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University of Kentucky

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**Evaluation of a Palliative Care Initiative on the African Continent:
Responsibly Improving Access to Pain Treatment**

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Spring 2019

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Executive Summary

The African continent today faces a crisis of inadequate palliative care, in spite of the growing level of suffering of its citizens who are faced with debilitating diseases and injuries. Much of this problem stems from deeply ingrained attitudes towards opioids: while the American continent grapples with the effects of opioid overprescribing, physicians trained in Africa are taught that opioids are inappropriate for virtually all scenarios, and therefore they come to fear and avoid their use or simply remain untrained on them altogether. Patients fail to advocate for themselves out of submission to the doctor's authority, governments remain apathetic to the situation, and as a result thousands of Africans die every year in agonizing and completely preventable pain.

Recognizing this growing problem, American Cancer Society (ACS) has partnered with African governments and hospice organizations to create an initiative known as "Treat the Pain." The main focus of the program is on in-house production of an oral morphine solution that is cheap to make, simple to administer, and highly effective at treating pain. The program has been implemented in 5 different African countries (Uganda, Kenya, Rwanda, Nigeria, and Swaziland), and several other countries have expressed interest and are currently receiving "technical support" from ACS. Due to a scarcity of high-quality data, attempts at program evaluation have been limited and it is not known whether the initiative is having its intended effect.

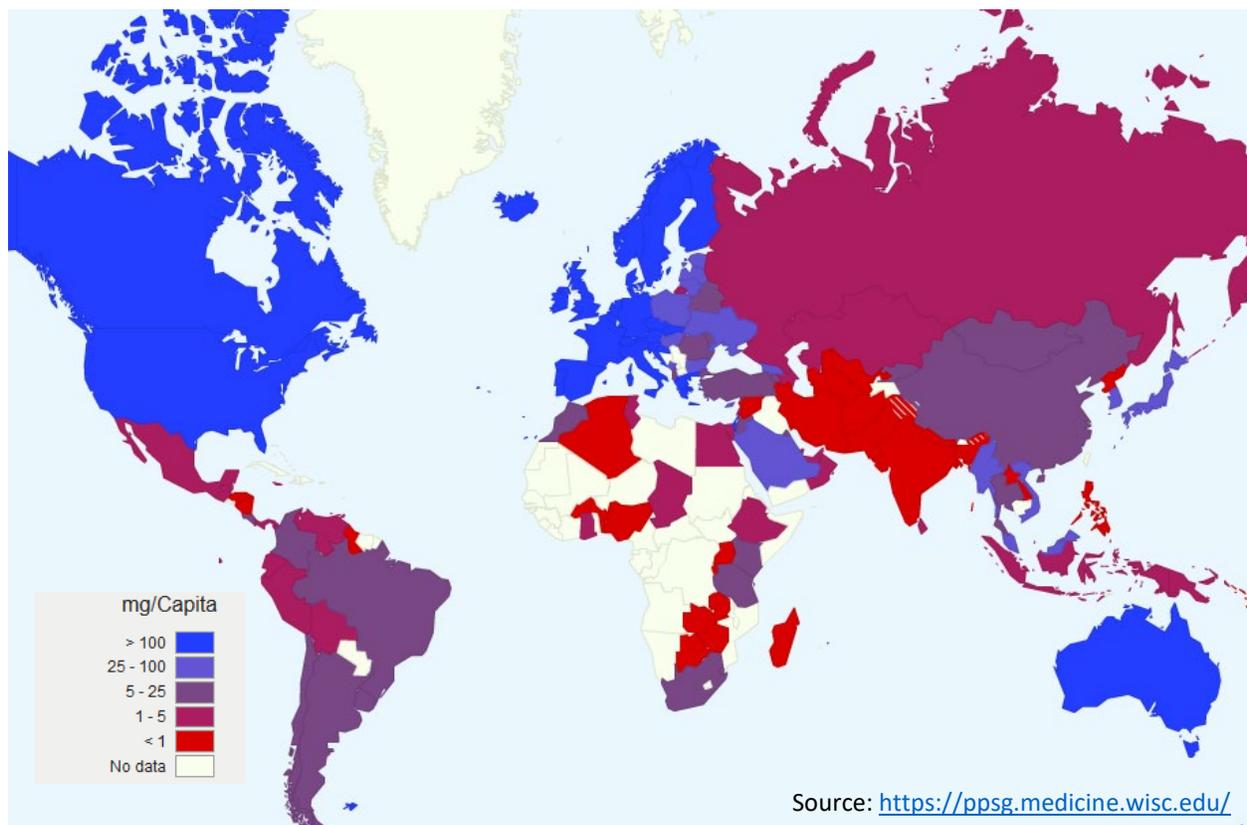
This capstone represents a first attempt at utilizing the available information to determine whether countries implementing "Treat the Pain" have indeed increased their consumption of opioids, specifically morphine. Utilizing a United Nations report on opioid consumption, I have attempted to determine whether there is a difference in reported morphine consumption after the date of program implementation when compared to the years before, and also in comparison to countries not participating in the initiative. Using a time series regression and difference-in-differences analysis, I found no statistically significant impact on morphine consumption due to

