Abstract: Belgium has been collaborating with the French-speaking University of Abomey-Calavi in Cotonou (Republic of Benin) for 15 years to train anesthesiologists for Sub-Saharan French-speaking African countries. At the end of the nineties, Sub-Saharan Africa was the only part of the world with a decreasing number of anesthesiologists. Thanks to various financial supports coming mainly from Belgian governmental cooperation funds, the program has been successful in reversing the demographic trend and even started a multiplying effect through the creation of schools for nurse-anesthetists, and through the creation of new training centers for physician anesthesiologists. Sixty-nine anesthesiologists from 13 countries graduated from Cotonou, 59 (85.5%) of whom actually choose to work in Africa. At least 40 of them teach anesthesia, playing a key role in the creation of new schools and training centers.

Key words: Developing countries; Africa; Anesthesia; workforce; Anesthesia; teaching.

INTRODUCTION

Since 1992, the World Federation of Societies of Anaesthesiologists (WFSA) has drawn attention to the demographics of our specialty in Sub-Saharan Africa, the sole region in the world with an absolute decreasing number of anesthesiologists, and the only one with a decreasing anesthesiologists-to-population ratio (1, 2). This only reflected the emerged part of the iceberg: in the same region of the world, anesthesia nurses or technicians (the primary anesthesia care providers) were also decreasing in numbers and were getting older. Continuous education was scarce or inexistent; many countries had no schools to train anesthesia nurses or technicians (the primary anesthesia care providers) were also decreasing in numbers and were getting older. Continuous education was scarce or inexistent; many countries had no schools to train nurses. Most of these countries had no or a few schools to train nurses. Most of them had no or a few schools to train nurses. The project was realized in 2004-5. The paper provides a return of information to the community of Belgian anesthesiologists. It

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will focus on the results reported to the CUD, but will not limit itself to that part of the project. Other partners and financial supports will be acknowledged in the following paragraphs.

**Material and Methods**

**Specific Objectives**

The PIC methodology is based on establishing measurable objectives from the outset and based on verifying their completion during the project and at its end. The pre-established objectives were:

- Support and reinforce the Benin academic program by ensuring at least 6 teaching modules a year for anesthesia residents (each module comprises one week of theoretical courses)
- Graduate and reintegrate in African practice at least 5 anesthesiologists per year, which would stop the negative demographic trend of our specialty in the whole region of Sub-Saharan Africa
- Improve the standards of local teaching, training and the documentation thereof
- Ensure the viability and continuity of the local academic program through the tutoring of a new generation of academic professors
- Foster a snowball effect by the integration of the greatest possible number of graduating anesthesiologists in teaching functions, especially in anesthesia nursing schools.

**Ways and Means**

**Sources of financial support**

Approximately one million euros were spent over fifteen years (see figure 1). The PIC project allocated 354,867 euros, which added to various CIUF (‘Coopération InterUniversitaire Franco- phone’) budgets that were totaling nearly 100,000 euros, and that were given over the previous four years. The APEFE (‘Association pour la Promotion de l’Éducation et de la Formation à l’Étranger’) gave a total of 50,000 to support the ‘Ecole Nationale de Formation des Infirmiers et Sages-femmes Spécialisés en Anesthésie et Réanimation’ (ENAF- ISAR). Belgian hospitals contributed nearly 400,000 euros by financing third year residents they welcomed and trained. The ‘Coopération Internationale Wallonie-Bruxelles’ financed short stays in Belgium for future professors. ‘Médecins Sans Frontières’ (MSF) Belgium helped launching the program by supporting the first candidate’s scholarship. The Belgian Technical Cooperation, other cooperation or private funds, hospitals, individual anesthesiologists, and the WFSA, also contributed on a punctual but helpful way. Pharmaceutical and medical material companies donated disposables, vaporizers, other anesthesia material and monitoring devices. The WFSA also gave pediatric anesthesia books to all students and graduates.

Not included in these calculations are African sources of income of candidates: most got paid for night duties in the emergency room, and a few got a fellowship from their government while in Benin. Gathered together, these sources of income barely allowed minimal needs to live in Cotonou. As a rule, the Belgian cooperation did not intervene at that level.

