# Analysing the costs of an innovative strategy to train and improve the healthcare workforce in rural KwaZulu-Natal, South Africa

**Dumsani Gumede** ( dumig@webmail.co.za )
University of KwaZulu-Natal School of Nursing and Public Health https://orcid.org/0000-0001-8739-6033

**Myra Taylor**
University of KwaZulu-Natal School of Nursing and Public Health

**Jane Kvalsvig**
University of KwaZulu-Natal School of Nursing and Public Health

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# Abstract

**Background**: To improve health in low- and middle- income countries in addition to improving the basic health infrastructure, requires addressing the shortage of skilled healthcare professionals (HCPs), particularly in rural areas. The Umthombo Youth Development Foundation (UYDF) is a non-profit organisation established in 1999 to assist in addressing the shortage of HCPs in rural areas. The aim of this study is to describe the role played by the UYDF in addressing HCP shortages in rural hospitals by calculating the cost-benefits and internal rate of return and reporting the progress of the UYDF bursary scheme in achieving this goal.

**Methods:** An economic analysis (cost-benefits and internal rate of return) was used to estimate and describe strategies used by the UYDF to improve shortages of HCPs in the health sector. This study presents a summary of the model and the UYDF achievements since 1999. The sources of data were the UYDF organisational records (finance, human resources and procurement), supplemented by the published and unpublished UYDF reports. The return on investment was estimated through the use of an Internal Rate of Return (IRR) calculation.

**Results**: The results indicate that the UYDF provided bursaries to rural youth to address the shortages of HCPs. The UYDF database showed that by 2017 a total of 337 HCPs had graduated and a further 254 were still studying. An average of ZAR 17 million (US$ 1.278 million) was spent every year on the students or ZAR 102 015 (US$ 7 219) per student per year. The IRR was encouraging being 63% higher than the interest rates on commercial loans. The UYDF graduates are expected to generate an estimated ZAR4 billion (US$ 62 479 million) in lifetime earnings at current prices.

**Conclusions**: The UYDF scheme demonstrates the potential to reduce the shortage of HCPs in rural hospitals, where the hospitals were able to retain the services of many now qualified locally sourced HCPs. The costs of implementing the bursary scheme were outweighed by the income generated from salaries, and their taxes contribute to the country's economy. This analysis has shown that the investment gives a multifactorial return and contributes to the socioeconomic development of the individuals, their community and the country.


# Background

Despite efforts since 1994 to reduce the burden of poverty and disease in South Africa, access to quality healthcare remains a problem and there is still an unequal distribution of healthcare professionals (HCPs) especially in rural areas [1, 2, 3]. The result is that the population often has poor access to comprehensive healthcare. The government and some non-profit organisations (NPOs) have invested in programmes to improve the healthcare system, but as in many countries the barriers that affect the quality of healthcare in rural communities, include poor infrastructure and chronic shortages of HCPs. This shortage of HCPs is a global problem, and the greatest burden is borne by low- and middle-income countries (LMICs), particularly in sub-Saharan Africa and parts of Asia [4, 5, 6]. It has prevented the

achievement of health-related sustainable development goals and impacted on the quality of health care in rural areas [5].

Globally and locally, government and non-profit organisations (NPOs) use a variety of strategies to mitigate this shortage of HCPs. For example, in Australia, the John Flynn Scholarship Scheme was established by the government as a long-term strategy to attract more doctors to practice in remote, and rural Australia in order to improve the quality of health care [7, 8, 9]. In South Africa these shortages are being addressed by non-profit organizations such as the Umthombo Youth Development Foundation (UYDF), the Cyril Ramaphosa Foundation, Wits Initiative for Rural Health Education (WIRHE), Ikusasa Student Financial Aid Programme (ISFAP), the Department of Health bursary scheme, the South African Medical Association (SAMA), the Zululand Air Mission Transport (ZUMAT) and the Michael and Susan Dell Foundation Dell Young Leaders [10, 11]. The UYDF in addition to the financial aid, provided for students, developed a support system to assist rural students to adapt and succeed in their studies.

# Study Objective

The aim of this paper is to describe the role played by the UYDF in addressing HCP shortages in rural hospitals by calculating the cost-benefits and internal rate of return to show how the UYDF bursary scheme is contributing to the goal of reducing the HCP shortages in rural hospitals.

# The Umthombo Youth Development Foundation (UYDF)

The Umthombo Youth Development Foundation (UYDF), originally called Friends of Mosvold Scholarship Scheme, provides funding to students from rural areas of KwaZulu-Natal Province in South Africa. The UYDF recruits and funds rural students to be trained in the health sciences and provides social and academic mentoring throughout their training. Upon completion of their degrees, they return to serve in hospitals near their rural homes [15,16]. The scholarship scheme started in January 1999 in Ingwavuma, an area with few clinics and schools and limited access to employment opportunities [17]. The UYDF addresses the shortage of qualified healthcare workers at these rural hospitals through the training and support of rural youth to qualify as HCPs. A selection panel consisting of community members and managers at local hospitals with a UYDF staff member playing an oversight role, choose suitable candidates in accordance with the skills required at the hospitals. The criteria for student selection are: they should i) come from the area; ii) have obtained a place at a university to study for a health science degree; iii) have undertaken at least one-week voluntary work at the hospital; iv) have financial need; and v) be willing to sign a work back contract to serve an equal number of years to their study years, in the hospitals that selected them. These students are given financial support and mentoring during their university training and are guaranteed employment on graduating. During their university studies a local mentor assists students to settle down in their new environment and to participate effectively in their academic programme and holds them accountable to the Foundation’s requirements [18]. Students are

required to meet monthly with their mentors and once per term with other UYDF beneficiaries so that they can assist one another academically. On graduation they are required to serve in local hospitals for a period of time equal to the time they were supported at university [16,17,18].

As part of the mentoring support, students are required to do at least four weeks' holiday work a year at their local hospital. This is an opportunity to build relationships between the hospital staff and the students. Another component of the mentoring support is the Student Life Skills' *Imbizo* (meeting to discuss crucial issues) which is held at the end of each year. The purpose of the *Imbizo* is to develop the character traits and interpersonal skills among the students and hence involves topics such as self-motivation; overcoming the pitfalls that youth face such as drugs, early pregnancy, peer pressure; and absorbing the good values and ethics of committed health care workers [16,18,19].

In 2008 the scheme expanded further to neighbouring districts in northern KwaZulu-Natal and part of the Eastern Cape Province and trained teachers in local schools to teach about careers in the health sciences. Interested learners were invited to attend the Hospital Open Days, and hospitals provided work experience to volunteers wishing to learn more about the specific health science disciplines. The aim of this study is to describe the role played by the UYDF in addressing HCP shortages in rural hospitals by calculating the cost-benefits and internal rate of return and reporting the progress of the UYDF bursary scheme in achieving this goal.

