects of genetic healthcare; (3) medical genetics; (4) human genetics; (5) ethics, law and sociology; (6) professional practice; and (7) education and research.

The need for appropriately trained genetic counsellors is now widely acknowledged. However, while programmes for education of genetic counsellors exist in a number of countries, these do not conform to any specific international standards. Variance in the professional identity and training of genetic counsellor may be due to differing practice healthcare systems between countries, but may also

contribute to inconsistencies in standards of patient care. Guidelines for uniform genetic counsellor education are needed to ensure the quality of professional practice, leading to equitable services for patients.<sup>6, 15, 16</sup>

In this context, we conducted a systematic review to evaluate the components of educational programmes for genetic counsellors worldwide.

## **METHODS**

Conducting a systematic review enables the evidence on a particular topic to be gathered, analyzed and synthesized. Adherence to a rigorous set of guidelines is essential to ensure rigour and objectivity. We followed the process for systematic reviews developed by the Centre for Reviews and Dissemination,<sup>8</sup> which involves identification of relevant search terms, selection of studies based on explicit inclusion and exclusion criteria and quality assessment of papers.

The research question was 'What are the components of professional education for genetic counsellors?'

### **Search strategy and Eligibility criteria**

A search of five relevant electronic databases: Medline, CINAHL, Educational research complete, Web of Science and Scopus, AMED and PsychInfo was conducted. Following an initial ad hoc search to determine the relevant search terms, we used the following search terms within any part of the text: 'genetic counselling' OR 'genetic counseling' OR 'genetic counsellor' OR 'genetic counsellor' AND 'education' OR 'training' OR 'master program' OR 'curricula' OR 'curriculum'. The search focused on papers published in English between 1<sup>st</sup> January 2000 and 28<sup>th</sup> February 2014.

Papers were eligible for inclusion if they: (i) were based on research using qualitative, quantitative or mixed methods designs as well as descriptive reports, (ii) included data on components of existing training programs for genetic counsellors and (iii) reported on existing training programs.

Papers were excluded if they: (i) focused on career development of health professionals other than genetic counsellors, (ii) were focused on competencies without inclusion of content (iii) were related to theoretical components or curricula for genetic counsellor training programs (but do not discuss actual training programs).

As a result of the initial search, we identified 481 potential papers for inclusion. After deleting duplicates, 406 papers were left for examination. Further to this process, a hand search of the indexes of *Journal of Genetic Counseling* was made, resulting in identification of five additional papers. After reading the titles of all papers, a further 282 were excluded, leaving a total of 124 papers. The abstracts of these papers were read, and a further 86 were excluded on the grounds that they did not fit the exclusion criteria (see PRISMA diagram). All 38 remaining papers were read in full, of these 11 fitted the criteria for the review.

### **Quality Assessment**

We evaluated each of the included papers for quality. Two (MP and HS) of the authors independently rated each paper and the scores were then discussed until consensus was reached. One of the papers was research-based, and for this we used the scoring system devised by Kmet *et al.*<sup>17</sup> This involves answering 14 relevant items related to issues such as study design, sample size and method of analysis by allocating a score of 2 (fully met), 1 (partially met) or 0 (not met) to each item. The total score is then converted to a percentage. The majority of the papers were reports, for which there are few scoring systems. We used the Joanna Briggs

Institute Notari scoring system [<http://joannabriggs.org/sumari.html>], which can be used for evaluating discussion or opinion papers.<sup>18</sup> It includes seven questions related to the veracity of the content and relation to other literature. Although not ideal for our purposes, after slight adaptations, it enabled us to make a judgment on the quality of the papers. The scores for all papers were above 70% and therefore all were included in this review.

### **Data abstraction**

Several of the authors (CI, HS, CC, NT) were involved in data selection and abstraction at every stage in the review. As the papers were so varied and the majority was not research-based, a meta-analysis was not possible. For each article, identifying information (such as objectives, research setting, study design, methods) was recorded and data relevant to the research study were extracted (such as objectives, admission requirements for genetics education, and types of genetics education program, characteristic of the program).

Original data from the included studies were abstracted and presented in Tables 1 and 2. A thematic analysis of the data was conducted and is presented in a narrative format.<sup>16</sup>

## **RESULTS**

Table 1 summarizes the characteristics of the papers included in the study. All of the papers were published after 2005. Table 2 provides an overview of genetics education, as reported in the articles included in the study.