program implementation. Given that there are few instances of the program and that the morphine consumption data is deeply flawed, I recommend continued controlled implementation of the program, and emphasize improved data collection going forward.

Introduction

It is difficult for those living in the developed world to imagine a scenario where a loved one suffering with a debilitating and painful disease (such as cancer) would receive only acetaminophen or ibuprofen as a treatment for their pain. Yet this is the daily reality for many people living in low and middle income countries, and it reaches nearly epidemic proportions when considering the African continent specifically. A graphical depiction of worldwide opioid consumption (in morphine milligram equivalents per capita) in 2015 starkly reveals Africa's anomalous behavior:

Figure 1. Worldwide Opioid Consumption, 2015



When repeating this map across multiple years, a similar pattern emerges: in any given year, different African countries might appear with a report of opioid consumption, but consistently at very low levels. It is also consistent that each year about half of African countries fail to make a report (i.e. “No data”).

In spite of the inexpensive nature of palliative treatment options, specifically morphine, African governments and physicians appear irrationally averse to providing such treatment to their patients. Yet little has been done to acknowledge or address the problem, leaving many thousands of Africans with inadequate care. One rare exception to this tragedy has appeared in the form of a hospice organization in partnership with American Cancer Society (ACS), creating an initiative known as “Treat the Pain.” The concept focuses on increasing the supply of morphine, building prescriber awareness and knowledge of palliative care, and advocating to government organizations for improved access to pain treatments for those who are suffering.

Analysis of the program to date has been difficult (mainly due to the scarcity of quality data on the African continent) and has focused largely on epidemiologic data to assess unmet need (ACS, 2013). It is the purpose of this capstone to determine what impact the morphine production initiative may have had on morphine consumption in the countries where it has been implemented. Morphine consumption data from individual countries will be analyzed in the context of the date of ACS program implementation and compared to countries where the program has not yet been adopted. While this analysis certainly bears flaws, its intent is to elucidate whether ACS is in fact achieving its goal of improving morphine utilization and access, and if further expansion of the program should be considered.

Literature Review

The Healthcare Situation in Africa

The African continent faces a unique crisis of suffering in comparison to the rest of the world. Perhaps its most pressing issue is an overwhelming burden of HIV/AIDS: according to hiv.gov, 53 percent of all cases worldwide are in eastern and southern Africa (19.4 million people), and 17 percent of cases are in western and central Africa (6.1 million people) (U.S. DHHS, 2018). While access to antiretroviral treatment is improving through the efforts of international organizations, those afflicted with the disease are still subject to many of its unfortunate effects. Often overlooked are the painful side effects of AIDS, either from infection or cancer and resulting damage to organs and tissues of the body. Also on the rise in Africa is the incidence of cancer, which now surpasses malaria as a cause of death in Africans (635,400 cancer deaths v. 394,000 malaria deaths in 2015) (Dent et al, 2017). Cancer treatments are even less accessible than antiretrovirals or antimalarials, meaning that the majority of cancer patients in Africa either die before receiving treatment, or they present at advanced stages of disease when tumors are disfiguring and extremely painful (Dent et al, 2017; Hannon, Breffni et al, 2016).

Access to palliative care services in most of Africa is similarly insufficient to meet the overwhelming need created by AIDS, cancer, and other diseases. Palliative care refers to the range of services employed to provide comfort and dignity to those suffering with a terminal or chronic illness that bears a high burden of pain (WPCA and WHO, 2014). In spite of the relatively inexpensive nature of palliative treatment options, various factors have led to the absence of such services from much of the African continent.