# Methods

A quantitative approach was adopted for this study in quantifying the contribution and evaluating the socio-economic impact of the UYDF. Data came from three main sources: the student database of the UYDF from 1999-2017; the UYDF records (finance, human resource and the procurement department of the UYDF; and secondary data from published and unpublished reports of the UYDF, supplemented by information from other organisations doing similar work, such as WIRHE, ISFAP, the Department of Health bursaries and the SAMA as discussed above. The study was conducted in the province of KwaZulu-Natal, South Africa from October 2017 to November 2019. A desktop analysis of the existing UYDF records as recorded in its accounting and administrative records (published and unpublished) was reviewed and these were supplemented with related literature from other organisations (as discussed above). The objective of this review was to estimate the total financial cost to UYDF and possible economic return on investment and to calculate the cost of training the supported HCPs. The future salary benefits and payable income tax were estimated. The UYDF gave full support to the majority of students receiving scholarships which included tuition fees, accommodation, meals, books, minor equipment, incidental expenses and mentoring support, but a small percentage of students were partially funded (meaning they were getting funds for certain things as needed).

The UYDF throughput rates were applied to the national student numbers and the impact of raising the throughput rates for the students in the UYDF program was estimated. We further analysed the potential costs (to government) and benefits (improved staffing of the health system) that the UYDF generates

from expenditure on each student at university until graduation, the potential benefits of the UYDF programme to the economy, and the feasibility of it being recognised as a sustainable program.

Bosri[12] suggested that when evaluating long-term plans, the following tools and techniques should be considered: the Payback Period; the Average Accounting Return; Discounted Payback; the Net Present Value; the Internal Rate of Return; and Net Terminal Value and the Profitability Index. For the purposes of this paper only the Net Present Value (NPV) and the Internal Rate of Return (IRR) will be discussed. The NPV is a straightforward method used to calculate the expected monetary gain or loss from a project, by discounting all expected future cash inflows and outflows back to the present time using the required appropriate rate of return [5]. The NPV is defined as the 'difference between the amount invested and the present value of future cash flows [13]. The IRR is a capital budgeting technique: the discount rate is the rate at which an investment's present value of expected cash inflows equals the present value of its expected cash outflows and this time value of money is expressed in percentage form [12]. The IRR represents the discount rate which leads to a net present value of zero where the present value of the cash inflows equals to the cash outflows [14]. Both NPV and IRR will be discussed in the paper.

# Ethical Considerations

Prior to data collection, permission to review the UYDF scholarship data was given by the UYDF leadership (i.e., the director and the trustees) and they also provided the gatekeeper's letter. The UYDF was assured that that their data will be solely used for the purposes mentioned ethical clearance. The study was given ethical clearance by the University of KwaZulu-Natal's Humanities and Social Science Ethics Committee.

# Analysis

The student and graduate data from UYDF were verified and merged in an Excel document. Descriptive analyses were conducted to identify the major cost centres, and the results were tabulated. A cost analysis was undertaken for the years 2009 to 2017 from a provider perspective to establish the actual cost of funding the education of the beneficiaries. This involved the identification of all costs related to the educational support of the potential health care professionals in the accounts and administrative records of UYDF. The costing was done across five major categories: recruitment, education support, mentorship, post graduate support and administration. *Recruitment* included the costs of school marketing, hospital open days and selection interviews, and salary costs for activities intended to recruit students. *Education support* included the costs of university fees, accommodation, books, meals, equipment, uniforms, professional registration fees and so forth. *Mentorship* included costs related to the provision of mentoring support to students, such as the salary, travel and accommodation costs for the UYDF's full-time mentor, stipends and associated costs for the network of local mentors at the different universities, and stipends paid to students on completion of their holiday work. *Postgraduate support*

included costs related to additional training and development of UYDF graduates and other hospital staff. Administration costs included: the salaries of three staff, bookkeeping and auditing costs, overheads, office rental, communication and travel.

The costing adopted an economic viewpoint, in that that the opportunity cost of the resource use was considered. Recurrent costs included items such as stationery, fuel, utilities and personnel time. Capital costs included items such as vehicles, computers and furniture, and other items whose useful life was more than a year and were annualised. The annual economic cost of capital items was calculated using a discount rate of 6% (the South African Reserve Bank's annualised rate) and this means that all costs were adjusted to 2015 prices using the consumer price index (CPI) [1], the productive lifespan for office equipment was ten years, and three years for both office and computers. The costs were aggregated into the total project cost and divided by the number of students in each year to obtain an annual average cost of supporting a student, using Excel 2010 for the costing and modelling. Average costs were also provided per study discipline.

Further analysis was done on the return on investment for the purposes of assessing whether the program was a worthwhile investment. The return-on-investment analysis was done in several stages. First, the cost of gaining an education was calculated. This included the cost of supporting a student through university (the cost of the bursary as described above) and the opportunity cost of education, which was considered to be the wages forgone in the period that a student stayed at the University. The annual salary of clerks and cashiers coming straight from school was used as the proxy for wages. Secondly, the annual wage streams for the various cadres of health personnel produced by UYDF were estimated. The wage streams were calculated over the expected working life of all graduates. An assumption was made that the average medical graduate (medical students are in the majority in the UYDF) will start work at 26 years of age, dental graduates at 24 years, and general health science graduates (4-year programmes) at 22 years (both internship and community services included where applicable) and retire at the age of 65. The salary data for public health workers in 2015, obtained from the Department of Public Service and Administration [1], were used to calculate wage streams, assuming an annual increase of 5%. The combined wage streams during this period were used as the proxy for the benefit to the economy and society at large, thus the annual wage streams were calculated for various cadres of health personnel produced by the UYDF to provide various health services while paying tax to the government. There were no modifications made on the normal employment erosion, promotion, or specialist training.

Using the costs and wage streams as calculated above, the IRR on the UYDF bursary and the NPV of the expected benefits were calculated. The IRR measures the efficiency of an investment and can be used to assess the profitability of an investment. The higher an investment's IRR, the more desirable it is to undertake the investment. The NPV allows for the expression of future costs and benefits in terms of the current prices. A discount rate of 6% was used for the NPV.

# Analyses of the potential costs and benefits of the UYDF approach

In order to examine the financial benefits that the UYDF generates from expenditure on each student at university to graduation, the potential benefits of the UYDF programme to the economy were examined in two scenarios. In the first instance the impact of raising the throughput rates for the students in the UYDF program was estimated, assuming that pass rates were comparable to the national average. In the second scenario, the UYDF throughput rates were applied to the national student numbers. Total costs, lifetime earnings and the net present value of investments were calculated in order to estimate the average benefit of a bursary provided by the UYDF.