Of the 11 papers, three focused on genetic counsellors in Australia and one paper in the United States, France, the Philippines, Cuba, Taiwan, Israel, Saudi Arabia and South Africa respectively. One study used a two phase cross sectional design.<sup>19</sup>

The remaining 10 papers were descriptive reports. The themes extracted from the



papers were: (1) Admission requirements for the program (2) Basic information of the programs (3) Teaching methods of the program (4) Expected Competencies from graduates and (5) Registration and certification requirement for genetic counsellors (Table 2).

Table 3 depicts content of genetic education programs reported in these papers. Although the authors have not included the entire content of the programmes, the majority provide the basic components. Depending on background of students, duration and the level of education, content of the education program can vary in a wide range of topics. Generally, programs encompass both clinical and theoretical teaching; however authors of only two papers mentioned including counselling practice.<sup>11, 26</sup>

### **Admission requirements for the program**

Authors of most papers stated that students of the program should have a undergraduate or bachelor degree, in science or health science<sup>21,23-27</sup> or nursing;<sup>21-24</sup> other authors mentioned graduates in psychology<sup>22,23,25</sup> or humanities,<sup>26,27</sup> as suitable candidates. In Cuba, there were two different programs, where the first of the programs was for physicians with other specialties<sup>22</sup> than genetics (such as family medicine, pediatrics or obstetrics) and the second was designed for other professionals as psychologist, nurses or social workers to become genetic counsellors. In Taiwan, students with various medical backgrounds such as nurses, technicians, doctors, psychologist could participate in the program,<sup>20</sup> in France practicing health professionals were eligible,<sup>21</sup> while in Australia the program was mostly targeted at non-medical health professionals.<sup>11</sup> Other pre-requisites stated were, for example, excellent knowledge of written and oral English,<sup>24</sup> 2-year military service<sup>25</sup> very high undergraduate grades<sup>25</sup> or specific citizenship.<sup>24</sup>

## **Basic information of the programs**

Authors of all papers except one<sup>27</sup> described two year (full-time) Master programs in Genetic Counselling. One Australian paper referred to a one year diploma program in Genetic counselling,<sup>27</sup> but that program has now developed since 2008 to a two year Master program.<sup>26</sup> The oldest Masters programme described, from which 51 genetic counsellors had graduated, started in Israel in 1997.<sup>25</sup> However, 837 genetic counsellors had graduated in Cuba since 2000.<sup>22</sup> The most recently developed program, available since 2011, was in the Philippines.<sup>23</sup>

## **Teaching methods of the program**

All programs include didactic coursework or formal education. The didactic coursework was delivered via lectures, group discussions and student-led seminars. Other important teaching tools were role play, encouragement of self-reflection, videotaping and problem based learning<sup>26, 27</sup> In addition, many programs include clinical training in relevant healthcare clinics, for example prenatal, general pediatrics and cancer<sup>11, 21,23-27</sup> or in primary health care.<sup>22</sup> Some programs include research or a research project, a thesis<sup>10, 11, 22, 23, 25, 26</sup> and some included laboratory work.<sup>20, 21, 24</sup>

## **Content of the Programs**

The information of the course content was limited in some papers. From those papers where content was included, some common areas could be identified.

### Theoretical subjects

*Genetics*; Genetics was included in a range of formats. Basic and Molecular genetics were mentioned when describing the content of the program in Saudi Arabia<sup>24</sup> and in Australia.<sup>26</sup> Human genetics and Human population genetics courses were also included in the Saudi Arabia curriculum.<sup>24</sup> Other authors mentioned Clinical or Medical genetic courses<sup>11,20,24,25</sup> as part of the program. Other subjects mentioned

were metabolic diseases molecular cytology, embryology, fetal ultrasound <sup>25</sup> and pathology. <sup>21</sup>

*Counselling;* Authors of six of the papers stated that courses in counselling skills<sup>11,20,21,24,26</sup> or health communication skills <sup>26</sup> were part of the program.

*Ethics and psychological issues;* The program in Saudi Arabia program included courses in cancer genetic counselling, psychological aspects of genetic counselling and genetic counselling and Islam. In Israel, the program included courses on decision making and ethics in modern genetics. <sup>25</sup>

#### Research methodology and thesis

Some of the programs included research design and methodology courses <sup>19, 21, 25,26</sup> as well as statistics or biostatistics <sup>19,20,25</sup>. In three of the papers it was stated that a research project<sup>10</sup> or a formal thesis<sup>19, 26</sup> was a requirement.