Factors Influencing the Crisis

Perhaps the most apparent factor contributing to Africa's palliative care crisis is the general scarcity of resources throughout much of the continent. This results in deficiencies across the entire

spectrum of healthcare, but palliative care is particularly hard hit because focusing on palliative care does not directly improve mortality measures (i.e. palliative care is not curative) (WPCA and WHO, 2014; Knaul et al, 2018). Thus, in spite of the low cost of certain opioids, such as morphine, more resources are directed towards other inexpensive medications such as antihypertensives, antibiotics, antiepileptics, and antineoplastics. Meanwhile, donors to charitable organizations put emphasis on supplying more expensive treatments such as antiretrovirals for AIDS, antimalarials, and vaccinations (Shiffman, 2006). These organizations likewise pass over palliative care, in part because of a lack of attention to the issue, but also out of a reluctance to supply opioids due to the unfortunate American experience with such medications. Whereas the Western world largely grapples with opioid overprescribing, addiction, and overdose deaths, they cannot fathom a situation wherein increasing opioid supply might be beneficial.

The palliative care issue is not merely one of access to resources, however, but also of attitudes towards those resources. From the government level, only 6 out of 54 countries in Africa have a national policy on palliative care, and if official policies exist on proper handling and tracking of controlled substances, they are either poorly defined or overly restrictive (Knaul et al, 2018; Luyirika et al, 2016). Government disinterest is further exacerbated by international regulations governing the ordering and tracking of controlled substances. The 1961 Single Convention on Narcotic Drugs established an International Narcotics Control Board (INCB) that oversees the international trade of controlled substances, such as opioids (Davis and Anderson, 2010). Individual countries are required to submit reports to INCB of estimated needs for the coming year, and upon review, an ordering limit is established on how much opioid or other controlled substance the country can import or export (Davis and Anderson, 2010). In any given year, nearly half of all African countries will either report absolutely no need for opioids or fail to report at all, meaning that INCB will not allow them to import any opioids for the coming year (further

appeals/negotiations are possible) (Board of Regents, 2018). It should be noted that this phenomenon is completely unique to the African continent – in every other continent, nearly every country indicates at least some yearly need for opioids. Yet this unusual behavior of African governments consistently inspires little to no response either from the international community or from within the individual countries themselves.

Such opioid-antagonistic attitudes by governments are reflective of a similar reluctance held by prescribers and patients within these countries. Although opioids have been historically poorly supplied as previously mentioned, the truth is that even if supply were improved the medications would still not likely end up being prescribed to patients. This can mainly be attributed to a phenomenon known as “opiophobia,” defined as fearful prejudice against the prescribing and use of opioid medications, even if medically appropriate (Knaul et al, 2018). While this fear can be healthy in the context of illicit drug use or inappropriate prescribing practices, it is inhumane and even dangerous when there is legitimate suffering. The origins of opiophobia from the prescriber perspective come from a lack of training on what constitutes a legitimate indication for the use of opioids, the appropriate dosing of these drugs, or necessary monitoring parameters (Knaul et al, 2018). It is also generally true that current educational models in these nations describe opioids as always being dangerous because of their potential to cause both addiction and life-threatening side effects. From the patient’s perspective, a similar fear of the medication exists along with the stigma of being viewed as an addict (Knaul et al, 2018). Culturally, the African patient is often a poor self-advocate because the doctor is viewed as an authority figure (Knaul et al, 2018). This means that if the doctor does not recommend treatment of pain, then it is not the patient’s responsibility to request this of the doctor. It is also not uncommon for patients to have very little experience interacting with doctors practicing modern medicine, and so they do not know how to handle the encounter or what to expect from their care (Knaul et al, 2018).

The Proposed Solution

Unique challenges such as the palliative care situation in Africa require innovative solutions, and such an intervention has been created to address multiple problems in this crisis. Originally conceived by a non-profit organization known as Hospice Africa Uganda (HAU) and later refined and expanded by the American Cancer Society (ACS), the program revolves around the concept of in-house production of oral morphine solution (Merriman and Harding, 2010). Morphine powder is ordered from a supplier and stored offsite in a secure location. When needed, small shipments are imported to the country and immediately mixed with water, preservative, and food coloring (to indicate product concentration), and then distributed by trained healthcare providers (Merriman and Harding, 2010). The end product is inexpensive, has a fairly long shelf-life, is difficult to divert, is easy to train on administration, and, importantly, is highly effective at treating pain. In addition to improving supply, the HAU and ACS partnership has also focused on prescriber education and palliative care advocacy efforts, which have raised awareness of the need for palliative care services and expanded the base of healthcare workers able to provide them (Merriman and Harding, 2010).