## Results

# Demographic Characteristics of UYDF students and graduates 1999-2017

The results shows that UYDF has supported nearly 2000 students between year 1999 and 2017 (Figure 1). This section presents data on students supported by UYDF who were registered in full-time studies in universities, and the total number of HCP graduates from the start of the UYDF up to 2017. This second group includes those who had completed their year-by-year work back obligation periods and those who had not, those who had joined the private sector or specialized and started their own private practices as well as those who had died since graduation.

[Figure 1 about here]

Since 1999, a total of 335 health science students of rural origin have graduated while being supported by UYDF. Of this total, 113 are medical Doctors. The program expanded from one hospital in 1999 to 15 hospitals in KwaZulu-Natal province and two hospitals in the Eastern Cape Province by 2015. Student numbers of those supported annually increased from 4 in 1999 to 254 in 2017 [20]. Furthermore, 63% of the graduates who have completed their work back obligations, are still working in rural hospitals and a further 6% are working for rural non-profit organizations, indicating a high retention rate of HCPs in the area.

[Figure 2 about here]

Figure 2 shows the gradual increase in the number of graduates and a jump from four students in 1999 to nearly 350 graduates in 2019 (not shown in this Figure). Other locally based NPOs have also supported students and some HCPs are being trained abroad in Cuba, Indian, China, Europe and America [21], but the unique advantage of the UYDF model is that it provides a sustainable retention strategy for HCPs in rural areas.

# Average cost of the UYDF bursary

In the period 2009 to 2015, the UYDF provided approximately 166 bursaries a year. The estimated annual cost of these bursaries was ZAR17m (US$ 1.278m) (Table 1 and Figure 3). About 75% of the total cost was spent on education support, 15% on administration and 8% on mentorship.

**Table 1**

**Total and average annual costs of supporting students, ZAR (2015 prices)**

| Cost centre | Total cost, ZAR | Cost per student, ZAR | Total cost, % |
|---|---|---|---|
| Recruitment | 109,821 | 663 | 0.6% |
| Education support | 13,022,407 | 78,583 | 77.0% |
| Mentorship | 1,221,051 | 7,368 | 7.2% |
| Post graduate support | 101,842 | 615 | 0.6% |
| Administration and overheads | 2,273,861 | 13,722 | 13.5% |
| Capital costs | 176,301 | 1,064 | 1.0% |
| Estimated cost per year | 16,905,283 | 102,015 | 100.0% |

The UYDF supports students of medicine and allied health science disciplines. Money is spent annually on recruitment of new students, students' books, meals, administration fees, post-graduate support and on the mentorship of students at traditional academic universities and universities of technology in South Africa (see Figure 3).

[Figure 3 about here]

The cost of accommodation varied greatly for students, depending on where the university was situated and, in some cases, was equal to or more than the cost of university fees. The fee structure also differed across universities and disciplines.

# Return on investment

A total of 254 graduates had been supported by the UYDF scheme (2009 – 2015). The total cost of training these graduates was estimated to be ZAR186 million (Table 2). Table 2 below is calculated on the assumption that these personnel would remain in their respective professions for the remainder of their working lives, but not necessarily in the same rural area. Some of the graduates (doctors) would specialize and perhaps move to a tertiary hospital, where they would serve the broader community. Some might transfer to private practice and continue to serve in semi-rural and rural areas (considered as

success), but it is unlikely that any will leave the health system entirely, and some are likely to remain in their rural areas.

These graduates are expected to generate an estimated ZAR15 billion (US$ 190.351 million) in lifetime earnings, which would be equal to ZAR4 billion (US$ 62.479 million) at current prices (2019). A weakness of the calculations in Table 2 is that it is impossible to calculate what the graduates would have earned without their university qualification. The IRR is 63%, higher than the interest rates on commercial bank loans, showing that the UYDF is a highly efficient programme [15]. For example, the types of IRR's that would be considered satisfactory in commercial settings might be 10% for acquisition of a stabilized asset, 15% for acquisition and repositioning of an ailing asset, 20% for development in established areas and 35% for development in an outstanding unproven area.

**Table 2**

**Costs- benefits of UYDF graduates, ZAR (2015 prices)[1]**

| | Disciplines | Graduates, n | Total cost, ZAR | Lifetime earnings, ZAR | NPV | IRR, % |
|---|---|---|---|---|---|---|
| 1 | Occupational Therapy | 5 | 3,384,293 | 198,093,126 | 56,732,609 | 46% |
| 2 | Radiography | 20 | 13,537,171 | 798,263,387 | 228,617,547 | 46% |
| 3 | Pharmacy | 19 | 12,860,312 | 1,497,155,785 | 428,775,876 | 86% |
| 4 | Biomedical Technology | 14 | 8,047,815 | 542,987,675 | 155,508,210 | 52% |
| 5 | Nursing | 32 | 21,659,474 | 980,647,587 | 280,851,220 | 37% |
| 6 | Physiotherapy | 20 | 13,537,171 | 798,263,387 | 228,617,547 | 46% |
| 7 | Medicine | 79 | 69,590,138 | 7,539,302,053 | 2,159,208,063 | 81% |
| 8 | Dental Therapy | 9 | 5,173,595 | 329,530,887 | 94,375,546 | 50% |
| 9 | Dietetics | 8 | 5,414,868 | 320,499,764 | 91,789,090 | 46% |
| 10 | Optometry | 12 | 8,122,303 | 479,754,305 | 137,398,576 | 46% |
| 11 | Speech Therapy | 8 | 5,414,868 | 320,499,764 | 91,789,090 | 46% |
| 12 | Social Work | 14 | 9,476,020 | 431,033,007 | 123,445,106 | 37% |
| 13 | Psychology | 7 | 4,738,010 | 578,601,746 | 165,707,853 | 90% |
| 14 | Environmental Health | 1 | 676,859 | 39,980,080 | 11,450,040 | 46% |
| 15 | Nutrition | 1 | 676,859 | 41,804,317 | 11,972,490 | 48% |
| 16 | Clinical Associate | 1 | 574,844 | 37,667,577 | 10,787,754 | 51% |
| 17 | Dentistry | 4 | 3,115,493 | 380,556,795 | 108,989,041 | 90% |
| | Total | 254 | 186,000,091 | 15,314,641,244 | 4,387,131,017 | 63% |

*UYDF = Umthombo Youth Development Foundation; NPV = net current value; IRR = internal rate of return.*

The assumption was that students who received sponsorship and were supported during their university training by the UYDF, would then return to the rural areas and while providing an improved health service, would through normal taxation mechanisms repay the outlay. To calculate the present value of the future income, the research team assumed that 20-30% of this will be paid in tax, then the present value of future tax is ZAR 4 billion, and this would more than pay for the programme. Had beneficiaries not been involved in the programme they would have nonetheless gone on to work and pay taxes. It is unlikely, however, that if we were able to consider their earnings, without these qualifications, that they would be sufficiently high to change the conclusion that this programme will pay for itself.