#### Clinical practice and rotation

Of the papers in which content of the programs was included, seven programs had some kind of clinical practice or observational clinical training included in the curricula<sup>10,11,21-23,25,26</sup>. The form of and time for clinical practice differed between the programs. In France, for example, there were clinical rotations of 28 weeks<sup>21</sup> whereas in Cuba students had 428 hours of training.<sup>22</sup> In Australia, practice included working as a trainee genetic counsellor under supervision,<sup>11</sup> observation at genetics clinics, as well as placements in a community setting. <sup>26</sup>

#### **Expected competences of graduates**

At the end of every program students undertook oral and written examinations to test their preparedness as a genetic counsellor. Students were expected to have knowledge of both genetics and scientific and medical fields, as well as in social,

psychological and ethical aspects of genetic counselling. In addition, required competences included counselling theories<sup>27</sup> communication skills, interviewing and counselling skills and critical thinking and analysis.<sup>5,11</sup> In the Philippines, the students were expected to document >40 counselling cases.<sup>23</sup>

### **Registration and certification requirement for genetic counsellors**

There were registration or certification processes of genetic counsellors reported in many of the included countries i.e. in Israel,<sup>25</sup> France,<sup>21</sup> Taiwan<sup>20</sup> and South Africa.<sup>10</sup> In addition, the programs in Cuba<sup>22</sup> and Saudi Arabia<sup>24</sup> have been accredited by the education system in each country.

### **DISCUSSION**

Core competences for the genetic counselling profession have been established.<sup>2,4,5,15</sup> In addition, educational standards and competences of genetic counsellors have been agreed in Europe<sup>4</sup> as well as in the USA.<sup>5</sup> In the studies included in this review, all genetic counselling programs except one<sup>27</sup> were two year master programmes. This is in accordance with the ACGC standards for accreditation of graduate programs in genetic counselling,<sup>5</sup> which states that all graduate programs in genetic counselling are required to provide training over a minimum of 21 months or two academic years. Two year Master programmes also comply with European standards, as the professional and educational standards for genetic counsellors in Europe state that a genetic counsellor is a health professional who has undertaken a period of education and training at Master level. The proposed Curriculum for registration of genetic counsellors by the European Board of Medical Genetics (EMBG) also proposes that all genetic counsellors should be educated at Master level to be able to eligibility to register as a genetic counsellor.<sup>4,28</sup>

Our findings indicate that the programs correlated well with both the European core competencies that state counselling skills, psychological issues, medical genetics, human genetics and ethics/law/sociology to be included in the training program <sup>14</sup> and the ACGC standards which show similar instructional content in their curricula e.g. human and medical genetics, science related to medical genetics, psychosocial content including counselling and social, ethical and legal issues in genetics.<sup>5</sup> In addition to these theoretical courses, competencies in research methods and education are part of the curricula of genetic counselling master programs. <sup>5, 14</sup> Research methods courses are mentioned in five the papers in this review and three of the programs include a research project or thesis, which is also mentioned in the European core competences.<sup>4, 6,15,28</sup>

Although many programs combined formal education and clinical training, the duration and components of clinical training are not clear in majority of the papers included in the review. Authors of seven papers described clinical practice or observation, but the format and duration of clinical practice differed between the programs. The proposed European curricula <sup>4,6,15,28</sup> states that Master programs for genetic counsellors should include at least 50 % of practical training and that 50 % of the training should be clinical practice in a genetic center. <sup>4</sup> The ACGC standards <sup>5</sup> indicate that the clinical cases must illustrate a diverse training to prepare the individual to provide effective genetic counselling within a variety of practice setting, so those programs that do not include substantial clinical training could be judged to be unfit for purpose. For this reason, more collaboration to produce agreed international standards is needed. The Transnational Alliance of Genetic Counsellors <sup>29</sup> was established in 2008 as an informal organization with an aim to foster communication and collaboration amongst providers of genetic counselling

programs, and members of this group would be important stakeholders in such initiatives. However, to ensure compliance, support by legal entities in each region or country would be desirable.