The money was spent in the following way:

- Scholarships for 3rd year candidates coming in Belgium. On top of the 15 paid by the PIC program and 3 paid by other Belgian cooperation organs, 19 have been paid by Belgian hospitals. Over time, the cost of a scholarship went from 16,000 euros to 25,000 euros.
- Scholarships, local financial support and tutoring publications for future academic professors for an amount of 35,000 euros.
- Local scholarships for anesthesia residents and nurse-anesthesia students.
- Financial support for residents sent for rotations far from the capital city.
- South-to-South teaching and jury missions allowing for professors from other African countries to come and participate in the Cotonou program. As a general rule, each jury featured at least one foreign African professor and one European professor.
- North-to-South teaching and jury missions by Belgian professors and anesthesia professionals.
- Books and didactic tools.
- Occasionally, medical material and disposables allowing for special training opportunities were either purchased, thanks to individual money gifts, or received from monitoring or pharmaceutical companies. Transport has never been paid, air transportation being organized by the Belgian Air Force and sea transport by the Swiss-based non-governmental organization ‘Terre des Hommes’. In both cases, empty container space, when available, was used.
- Support to the creation of the ENAFISAR.
- Improvement of the academic secretarial performance.
BELGO-BENINESE COOPERATION AND ANESTHESIOLOGY DEMOGRAPHICS IN AFRICA

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RESULTS

All specific objectives of the PIC have been largely exceeded.

– The Abomey-Calavi DES (former CES) for Anesthesia and Intensive Care has obtained full CAMES (‘Conseil Africain et Malgache pour l’Enseignement Supérieur’) credentials.

– Forty-five African anesthesiologists graduated from Cotonou over the PIC five years (instead of the planned 25), and 69 from the beginning of the program to present. Noteworthy, in a four-year specialization program, no graduation can be obtained during the first four calendar years of the program …

– Of the 69 graduates, 59 (85.5%) settled and worked Africa. More than 40 (66%) are already involved in teaching at various levels in Benin or other African countries. Teaching structures include academic establishments, hospitals providing postgraduate training in anesthesia, and anesthesia-nurses or anesthesia-technicians schools. Mean age of graduation was 37 years and four months. On average, candidates obtained their diploma after five years and three months of specialization. Out of the 59 graduates who stayed in Africa, two died and two can no longer practice anesthesia because of severe health problems. Altogether, graduates have practiced for 252 years in Africa. Hence, the loss of four individuals for health reasons leads to an average loss of 1.6 % per graduate-year. Only 12 graduates [15%] were women, and only 9 of the current 64 [14 %] in-training candidates are women.

– Sixty-four residents are still in training. Theoretically, there are 16 new students each academic year, but, in practice, there is only a mean effective number of 12 per year. Among the in training residents, four were rescued from the Abidjan and Tunis residency programs and included in the present one. This prevented them from losing one or more years because of war or political turmoil. Four candidates are also currently out of the system, and may or may not reintegrate the Cotonou program in the future.

– Since CES launching, candidates from 17 French-speaking African countries entered the Cotonou program. Those countries included Benin, Burkina-Faso, Cameroon, Central Africa, Chad, Congo Brazzaville, Democrat Republic of Congo, Djibouti, Comores, Gabon, Guinea Conakry, Ivory Coast, Malagasy, Mali, Morocco, Niger and Togo. At present, graduates originate from already 13 countries. Figure 2 details which countries sent the largest number of students and Table 1 details the impact of past and future graduates on individual countries. Bénin and Burkina Faso feature the largest number of graduates. Noteworthy, graduate ages of both countries are regularly spread, avoiding clusters of specialists with the same age.

– The three last columns of Table 1 also propose a rough estimate of the future impact of the Cotonou program over the next 5 years, based on

Fig. 1. — Money spent during the first 15 years of the project, including PIC
During the PIC, 20 South-to-South missions were performed, instead of the planned 12.

In 1996, only one hospital in Benin had certified anesthesiologists. By the end of 1999, three hospitals had at least one certified anesthesiologist and accepted candidates for clinical rotations. Today, the number of hospitals meeting the conditions to accept trainees on clinical rotations has increased to twelve: four academic hospitals (‘Centre National Hospitalier Universitaire de Cotonou’ (CNHU), ‘Cotonou HOMEL Hôpital Mère-Enfant Lagune’, ‘Centre Hospitalier Départemental de Porto-Novo’, and ‘Hôpital Universitaire de Parakou’), the Cotonou Military Hospital and seven District Hospitals (‘Hôpitaux de Zone’) (‘Ménontin’, ‘Cotonou Saint-Luc’, ‘Comè’, ‘Allada’, ‘Lokossa’, ‘Abomey-Calavi’, and the Italian Cooperation Hospital Tanguieta).