Given that once the graduates are working as qualified professionals, they will pay a significant amount of tax over their lifetimes (20–30%, estimated here as ZAR 4 billion (US$ 62.479 million), the costs of the UYDF investment will be paid for several times over as shown in Figure 4. Thus, the money spent on a student can be viewed as an investment and not an expense. The returns from each individual graduate including their taxes and the private practices of those who specialise and open their own surgeries and other things are the good returns on investment. However, the money spent on students who fail or those who died has not been factored into this calculation.

[Figure 4 about here]

The return on investment for UYDF graduates is presented in the following sections based on the calculations made for each of the cases. First the costs and benefits of the mentoring programme and secondly the UYDF model is extrapolated to the national scale.

# Costs and benefits of the mentoring program

The UYDF has been successful in assisting many underprivileged youths to graduate from university, achieving a pass rate of 93% in the last four years. In comparison, the throughput rates for undergraduate students mostly undertaking a three-year degree in various subjects in South African universities are quite low. A Department of Higher Education and Training (DHET) report [22], which followed cohorts of first-time undergraduate entrants undertaking a three-year degree between 2000 and 2008 showed that in the 2008 cohort, the throughput rates were 42% after four years and 61% after 6 years. This reflects poorly on the South African primary and high school system and shows that the low throughput rate in the system could be quite costly. The UYDF model provides an example of how these losses can be minimised. The pass rate achieved by UYDF-supported students has been mainly attributed to the UYDF mentorship programme, which provides students with sufficient support to enable them to cope with both the academic and social pressure. The potential loss associated with non-graduating and failing students was estimated by applying the throughput rates provided in the DHET report to the UYDF cohort of 254 graduates: assuming pass rates of 19% after three years, 42% after four years and 61% in year six.

In the analysis provided in Table 3, if the pass rates are adjusted according to the DHET throughput rates, this would imply that only 114 students would have graduated (about 45% of the 254 cohort). Thus, instead of the potential lifetime earnings of ZAR15 billion (US$ 190 million) estimated in Table 2, society would only realise ZAR7.7 billion (US$ 98 million).

**Table 3**

**Analysis applying DHET pass rates to UYDF graduates**

| Disciplines | Graduates, n | Total cost, ZAR | Lifetime earnings, ZAR | NPV |
|---|---|---|---|---|
| Occupational Therapy | 2 | 1,184,502 | 70,607,451 | 20,221,524 |
| Radiography | 7 | 4,738,010 | 280,686,129 | 80,386,719 |
| Pharmacy | 7 | 4,501,109 | 526,558,727 | 150,803,064 |
| Biomedical Technology | 5 | 2,816,735 | 191,301,708 | 54,787,590 |
| Nursing | 11 | 7,580,816 | 344,221,072 | 98,582,721 |
| Physiotherapy | 7 | 4,738,010 | 280,686,129 | 80,386,719 |
| Medicine | 51 | 45,233,590 | 4,902,215,377 | 1,403,963,244 |
| Dental Therapy | 3 | 1,810,758 | 116,519,209 | 33,370,359 |
| Dietetics | 3 | 1,895,204 | 113,468,861 | 32,496,759 |
| Optometry | 4 | 2,842,806 | 169,207,950 | 48,460,079 |
| Speech Therapy | 3 | 1,895,204 | 113,468,861 | 32,496,759 |
| Social Work | 5 | 3,316,607 | 151,858,604 | 43,491,336 |
| Psychology | 2 | 1,658,303 | 205,177,924 | 58,761,650 |
| Environmental Health | 0 | - | - | - |
| Nutrition | 0 | - | - | - |
| Clinical Associate | 0 | - | - | - |
| Dentistry | 3 | 1,947,183 | 239,609,834 | 68,622,729 |
| Total | 114 | 86,158,838 | 7,705,587,834 | 2,206,831,251 |

*The costs were estimated in Rands [ZAR] (31 October 2019) and the exchange rate used is ZAR= US $ (ZAR15.105 = 1 US $)*; *DHET: Department of Higher Education and Training*

The potential losses are not only in terms of the lifetime earnings (benefits), but also 'wastage' of resources that could be spent on supporting students who succeed at university and graduate. In Table 3, a total of 140 students do not graduate. This translates into approximately ZAR100 million that would have been spent supporting students who do not eventually get their qualifications. This ZAR100 million (approx. US$ 13 million) is the opportunity cost to society, as these resources would have been invested in alternative ventures that could yield some future benefits.

Figure 5 illustrates the potential losses associated with non-graduating students. The net present value is halved to about ZAR 2 million (US$ 260 000), and society loses about ZAR7 billion (US$ 97715 million) in lifetime earnings at lower student pass and throughput rates. Thus, with an investment of approximately ZAR 7400 in mentorship per annum (about 10% of total education support), the UYDF model can result in

substantial saving and ensure a higher future earnings potential. These analyses are based on the available statistics, but it could be argued that the comparison should be with other health professional students, engaged in studying similar subjects.

[Figure 5 about here]

# Discussion

Throughout the developing world the provision of health services is often inadequate, and the lack of qualified health care personnel is a major constraint [23]. Training local people to provide services is an innovative e approach that the UYDF has shown to be feasible. The UYDF policy of providing students from rural areas not only with financial support but also with social and academic mentoring, and guaranteed employment when qualified in health facilities close to their rural homes has been examined in these cost-benefit analyses. Regardless of the financial loss due to a student's slow progress in a university course or for those who do not complete the course, the results of the cost-benefit analysis show that those who graduate and return to work in their rural communities benefit the health services. The majority of graduates stay longer in the rural areas than the years for which they were funded and provide continuity to the health services and the personnel. Their average annual university pass rate over the past five years has been 92% even though the schools in rural areas are generally under-resourced, and this success is probably a result of the mentoring program [1,18]. With such a high percentage of students graduating and most returning to work in the rural areas, this demonstrates that the UYDF is positively contributing to addressing the HCPs' shortages at rural hospitals within the sub-districts where the UYDF is active. This suggests that if the funding had increased tenfold, this could possibly have produced 3500 graduates to date, a number which would contribute to easing the shortage of HCPs particularly in rural areas in the country. The analysis shows that it is also of benefit to the country's economy, in that as taxpayers their lifetime earnings contribute to the economic development of South Africa, as these graduates continue to support their families in the rural areas and to pay tax to the state.

In the current analysis only 5.7% of graduates either bought themselves out or defaulted, which is, in contrast with an international finding described below. A review of the Queensland Health Rural Scholarship Scheme, which focused on allied HCPs, reported that 13.7% of the participants had broken their service bonds either before graduation or before completion of their service period, but this is only one such international example [24]. With the UYDF, the majority of those who defaulted or bought themselves out had at least served between one to two years in a hospital before moving on.