One of the key issues that arises from this review is the need for Master's level education to be available for the training of genetic counsellors. In Europe, there are approved courses in only five countries<sup>14</sup>, meaning that unless prospective counsellors are able to fund their studies outside their home country and are able to study in a second language, there is no opportunity for them to achieve the required standard of education. This obviously reflects upon the level of care they can offer. It is financially difficult for institutions to support such courses in countries with a low population, therefore individual courses in each country may not be feasible. However, it is important that students are trained in the context of their own culture. Solutions to this problem need to be urgently sought at European level, and one option would be to develop European courses for the theoretical components, with local opportunities for practical training, or to organise courses across several countries with a common language or similar cultural mores.

### **Strengths and limitations**

This was a comprehensive review of all published material on educational programs for genetic counsellors. The review of the papers identified in the search and the quality appraisal was conducted by two experienced researchers, enhancing the rigor of the work. The number and range of countries represented is also a strength, however, it should be noted that many of the papers were descriptive reports rather than research based papers.

## Conclusions

According to the results of this review, in general the theoretical components of genetic counsellor programs conform to the recommendations and requirements of professional bodies. However, it is concerning that the clinical preparation of genetic counsellors in real-life professional practice settings seems to be less well addressed. As genetic counsellors may go directly from their training program into practice, they may not have sufficient clinical experience to offer safe care for patients. It is important that genetic counsellor programs include not only academic courses but also practical preparation for professional work. Further work to introduce international standards of training will benefit the profession and ultimately, patients.

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## TABLES

**Table 1 Characteristics of included papers**

<i>Reference</i>	<i>Objective of the study</i>	<i>Study design /type of paper</i>	<i>Quality assessment % score based on assessment using tool by Kmet et al (2004)</i>
Bedard <i>et al</i> <sup>19</sup>	To explore genetic counselling students' interest and training in research.	A Two phase cross sectional (including directors and students).	85 %
Chien <i>et al</i> <sup>20</sup>	To report on the development of genetic counselling services in Taiwan	Descriptive report	93 % Few data on GC programme
Cordier <i>et al</i> <sup>21</sup>	To trace the development of the profession in France	Descriptive report	93 % Data sources not clear
Cruz <sup>22</sup>	To report an overview of the history and current status of genetic services in Cuba	Descriptive report	79 % Not all figures referenced
Kromberg and Krause <sup>10</sup>	To focus on the development of departmental activities at the department (Division) of Human genetics in Johannesburg.	Descriptive report	100 %
Laurino and Padilla <sup>23</sup>	To explain how the Philippines implemented the Master of Science program and how to overcome the challenges the program faced to help other to build similar programs in other low- and middle income countries	Descriptive report	93%

**Table 1 Characteristics of included papers (Continued)**

<i>Reference</i>	<i>Objective of the study</i>	<i>Study design /type of paper</i>	<i>Quality assessment % score based on assessment using tool by Kmet et al (2004)</i>
McEwen et al <sup>11</sup>	To provide a detailed description of genetic counsellor training and certification in Australia	Descriptive report	86 %
Qari et al <sup>24</sup>	To describe the development of a genetic counselling training program and the factors that lead to its establishment.	Descriptive report	86 % Few data on GC program
Sagi and Uhlmann <sup>25</sup>	To summarize the history and training of Master level genetic counsellors in Israel.	Descriptive report	86 % Sources of data unclear
Sahhar et al <sup>26</sup>	To explain the development of a 2-years master program evolving from a 1-year course and to discuss principal challenges of developing the Master program.	Descriptive report	93 % Sources of data unclear
Sahhar et al <sup>27</sup>	To document the training and certification system for genetic counsellor in Australia, to compare these to other international programs and to describe Australian experience of genetic counselling education and history of the profession.	Descriptive report	86 %

**Table 2 An overview of genetics education programs**

<i>Reference and country</i>	<i>Admission requirements</i>	<i>Basic information</i>	<i>Teaching methods</i>	<i>Expected Competencies from GC</i>
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Bedard <i>et al</i> <sup>19</sup> United States	Bachelor's degree	Accredited genetic counselling training programs.	Formal education Research activity	-
Chien <i>et al</i> <sup>20</sup> Taiwan	Various medical backgrounds; nurses, medical technicians, MDs, research assistants a high school teacher, a psychologist and a founder of a biogenetic company.	A master-level genetic counselling program. Started in 2003, since then 80 graduates.	Coursework and laboratory experience.	-
Cordier <i>et al</i> <sup>21</sup> France	Undergraduate or postgraduate science degree or already practicing health professionals (e.g PhD scientist, nurses, midwives, chemist).	Master's degree in genetic counselling and predictive medicine. 2-year program Available since 2004  -107 graduates since then.	Academic and clinical training. Laboratory practicum recommended for nurses and midwives.	Provides a high level of knowledge in both scientific and medical fields, dealing with psychological, social and ethical aspects of genetic counselling.