Seven hospitals already welcome trainees, on a more or less regular basis. A new program supported by the ‘Coopération Internationale Wallonie-Bruxelles’ finances the additional costs of delocalizing third-year residents.

Three new academic teachers (authors T.L. P.A. and E.Z.) achieved CAMES professorship in 2008, 2010 and 2012 respectively. This already ensures the objective of fully replacing the previous generation of teachers before their retirement.

A school for nurse-anesthetists (ENAFISAR) has been created in 2002 in Cotonou, which has already graduated 159 field practitioners.

During the PIC, 12 North-to-South missions have been fulfilled, as programmed.

An emergency rescue operation has been organized to take care of the 2008 catastrophe victims in the border-city of Porga, where a crashed tanker leaked and exploded in the middle of the population, killing 52 and leaving 83 with severe burns extending up to 80% of the body surface. All residents and many teachers rotated in Tanguiéta, the nearest hospital, during the following weeks. This delocalization has been paid for by reallocating part of the PIC budget. Twenty-five burned patients ultimately survived.

The number of candidates that are currently trained. It corrects for expected loss related to retirements, brain-drain to Europe and other continents, mortality and drop-outs. It does so by applying to each country the ratios of trainees in the program over the entire population, assuming all countries will behave in a similar fashion. It does not take account of other important variables such as a foreseeable increase in female enrollment, nor the age of graduates, as it assumes a complete career being of 35 years of length.

During the PIC, 50 teaching modules occurred, instead of the planned 30. In addition, 26 residents came to Belgium for their third year of training. Adding them to those who came before or after the PIC leads to a total of 38 residents and 3 PhDs that were at least partially trained in Belgium.

During the PIC, twelve North-to-South missions have been fulfilled, as programmed.

Fig. 2. — Countries of origin of the 137 physicians enrolled up to date in the Cotonou program. Nine countries account for 88% of students, and eight other countries for the remaining 12%.
**Table 1**  
Impact of the Cotonou program of Anesthesia and Intensive Care on the sub-Saharan anesthesiologists’ demography

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<td>17</td>
<td>22</td>
<td>11</td>
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<td>Brazzaville (Congo)</td>
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<td>4</td>
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<td>4</td>
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<td>3</td>
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<tr>
<td>Burkina Faso</td>
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<td>1</td>
<td>1</td>
<td>12</td>
<td>17</td>
<td>6</td>
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<td>377%</td>
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<td>Central Africa</td>
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<td>Chad</td>
<td>1</td>
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<td>2</td>
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<tr>
<td>Djibouti</td>
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<td>2</td>
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<td>Gabon</td>
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<td>Guinea Conakry</td>
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<td>3</td>
<td>0</td>
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<td>2</td>
<td>5</td>
<td>4</td>
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<tr>
<td>Mali</td>
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<td>3</td>
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<td>0</td>
<td>3</td>
<td>13</td>
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<tr>
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<td>6</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>10</td>
<td>4</td>
<td>11</td>
<td>273%</td>
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<tr>
<td>Togo</td>
<td>3</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>9</td>
<td>10</td>
<td>15</td>
<td>484%</td>
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<tr>
<td>Totals for 11 countries</td>
<td>42</td>
<td>67</td>
<td>4</td>
<td>8</td>
<td>56</td>
<td>96</td>
<td>53</td>
<td>115</td>
<td>275%</td>
</tr>
</tbody>
</table>

*Other countries with past or present students but no graduates: *Ivory Coast, Democratic Republic of Congo, Comoros, Malagasy, Morocco, Cameroon.

*Other countries with 1 graduate:*

£ Retired anaesthesiologists still counted in this column

$ Considering retirement after 35 year careers and taking into account the observed losses due to failures, drop-outs, mortality, and brain-drain to Europe.