Methods

The goal of my capstone project is to examine the impact of an ACS-led initiative to improve access to palliative care services (specifically morphine for treatment of pain) in various countries in Africa. To do this, I have collected information reported to the International Narcotics Control Board (INCB), which is an agency within the United Nations that is tasked with overseeing imports and exports of opioids (and other controlled substances) throughout the world. Each year, countries are expected to report estimates of national opioid consumption to the INCB in order for the INCB to then establish yearly ordering limits.

Accessing these reports from the INCB website (www.incb.org), I collected morphine consumption data for 55 African countries from 2007 to 2016 (the most recent report available on

the website). Of these 55 countries, 7 were listed as having failed to report across all years, 2 countries failed to report on morphine consumption specifically, and 5 countries lacked data for other variables in the analysis. This resulted in a total of 41 countries for my analysis. A complete listing of included and excluded countries may be found in Appendix A.

It should be noted that there is considerable variability in how countries choose to report opioid consumption, which requires careful consideration of the best way to handle the available data. For example, it is very common for countries to report consumption as merely a reflection of imports, and whatever quantity they order for the year they immediately report as “consumed.” Given utilization and ordering patterns, it is instead more likely that a quantity of morphine ordered in a given year may instead last several years before more must be ordered, or it may even expire without being used at all. As previously mentioned, there are also many African countries that fail to submit any report at all in a given year, which would technically disallow them from ordering any opioids in that year, but to which international organizations often turn a blind eye because utilization and ordering are so low. There are also countries that report quantities so low that the INCB simply refers to them as “<0.5 kg,” and yet others that actually report “0 kg” of consumption (likely an inaccurate statement but again related to the tendency to link ordering to consumption). Because of all of these considerations, I made several decisions in my handling of the data: 1) I listed all “<0.5 kg” reports as 0.25 kg; 2) I converted all “no reports” to 0 kg; and 3) I took 3-year averages of opioid consumption data (e.g. “2008 morphine consumption” is the average of reported consumption for 2007, 2008, and 2009).

After contacting ACS, I also obtained dates for when they began operations in 5 separate countries: Uganda, Kenya, Swaziland, Nigeria, and Rwanda. Using this information, I created a binary “yes/no” variable with “0” representing a year in which the ACS program was not present and a “1” to represent a year in which the initiative was operational. I further learned that they have

partial involvement in 4 other countries (Botswana, Democratic Republic of Congo, Togo, and Benin), where they are providing “technical support” as these countries create and implement their own palliative care initiatives. In these scenarios, ACS has offered themselves as a resource to answer questions and give advice. In none of these 4 cases was technical support initiated prior to 2017, and so there is no direct impact on the years considered in the analysis, but it is worth noting that there are likely some differences in morphine consumption behaviors in these countries.

Using morphine consumption as the dependent variable, I analyzed the presence of the ACS program as the explanatory variable with the effect determined by 1) a pooled, time series regression accounting for the fixed effects of an individual country, and 2) a difference-in-differences (diff-in-diff) analysis. Other variables included in the analysis are codeine consumption, which was also obtained from the INCB reports and converted to 3-year averages as explained above; population data (in millions of people), as obtained from the United Nations yearly estimates on population; a corruption perceptions index (CPI), created and published by Transparency International; and an education index, produced by the United Nations Development Program.

Codeine Consumption

Codeine is a lower potency opioid that is internationally scheduled in a less restrictive category than morphine or other stronger opioids. In addition to its use as a treatment for pain, it is also commonly found in cough syrups. Because of its lower level of restriction and its multifaceted uses, it is easily the most commonly used opioid worldwide (Davis and Anderson, 2010). In spite of its widespread use, it is actually much more difficult than morphine to dose correctly because of genetic variations in liver metabolism, and so it is not commonly used for treatment of severe pain as would be the case in palliative care (Dean, 2012). I have chosen to include it in this analysis to serve as a “baseline level” of prescribing behaviors against which to compare morphine prescribing

behaviors (i.e. Are prescriptions for pain generally increasing throughout the country, or is morphine alone increasing because of the effect of the initiative?).

Population Data

United Nations' yearly population estimates were accessed from their website at <https://population.un.org/wpp/Download/Standard/Population/>. Population numbers were included because it would be expected that more populous countries would consume more morphine. It should be noted that their report did not contain estimates for the year 2016, and so I chose to use Microsoft Excel to estimate a population value for 2016 based off of trends.