**Table 2 An overview of genetics education programs (Continued 1)**

<i>Reference and country</i>	<i>Admission requirements</i>	<i>Basic information</i>	<i>Teaching methods</i>	<i>Expected Competencies from GC</i>
Cruz <sup>22</sup> Cuba	Two different master level programs for university graduates. One for physicians with other specialties (e.g. in family medicine, pediatrics or obstetrics), Second program was for professionals such as psychologists, nurses or social workers.	Master in Genetic counselling. Available since 2000. 837 Graduates from 11 intakes. -18 months training.	Practical training in a primary health care and a research project.	-

Kromberg and Krause <sup>10</sup> South Africa	Master-level course in genetic counselling. Available since late 1980's. 2 years full time training In 2008 there were 15 registered GCs (There is also informal ad hoc genetics training for various health professionals, particularly nurses since the early 1980s)	-	-
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**Table 2 An overview of genetics education programs (Continued 2 )**

<i>Reference and country</i>	<i>Admission requirements</i>	<i>Basic information</i>	<i>Teaching methods</i>	<i>Expected Competencies from GC</i>
Laurino and Padilla <sup>23</sup> The Philippines	Completion of undergraduate degrees at least at a baccalaureate level in fields such as nursing, biology, chemistry, psychology, or related disciplines. Scholarship for full-time MSGC-students.	- Master of Science in Genetic Counselling Program. - Available since 2011. - Two student cohorts have been accepted to the program.	Didactic coursework, clinical rotations (at prenatal, cancer, general pediatric, metabolic, and in-patient clinics) and overseas exposure of genetic counselling program in US and Australia	MSGC students are expected to earn a "pass" grade on a written comprehensive examination, submit a log documenting at least 40 genetic counselling cases, and complete a research project
McEwen <i>et al</i> <sup>11</sup> Australia	Non medical health professionals including nurses.	Two different master program in genetic counselling as Associate Genetic Counselor (Part 1), and second for Certified Genetic Counselor (Parts 1-2). For a minimum of 2 years full time	Clinical, research and theoretical teaching, reflective practice, and attending both counselling supervision and genetic supervision.	There are established competencies: Communication Skills, Reflective Practice, Counselling Interview Skills and Case

equivalent.  
Available since 2008.

Management  
Skills

**Table 2 An overview of genetics education programs (Continued 3 )**

<i>Reference and country</i>	<i>Admission requirements</i>	<i>Basic information</i>	<i>Teaching methods</i>	<i>Expected Competencies from GC</i>
Qari <i>et al</i> <sup>24</sup> Saudi Arabia	1- To be a Saudi National or one of the Arab Gulf State Countries. 2- To have a bachelor degree in Applied Health Science (biology, chemistry, biochemistry) or nursing with a cumulative grade point average of at least 3.0. 3- To have an excellent knowledge of written and oral English. 4- To pass the pre-selection examination conducted by Training & Development.	A high diploma-level program in genetic counselling.  2 years training and a 6-month clinical internship at the end of the program. Available since 2005. Have graduated 5 GCs	- Didactic course work is delivered via lectures, group discussions, student led seminars, tutorials, and role-plays. - Extensive clinical rotations (a medical genetics clinical rotation, OB/GYN a clinical rotation, and a hemoglobinopathies ) - Laboratory practice (Biochemical Genetics, Cytogenetics and Molecular Genetics laboratory practicum.)	At the end of the internship period, the trainees are administered an oral and written comprehensive exam to assess their preparedness as a genetic counsellor.
Sagi and Uhlmann <sup>25</sup> Israel	- 2-years of army service - 3 years of university studies (a Bachelor of Science degree in Biology, Medical Sciences; or in Psychology) - having very high grades in undergraduate studies	Master's Degree genetic counselling training in two universities. 2-year program. Total 51 graduates as GCs (6 students at time) Available since 1997 and 2009.	Coursework, clinical work and thesis.	-

**Table 2 An overview of genetics education programs (Continued 4 )**

<i>Reference and country</i>	<i>Admission requirements</i>	<i>Basic information</i>	<i>Teaching methods</i>	<i>Expected Competencies from GC</i>
Sahhar <i>et al</i> <sup>26</sup>	Undergraduate studies in science or	Master of genetic counselling program	Self-directed learning approach:	-