Besides the shortfalls documented above (where graduates default or buy themselves out), the findings in this paper demonstrate that most rural students from schools serving very poor and disadvantaged communities (categorized by the Department of Education as non-fee-paying schools), can succeed at university if provided with the necessary financial, academic, and social mentoring support. The mentoring program bridged the gap of poor schooling and avoid the probability of failing by building resilience and boost their self-confidence, develop their study skills, and prevent unnecessary dropout

from university [18], and the graduates will return to work in their local hospitals if it is a condition of that support [24]. Furthermore, many students of rural origin who graduate remain at work in rural areas after completing their work back obligations. This confirms that investing in rural youth to address rural hospital staff shortages is indeed a cost-effective strategy [26,27], because the majority of these graduates remained in a rural setting and continued to provide services to underprivileged communities who do not have too many choices of health care providers and they dependent on the State [10,15,16,18,20]. Their contribution has not been limited to healthcare facilities but benefits development in rural communities in general as models of success and the families of the graduates in particular, by encouraging the HCPs to remain in their jobs, thus providing regular health services. Thus as described in the paper the cost-benefits are received by the sponsored students, their family, the community and the health system. Although there are substantial costs, it is an important programme because the health system benefits from the professional, skilled staff, the community benefits from improved health services which reduces morbidity and mortality, and having skilled people from the area who have studied and returned to the area contributes to the increased educational level in the community. The personnel live locally and contribute to the local economy, and pay taxes thus contributing to the economy of the country. This is in addition to the now qualified former students' personal and family benefits resulting from the program.

# Policy implications

Policies formulated and implemented to retain HCPs in rural public health facilities, should consider the role played by organizations like the UYDF to assist governments with sustainable HCPs' retention strategies in rural areas. To improve health services in developing countries requires strategies that take account of improving the health facilities, improving the supply of equipment and medication, and improving access to the facilities for communities in rural areas, but a key requirement is the adequate number of skilled health care professionals able to attend to the patients' needs [28,29]. Funding is required to sustain such a program and the Departments of Health and Education should be encouraged to contribute. A recommendation could be that public health facilities should consider using a portion of their budget allocation to support organizations that train HCPs from rural areas to serve their communities, so that after completion of their studies these students return to work in these rural facilities. This will increase the number of HCPs working in the rural settings.

The UYDF data has shown that training the HCPs is an economic investment and not merely an expense but requires both political and financial commitment from the State as it renders a multifunctional return and has the potential to contribute to the socioeconomic development of individuals, their communities, and the country. Based on the success of the UYDF model, other low-and middle-income countries could benefit from such approach if it could be emulated and replicated. The critical factor is the attention to detail, as acknowledged and implemented by the UYDF. The organization has recognized the potential of the country's youth and the capability of this cohort of young people to contribute to the country's health services but has also identified the support that is required for such students to succeed. The UYDF

mentorship program therefore is an important contribution that should be considered towards reducing the lack of HCPs in rural areas in developing countries. South Africa is in the process of implementing a National Health Insurance (NHI) policy, which will require a sustainable supply of competent and committed HCPs willing to live and work in underserved areas. The UYDF model has shown itself to be effective for this purpose.

In this paper we have reported on a South African initiative that has proved successful in training HCPs who return to work in rural areas. The international ramifications of the COVID-19 epidemic highlight the importance of improving the healthcare workforce throughout the developing world. It has been shown all too clearly that no country is an island and that infections rapidly spread. The UYDF initiative indicates the possibilities for collaborative ventures to increase the number of HCPs in LMICs.

# Limitations

There was potential author bias due to the first author's previous affiliation with the UYDF, but this was mitigated by the other authors who were independent with no previous affiliation to the UYDF. Data collected at the initial phases of the UYDF (1999 to 2008) had shortcomings, so the authors confined the sections of analysis only to the years for which sufficient data were available (2009-2015). This means we only measured the benefits based on the available data for 254 students for these years. The recorded data did not include details of the students that did not complete their studies and did not indicate how long each student took to complete his or her training and this was not included in the review. The costs to the UYDF were based on data that were regularly audited and the analysis was based on these reliable figures. The important benefit from the UYDF initiative was the improvement of health outcomes in the rural areas where the graduates work, but this is difficult to quantify and assign a monetary value. For this reason, the researchers used the proxy of HCP placement in a rural hospital as a proxy of the social value. Of interest however is the contribution of the HCPs, who were graduates of the programme and are now working to improve health in their communities which has also been documented [30]. Looking at the UYDF from a wider perspective, the UYDF model unfortunately caters only for a minority of the universities' student body and is not integrated into the universities' curriculum. Further, the mentoring program worked from a deficiency model, responding when problems were identified, but over the years the program has developed successfully as shown by its achievements, and is very replicable.

## Conclusions

The UYDF data that has been reviewed shows that the UYDF has made a notable contribution to the reduction in the shortage of HCPs in rural areas in northern KwaZulu-Natal, South Africa. The cost-benefit analysis has shown that the investment providing rural youth with opportunities to study for health science degrees renders a multifactorial return. Thus, the income received, and taxes paid by the HCPs contribute to the socioeconomic development of the individual, their community and the country. We believe that the UYDF has also indirectly contributed to the economy of South Africa as the majority of

graduates now work in public health facilities and thus are active tax contributors. Although this paper focuses only on the UYDF model and its contributions, it offers a vision that can be emulated as the results can feasibly be replicated in other settings to achieve similar results.

## Abbreviations

DHET – Department of Higher Education and Training

HCP – Healthcare Professionals

IRR – Internal Rate of Return

NHI – National Health Insurance

NPO – Non-profit organisation

NPV – Net Present Value

UYDF – Umthombo Youth Development Foundation

## Declarations

- ## Ethics approval and consent to participate –

Ethical clearance was given by the University of KwaZulu-Natal's Humanities and Social Science Ethics Committee (ethical clearance reference number: HSS/0857/017D). The gatekeeper's letter, given by the Umthombo Youth Development Foundation (UYDF) director, gave permission to use the records of the UYDF for publication as part of the first author's Doctoral studies (Gatekeepers letter included).

- ## Consent for publication –

All authors read the final version of this manuscript and approved it for publication. The authors were also given the permission to disseminate the findings to any journal of their choice or that will be approved by the university as the first author's is a Doctoral candidate as per the permission letters dated 28 April 2017 and 02 October 2017.

- ## Availability data and materials –

Data supporting the results are available at the Umthombo Youth Development Foundation (UYDF) and accessible upon request.

- ## Competing interests –

The authors declare that there are no competing interests and the views expressed in this paper are not necessarily the views of the UYDF but of the authors.