Corruption Perceptions Index (CPI)

The Corruption Perceptions Index (CPI) was created in 1995 by an organization known as Transparency International. Per the website, (www.transparency.org/research/cpi/overview) its goal is to bring to light the corrupt behaviors of certain governments and thereby hold them accountable to the international community. The index is compiled by collecting data from several surveys distributed to various organizations (e.g. international banks, think tanks, watchdog organizations, research groups, etc.). These surveys all contain questions dealing with the actions of governments and their potential abuse of power. Depending on the year, there are around a dozen possible surveys that may be completed for an individual country, although not every survey will be completed for every country. Results are normalized to a scale of 0 to 10 (or 0 to 100, starting in 2012) and averaged, and this average comprises a country's CPI score.

I chose to include this index (with appropriate adjustments to account for the scale change in 2012) because the morphine consumption values reported to INCB, in addition to reflecting prescribing behaviors, are also indicative of government awareness of palliative care and their involvement in it. Healthcare throughout much of Africa is nationalized, so it would be reasonable to presume that a government's level of corruption might impact the provision of quality care to its

citizenry. It should be noted that Swaziland did not participate in the CPI for the years 2015 and 2016, although they resumed participation in 2017 with a score of 3.9. Given that their 2014 score was 4.3, I chose to assign 2015 and 2016 scores of 4.1 and 3.9, respectively.

Education Index

The United Nations Development Programme’s Human Development Report Office (HDRO) calculates a yearly education index to reflect the level of education of a country’s population. It takes into consideration both the average years of schooling of the adult population and the expected years of schooling for children. These numbers are converted to an index by scaling against corresponding maxima, and averaged together to form the overall education index. In practical terms, an index score below 0.5 would suggest that, on average, adults and children are receiving less than half the amount of education that is desirable or possible. Because morphine consumption is also a reflection of patient attitudes toward their healthcare, I chose this index in an effort to reflect the education of the population and thus their ability to understand and accept treatment.

Results

This analysis was performed to compare the expected trajectory of morphine consumption against actual consumption in countries where the ACS program was implemented. A summary of the information used in the analysis is provided in Table 1 below.

Table 1. Summary of Data

Variable	Mean	Std. Dev.	Min	Max
Morphine Consumption (kg)	12.6	62.6	0	573
Codeine Consumption (kg)	211	701.8	0	4829
Corruption Perceptions Index	3.2	1.1	1.1	6.5
Education Index	0.46	0.13	0.16	0.73
Population (millions)	25.3	31.1	0.49	181

Results of the time series regression are found in Table 2.

Table 2. Time Series Regression, Effects on Morphine Consumption

Variable name	Coefficient	P-value	95 % Conf. Interval
Presence of ACS program	1.33	0.849	(-12.46 – 15.13)
Codeine Consumption	-0.044	<0.001	(-0.058 – -0.030)
Corruption Perceptions Index	-7.04	0.050	(-14.08 – -0.001)
Education Index	13.97	0.842	(-123.73 – 151.67)
Population	1.96	0.001	(0.81 – 3.11)

Several observations can be made from the results: First, the ACS program does not appear to have a statistically significant effect on morphine consumption, at least as reported by the country to the INCB, although the trend appears to be towards increased consumption. Three variables did demonstrate statistically significant effects: codeine consumption, which actually tended to decrease consumption of morphine (likely by substitution effect); population, where having a more populous country would, as expected, lead to higher consumption of morphine; and having a higher corruption perceptions index, which led to a sizeable decrease in morphine consumption.

Diff-In-Diff Analysis

In this analysis, countries not implementing the ACS program were used to form a “control group,” indicating general trends in morphine consumption across the African continent. Countries where the program was implemented then formed the “treatment group,” and comparisons could then be made between pre- and post-treatment time periods (comparing treatment to control). The results of the diff-in-diff analysis are found in Table 3.

Table 3. Diff-in-Diff Analysis, Effect on Morphine Consumption

Variable name	Coefficient	P-value	95 % Conf. Interval
Presence of ACS program	0.39	0.956	(-13.50 – 14.28)
Codeine Consumption	-0.044	<0.001	(-0.058 – -0.030)
Corruption Perceptions Index	-6.86	0.079	(-14.52 – 0.81)

Education Index	-105.12	0.292	(-300.95 – 90.72)
Population	1.73	0.005	(0.52 – 2.94)

The results are very similar to the previous time series regression, with the exception that the effect of CPI is no longer statistically significant, and the coefficients are generally smaller in magnitude.