Australia	the humanities.	2 years training. Available since 2008	Role plays and encouragement of self-reflection. Use of process records to document genetic counselling interviews, use of group process. Weekly tutorials. Journal club presentations, case presentations and facilitated discussions, videotaped simulated patient session. Undertaking a clinical placement overseas.
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**Table 2 An overview of genetics education programmes (Continued 5 )**

<i>Reference and country</i>	<i>Admission requirements</i>	<i>Basic information</i>	<i>Teaching methods</i>	<i>Expected Competencies from GC</i>
Sahhar <i>et al</i> <sup>27</sup> Australia	Completion of undergraduate studies in science or the humanities.	4 different programs ; - Graduate diploma in/of Genetic counselling (1 year full time or 2 years part time) - Master of Health science ( 1 year part time / full time or 2 years part time) - Master in/of genetic counselling (6 months full time, 1 year full time, or 2 years part time) - Master with honours in genetic counselling (research project 6	Problem based learning tutorials, clinic observations, lectures, seminars, coursework, laboratory practice, research, clinical training and distance education, depending on program	Proposed competencies Professional ethical practice Interpersonal counselling and interviewing Communication skills Critical thinking and analysis To be certified the GC must demonstrate adequate knowledge in genetics, counselling



	months full time or 1 year part time) Available since 1995.	theory and practical application of counselling s
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**Table 3 Content of genetic education programs**

<i>Reference</i>	<i>Content of the program</i>
Bedard <i>et al</i> <sup>19</sup>	A formal thesis requirement (62 %), Research design courses (58 %), Biostatistics courses (42 %) and independent study projects (35 %).
Chien <i>et al</i> <sup>20</sup>	Course work includes genetic counselling related courses medical genetics, and statistics
Cordier <i>et al</i> <sup>21</sup>	40 weeks of formal instruction and 28 weeks of clinical rotations. 11 compulsory and 5 elective courses and clinical rotations. - Methodological course work - Genetic counselling and pathology - Elective coursework
Cruz <sup>22</sup>	Four curricula areas. Practical training.
Kromberg and Krause <sup>10</sup>	2 years full time formal teaching and clinical training, research project and 2 year internship.
Laurino and Padilla <sup>23</sup>	Specific topics (e.g cancer genetics, neurogenetics) that are included in the established training program in developed countries included as modules in the Genetics course.
McEwen <i>et al</i> <sup>11</sup>	Part 1 involved completion of a checklist of core knowledge in aspects of genetics and counselling obtained by enrolling in existing university programs and/or through additional training such as professional development courses within the clinical genetics unit where the trainee genetic counsellor was employed. Part 2 involved completion of a prescribed number of written cases and annual education reports while working under supervision as a trainee genetic counsellor

**Table 3 Content of genetic education programs (Continued)**

<i>Reference</i>	<i>Content of the program</i>
Qari <i>et al</i> <sup>24</sup>	Introduction to Human Genetics, Human Population Genetics, The Genetic Basis of Inherited Disease, Clinical Genetics Review Course, Topics in Genetic Counselling I, Topics in Genetic Counselling II, Psychosocial Aspects of Genetic Counselling, Cancer Genetic Counselling, and Genetic Counselling and Islam.
Sagi and Uhlmann <sup>25</sup>	Year 1: Basic clinical genetics, molecular genetics, gene expression, molecular cytogenetic, metabolic diseases, genetic screening, seminar in medical genetics, genetic lab technologies Observational clinical training Year 2: Advanced clinical genetics, molecular genetics, embryology, fetal ultrasound, statistics for GCs, medical psychology, seminar in medical genetics, Decision making course, seminar on research in GC, workshop (role play) in GC, Ethics in modern genetics and clinical training. Note: graduates from in Psychology have to take a year of supplementary studies in Biology.
Sahhar <i>et al</i> <sup>26</sup>	1 <sup>st</sup> year: Three genetics subjects, one counselling skills and two health communication skills subjects, one research design and methodology subject + observation in genetics clinics and placement in community setting 2 <sup>nd</sup> year: Completion of minor thesis on a supervised topic, clinical placements and attending a weekly counselling practice tutorial.
Sahhar <i>et al</i> <sup>27</sup>	Genetics, legal, ethical and psychosocial issues that face families as more tests available.