V The last anaesthesiologist in Central Africa died in 2006, to be replaced in 2010 by a young Cotonou graduate who also died.
therefore unlikely to play a leading role in correcting the regional shortage in anesthesiologists. The recent civil war in the Ivory Coast further impacted Abidjan’s training capabilities. Actually, during the last fifteen years, Cotonou trained more than half of the anesthesiologists in the former French African territories south of the Sahara. Cotonou’s action alone did change the landscape of our profession in the whole region.

Even if the future still rests on an exceedingly small number of qualified individuals fighting against all odds, there are now clear signs for hope. First, anesthesiologists did create schools for nurse anesthetists. In the foreseeable future, there is no way anesthesia could be delivered only or even predominantly by anesthesiologists in any of the targeted countries. Nurse anesthetists will continue for a long time to deliver the bulk of anesthesia care. Therefore, anesthesiologists should teach, train and supervise nurse anesthetists, monitor the quality of their clinical results, and set up quality improvement schemes. Benin counts 104 operating rooms. When adding acute obstetrical points of care, the need for nurses or midwives specialized in anesthesia can be estimated to range between 200 and 300 professionals. With 159 professionals trained by a mere dozen anesthesiologists over ten years at the ENAFISAR, Cotonou gives an idea of the multiplication power such specialized nursing schools can have. This fact supports the idea that a rather small critical mass of determined anesthesiologists is enough for getting the teaching “snowball effect” ongoing (1, 4). Second, several countries have created or reopened, or are in the process of doing so, their own school for nurse-anesthetists, including, Togo, Congo Brazzaville, Burkina Faso, Niger, and Gabon. Third, Burkina Faso and Gabon opened their own academic school to specialize physicians in anesthesiology. Burkina Faso can be cited as an example of planning. Over the last 15 years, this country sent 17 candidates to Cotonou, and managed to attract 13 of its 14 graduates, patiently building its own “critical mass”. It then opened its own DES in 2010. Obviously, countries with a stable political system fare better than those suffering from internal feuds or open war. The profound disruption of the anesthesiology program in Abidjan is a sad example of such a situation. In that country, hospitals have been looted to such an extent during the events surrounding Ivory Coast President Gbagbo’s end of reign that clinical teaching could not resume after the events, and still have not at the time of writing this paper (December 2012). Even worse: some countries like Chad, Guinea Bissau and the Republic...
of Central Africa are still on the “descending path” of anesthesia skilled professionals’ demography.

**Source of knowledge to plan anesthesia future**

Besides reversing the demographic trends of our profession, the Cotonou program provided some useful data for planning the future of anesthesia in Africa. The number of trainees is large enough to attempt quantifying factors that affect training programs, and that should be taken into account when planning a country’s future needs for anesthesia workforce. Some factors were included in the calculations used for Table 1, in a one-suits-all fashion. Therefore, these extrapolations should not be taken at face value for each country. The main message from this preliminary exercise is that the number of anesthesiologists will not increase at the same rate as the recent one in the near future, mainly because retirements will start to influence our profession demographics. Our calculation did not take account of factors such as the real age at graduation, or a possible increase in feminine participation. Nevertheless, it is already plainly obvious that more physician training centers in anesthesiology are needed. Cotonou is not suited to accommodate more than 15 residents per study year, essentially because of limited access to patients during training. An interesting development might come from its recent capability to dispatch residents in provincial hospitals, where anesthesiologists who graduated over the last years can now act as tutors.

The following factors could be identified as influencing the efficiency of our program in terms of demography of the profession of anesthesiologists. For the sake of future use in prospective computations, we shall distinguish factors exerting their effects during specialization years from those acting after graduation, even though some share common causes.