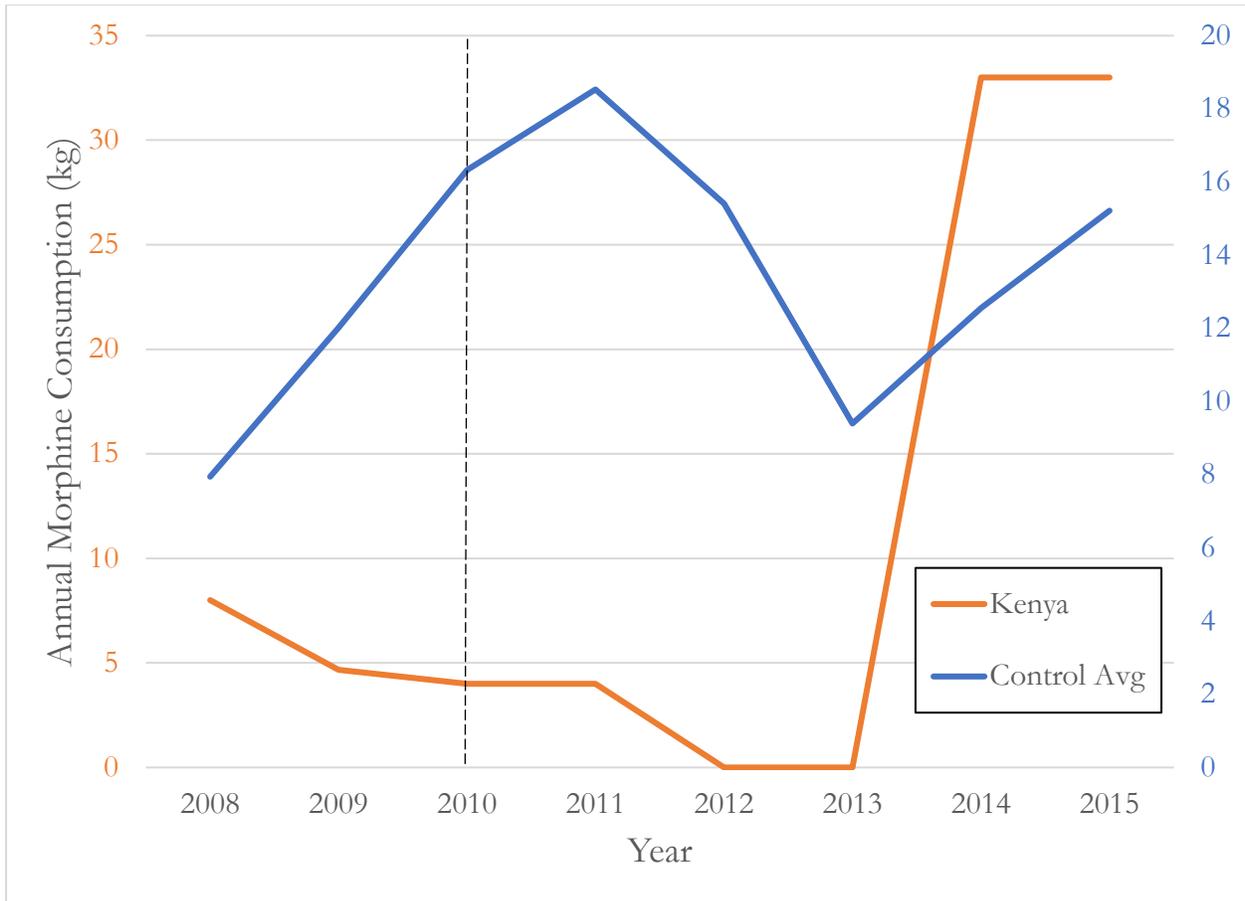
Graphs of Treatment Countries

Graphical depictions of this analysis comparing the control group average to individual treatment countries provides visual insight into a potential treatment effect. Note that for each of the following figures, the vertical axis is scaled to the treatment country on the left side, and to the control average on the right side. The dashed line indicates the year of ACS program implementation. Also, the numbers depicted for morphine consumption are 3-year averages as previously described.