- ## Funding –

All the authors declare that no external funding received for this study. This paper forms part of the Doctoral thesis as the first author is a Doctoral candidate at the University of KwaZulu-Natal, School of Nursing and Public Health within the College of Health Sciences. The first author is self-funded for the work towards the Doctoral degree.


- ## Authors Contributions –

The first author (DG) designed the outline of the manuscript, collected, analyzed, and compiled the first draft. The second author (MT) and third author (JK) did the editing of, proofreading of and formatting of the figures and edited several sections of the manuscript. All authors have read and approved the final manuscript.


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# Figures

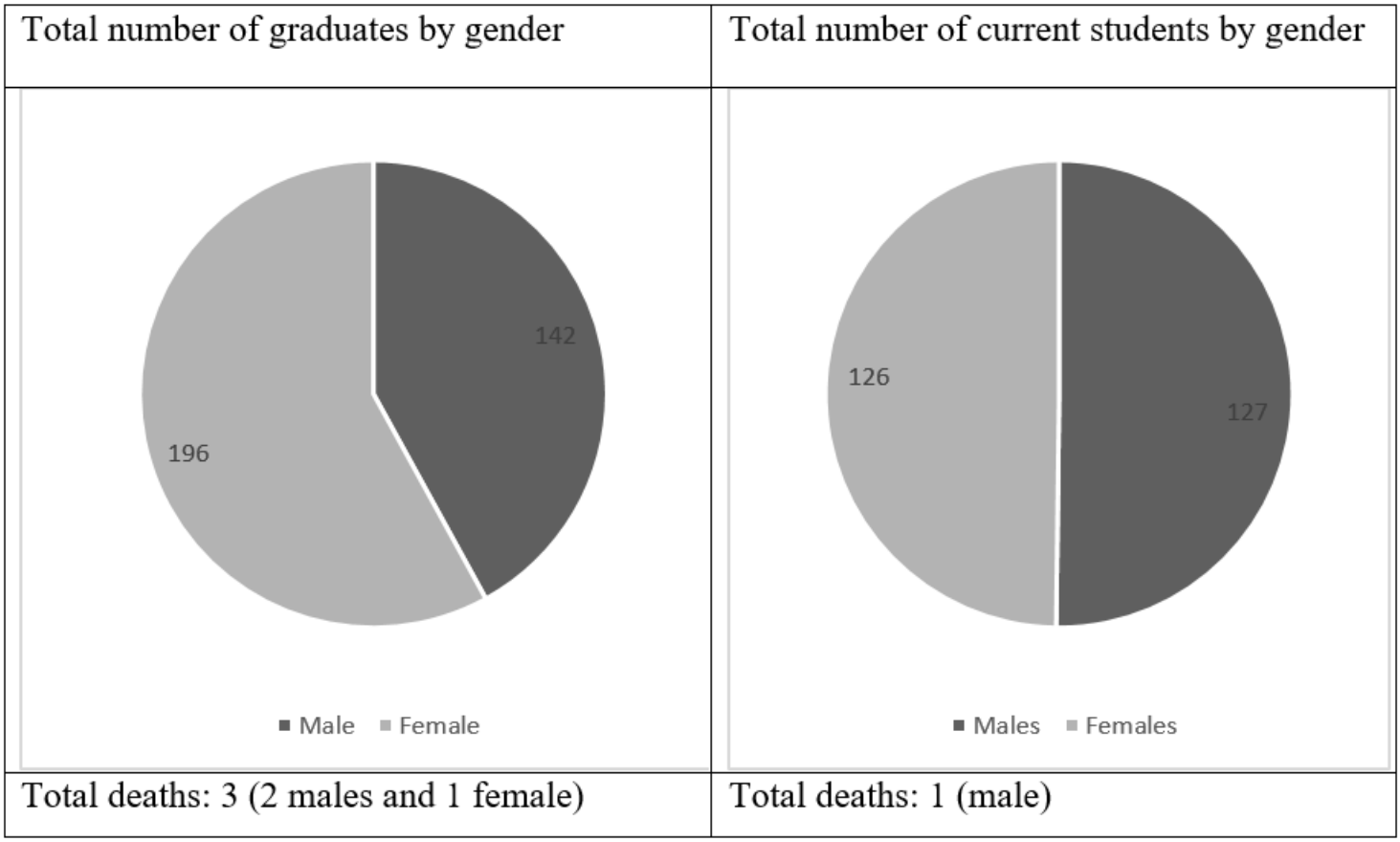



**Figure 1**

**Total number of graduates and total number of students by gender (1999 – 2017)**

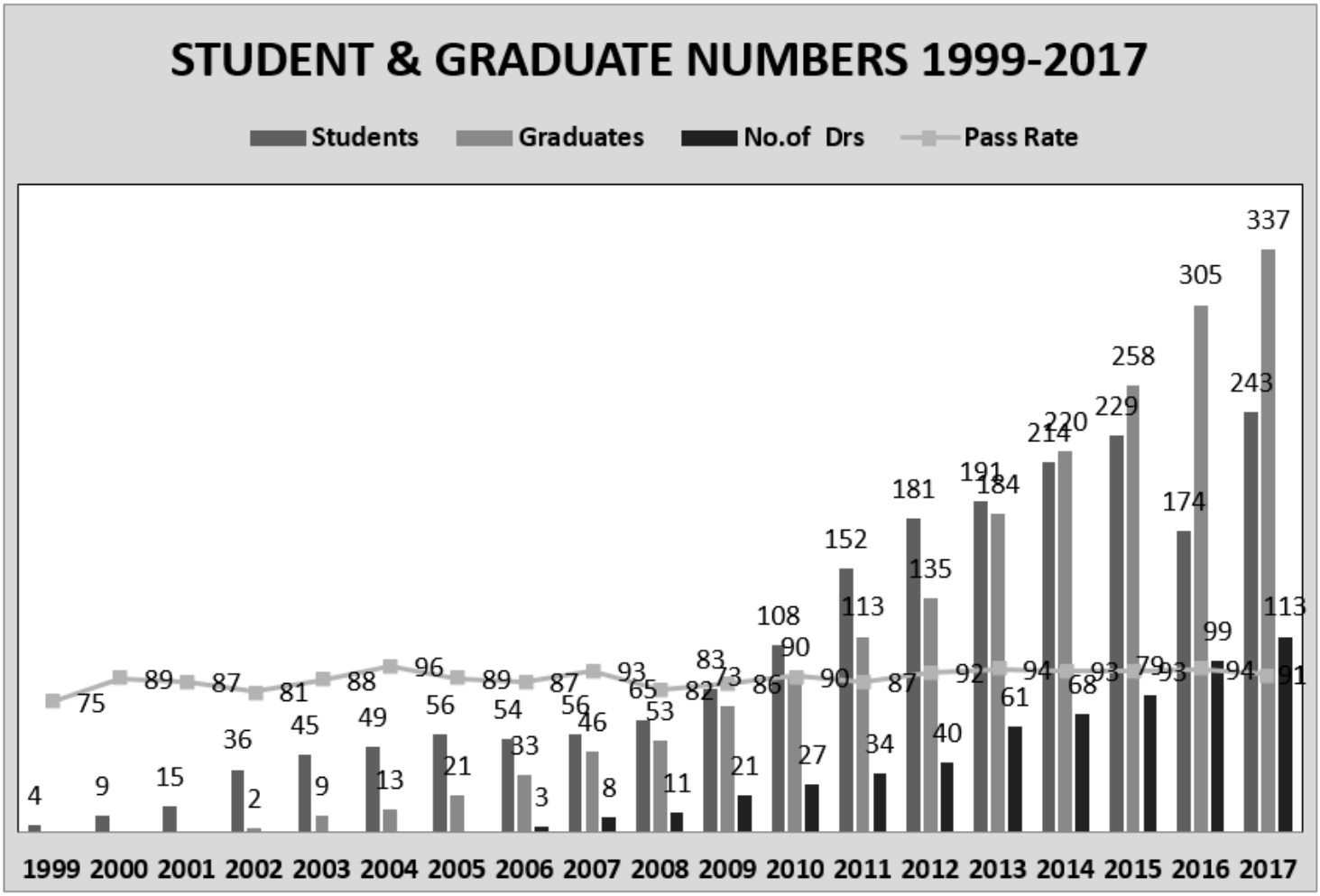
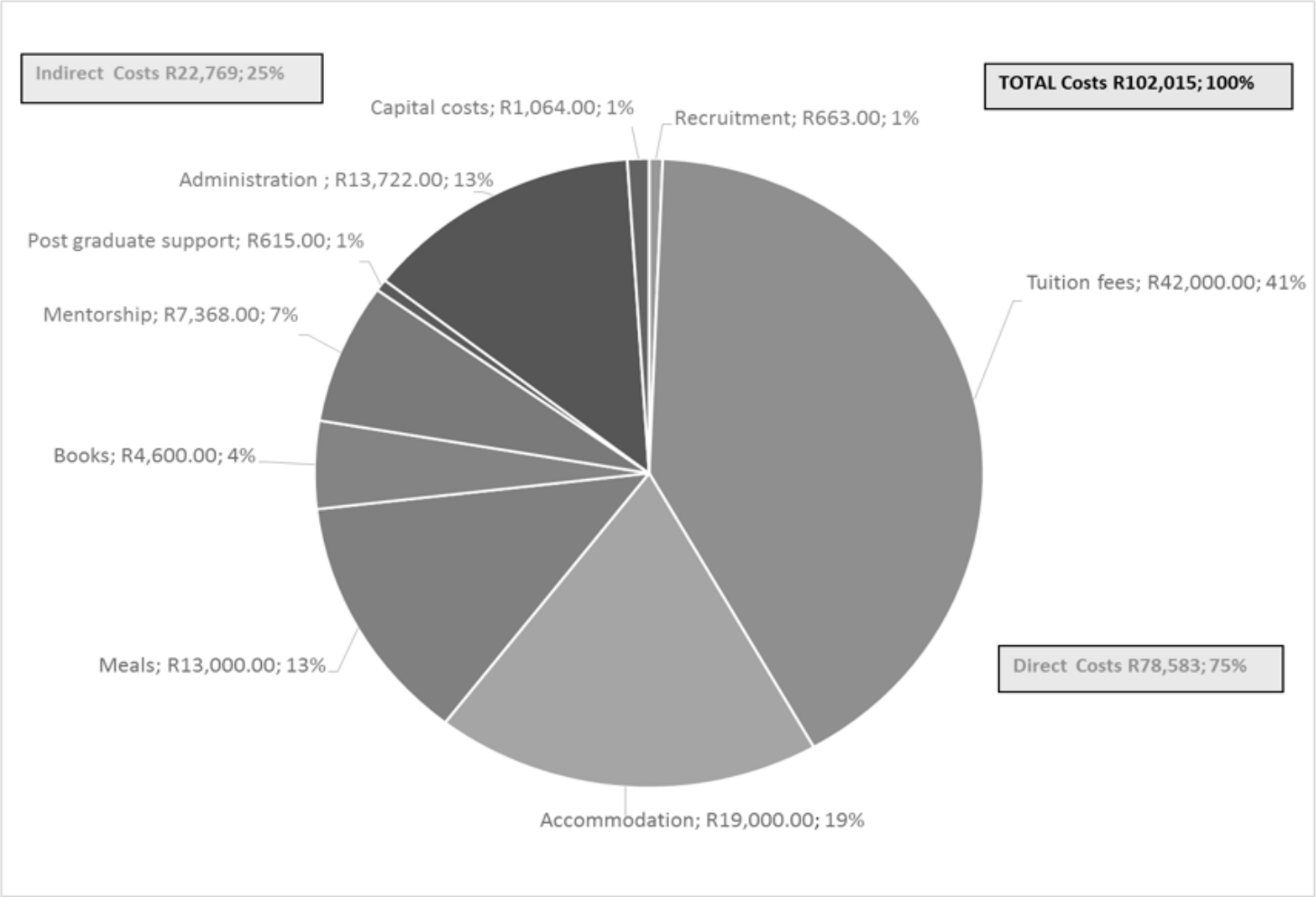



Figure 2

Student and graduates' numbers plus annual pass rate (1999-2017)