- First, *during training*, the program lost 4.4% of its residents (6 over 137). The reasons for loss were equally distributed between health problems (one died and one resumed training only after 6 years of absence), drop-outs for other careers (two), and brain drain to France (two).
- Second, although the theoretical duration of specialization is 4 years, the average time taken by residents to complete their formation was 5.2 years. No major differences could be seen between students coming from different countries. A variety of reasons account for this delay, including variable lengths for academic terms, and strikes in public hospitals or even at the university. However, the major cause remains an unwritten rule that allows residents to “disappear” for months at a time when they find an opportunity to get a paid job in France, usually between their third and fourth year. Although they bring valuable clinical experience, such absences lasting from a few months to several years disturb health care organization in Benin. Indeed, these absences are not coordinated with the professor in charge of the training program in Cotonou. Sanctions would not be understood as all other specialties, and even university authorities, turn a blind eye on such behavior. Health problems did not measurably affect the duration of specialization. So far, few pregnancies occurred. This should be expected to change if the proportion of female candidates increases in the future.
- Up to date, two *graduates* died, a third one became hemiplegic and a fourth could never practice in Africa, due to major health problems. The combined health toll of 4 must be reported to an aggregate sum of 252 years of graduate activity, giving a loss of 1.6% per graduate-year. This is clearly a high ratio for such a short period (the first diploma was given in January 2000), particularly for such a highly educated, medically knowledgeable and rather young population. The unusually high graduation age (37 years old) does not explain it.
- People graduated at a relatively late age because many had one or more years of clinical experience in bush district hospitals before being selected for anesthesia by their authorities. Their medical knowledge clearly constitutes an advantage, both at the patient bedside, and when they take organizational responsibilities after returning to their countries as specialists. This peculiarity should be expected to disappear with time, as more candidates now enroll directly after medical school.
- The Cotonou program features a highly satisfactory reinsertion score of 85%, with the highest rates documented for Burkina Faso and Niger, i.e. very poor countries with a strong, directive and centralized administration of Public Health. At the other end of the spectrum, Benin and Cameroon feature the largest losses.
- However, the largest loss came from brain-drain, which funneled 9 young specialists (i.e. 13%) to France, usually just *after their graduation*, despite the absence of direct recognition of their diploma in that country, or any European country. This effect should be added to the brain-drain experienced during training (2 candidates), and
to the candidates retained for a second year or longer after their third-year rotation in Europe. Some never returned to Africa. Considering the major difficulties each African country experiences to assemble the critical mass needed to teach nurse anesthetists, every single specialist lost translates into delays to open schools, into diminished tutorship for trainees, and into lower quality of training (6-11). Considering the marginal benefit Europe takes from such transfers, and its unquestionable capability to train its own specialists, hiring African graduates in a European hospital, or retaining a candidate after his/her normal rotation, should raise serious ethical questions. It must also be said that not all African governments took good measure of this problem, and many failed to realize the importance of proposing them a paid job at the very moment they finish training. Other policy barriers have been described, preventing adequate anesthesia coverage for resource-poor countries (12). Many countries still consider that losing an anesthesiologist can be compared to losing any specialist. This is fundamentally untrue, because the presence of a sufficient number of anesthesiologists is the *conditio sine qua non* for teaching and maintaining the competence of nurse anesthetists, and because no hospital can function nowadays without adequate anesthesia services (quantitatively and qualitatively). Bluntly stated, without anesthesia, any hospital must quickly close its doors, a reality which does not apply to any other specialty. Most African countries still have a substantial number of district or zonal hospitals without full-time operative capability, essentially because of a lack of anesthesia personnel (2, 3, 5, 6, 13-16). For example, nearly half of district hospitals in Benin still are, at least part of the time, in such a situation. It has been demonstrated earlier that the introduction of anesthesiologists in countries, regions or institutions previously managed exclusively by anesthesia nurses or technicians rapidly results in improved outcomes, through a larger usage of loco-regional techniques and introduction of more sophisticated monitoring devices (2, 17). Therefore, losing even one anesthesiologist directly affects the entire curative health system in most Sub-Saharan African countries.

**Conclusions**

Fifteen years of cooperation between Benin and Belgium have succeeded in changing the landscape of our specialty in a majority of French-speaking sub-Saharan Africa countries. This goal could be achieved despite limited financial and human means. The keys to success were: concentrating trainees in one center and under a single authority, and leaving Africans themselves managing the project according to their capabilities, opportunities and knowledge of local politics.

Past and present demographics of our specialty let predict that clinical duties at the patient bedside will remain in the hands of specially trained anesthesia nurses, midwives or other technicians. In those countries, the role of anesthesiologists is essential in creating and maintaining the qualitative and quantitative teaching and training capabilities of nurse-anesthetists schools.

The second interest of this report is that it provides credible data on factors affecting the efficiency of anesthesiology training programs in Africa, such as graduate brain-drain to Europe, trainees’ morbidity and mortality, age of candidates at graduation, in-training drop-out ratios, and feminine enrollment rate. It clearly appears that brain-drain to Europe results in the largest losses.

In most African countries, the failure to retain even one anesthesiologist directly affects the entire health system.

**References**