Kenya

The ACS program was implemented in Kenya in 2010, and from Figure 1 there appears to have been a significant lag effect. This could have been due to the initiative itself being in its very early stages, and therefore requiring some time for training, facility location and preparation, identification of target patient population, etc. It should also be noted, however that 2011-2014 were all “no report” years for Kenya, after which a very large quantity was reported in 2015 (potentially a “catch-up” report accounting for several years of missing data?). It would be interesting to see if this trend of increased consumption continued in subsequent years, but the latest available data on the INCB website is from 2016.

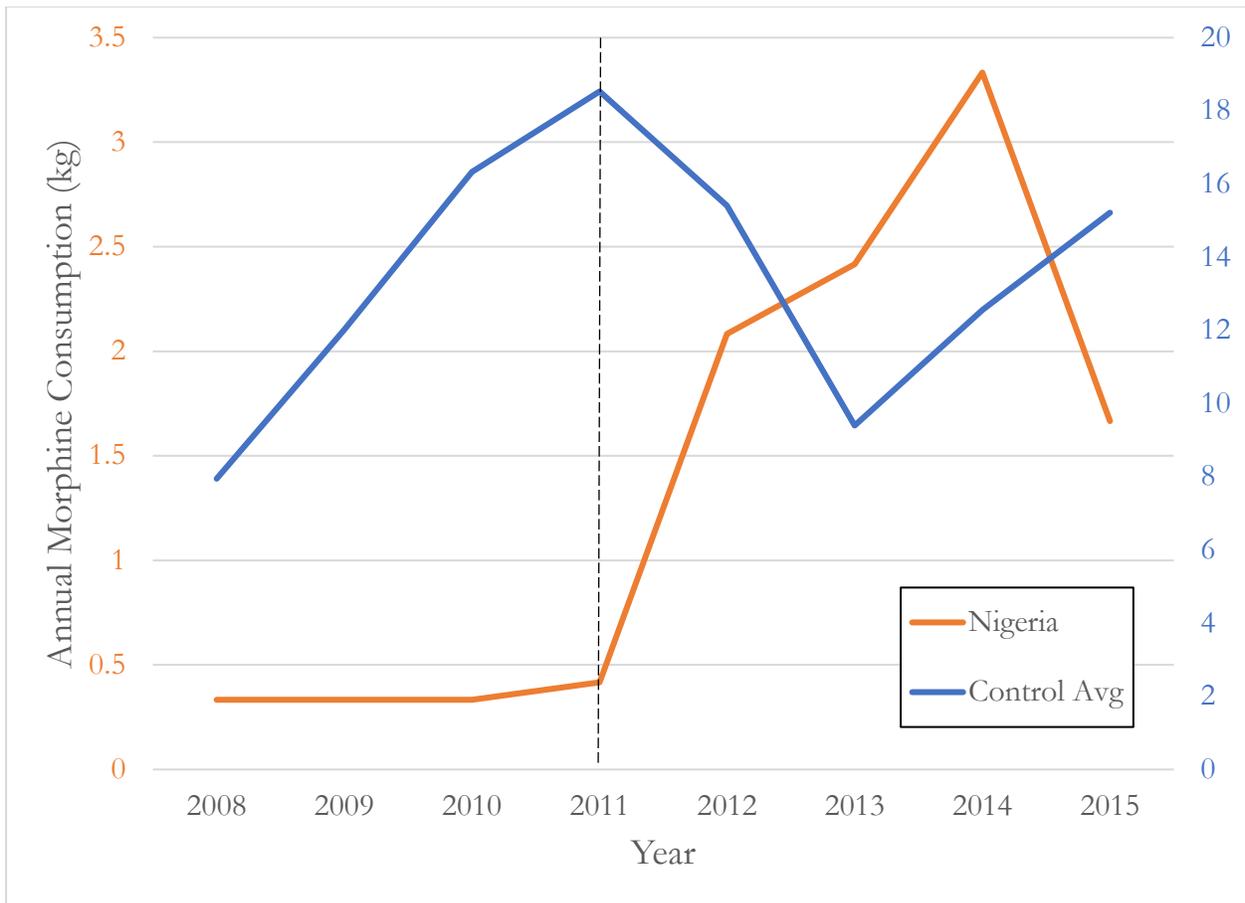
Figure 1. Kenya vs Control



Nigeria

Nigeria officially partnered with ACS beginning in 2012, and as depicted in Figure 2, there appears to have been an initial surge in consumption. This effect tapers off in 2015, however, blunting the overall post-treatment effect and calling into question the sustainability of the initiative. It should be noted that Nigeria is Africa’s most populous country, so these morphine consumption numbers being well below the continent’s average is discouraging and are most certainly insufficient to meet needs.