## Figure 3

## Analysis of the average annual cost structure (ZAR) for a health science student – 2015

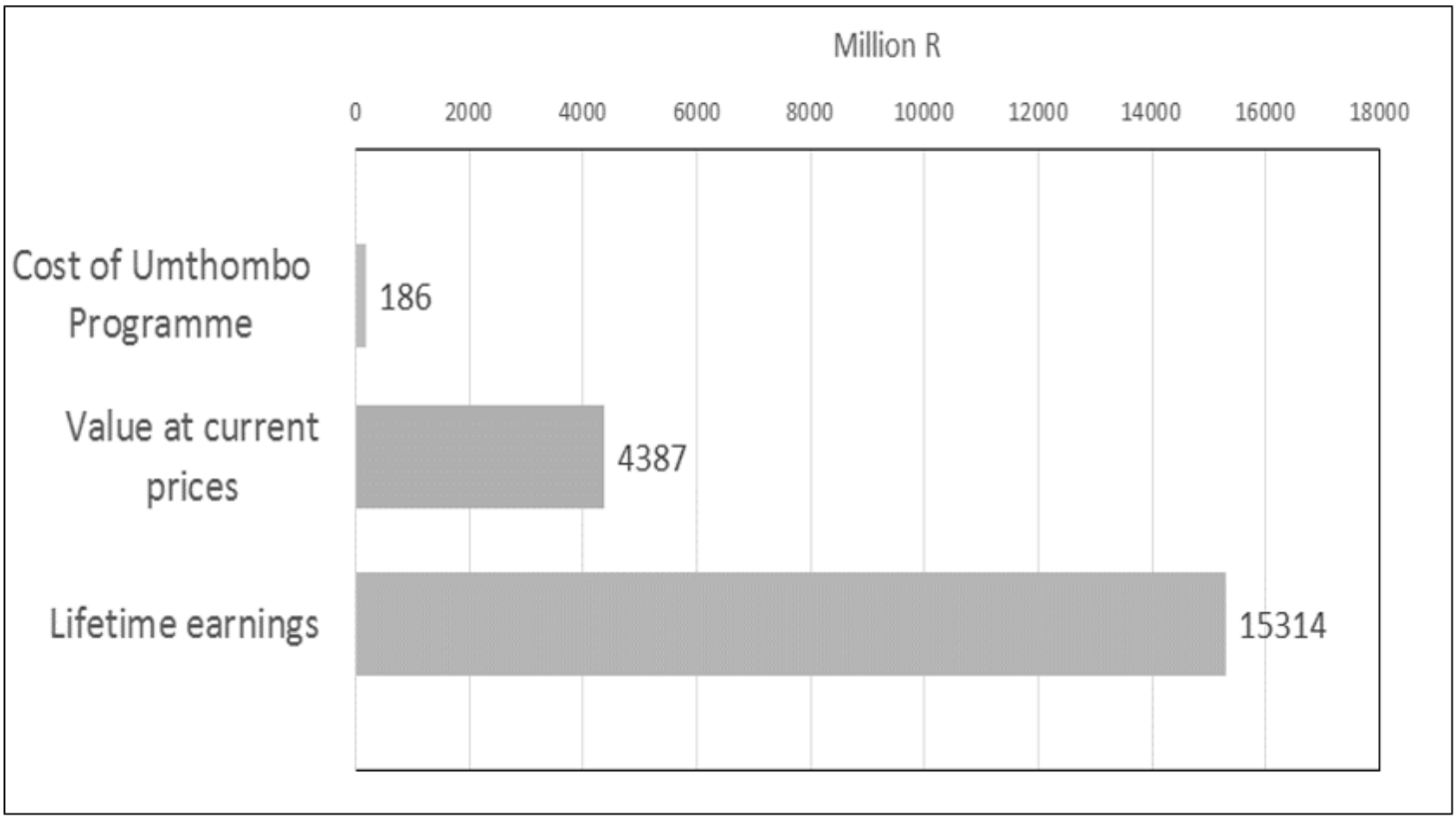
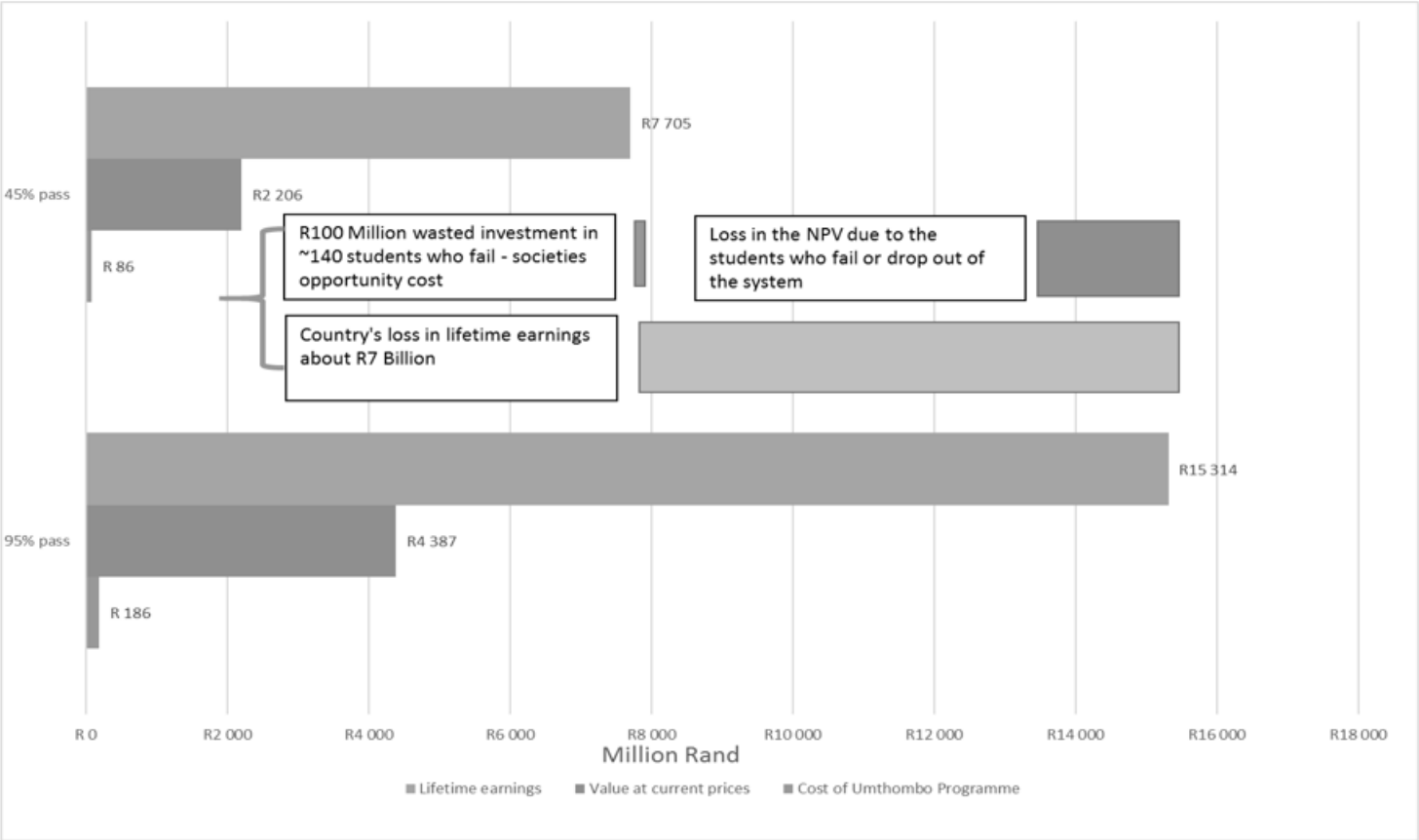



**Figure 4**

**Return on investment for UYDF graduates**




## Figure 5

## Potential losses associated with non-graduating students