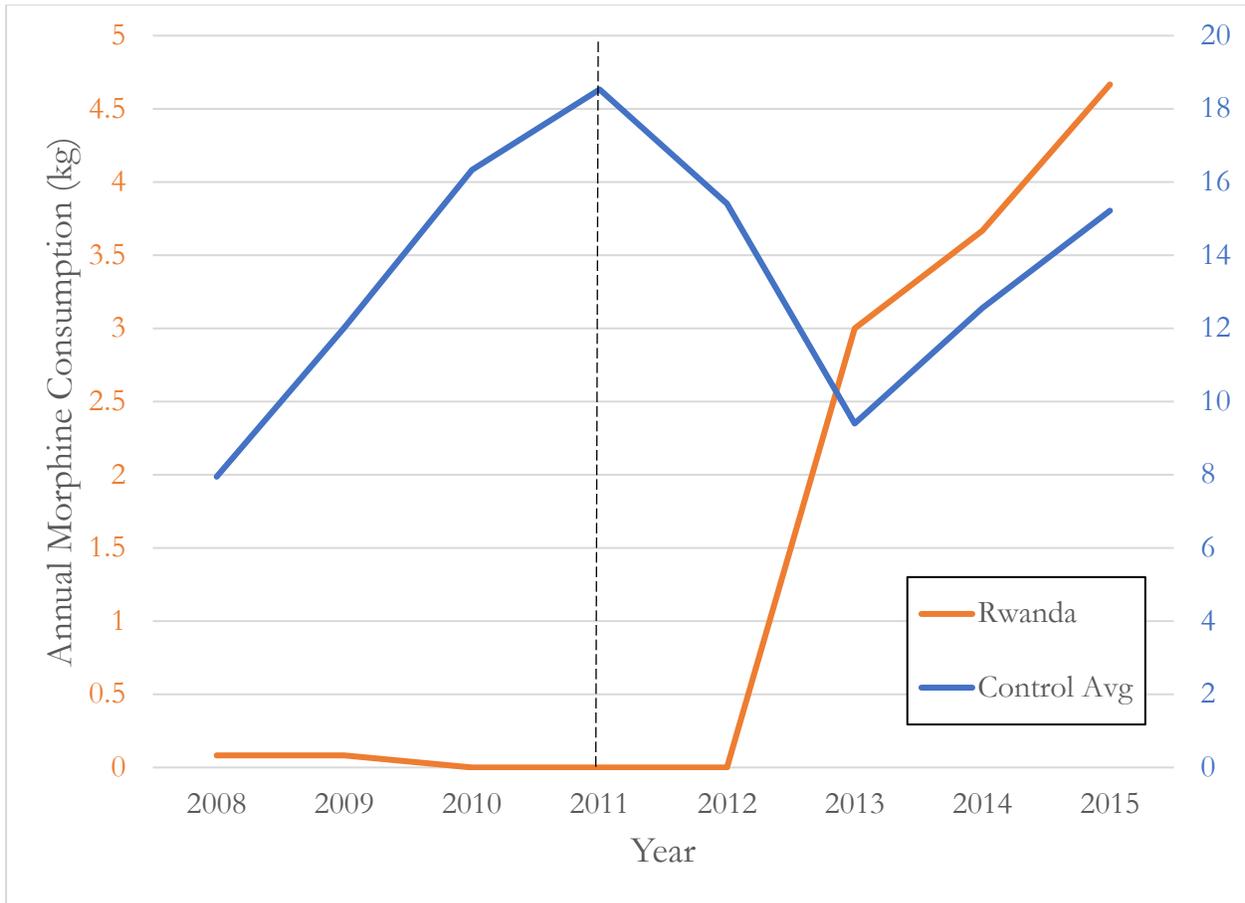
Figure 2. Nigeria vs Control



Rwanda

Rwanda implemented the ACS program during 2011 and seems to have experienced a lag in program implementation, similar to Kenya, as depicted in Figure 3. Unlike Kenya and Nigeria, however, the effect does not appear to reach a saturation point and consumption grows throughout the time period in question. It should be noted that, from the national level, Rwanda also became the first African country to establish a national policy on palliative care in 2011 (Krakauer et al, 2018). This underscores the importance of government involvement in achieving success with the ACS initiative, particularly when healthcare is run from the national level.

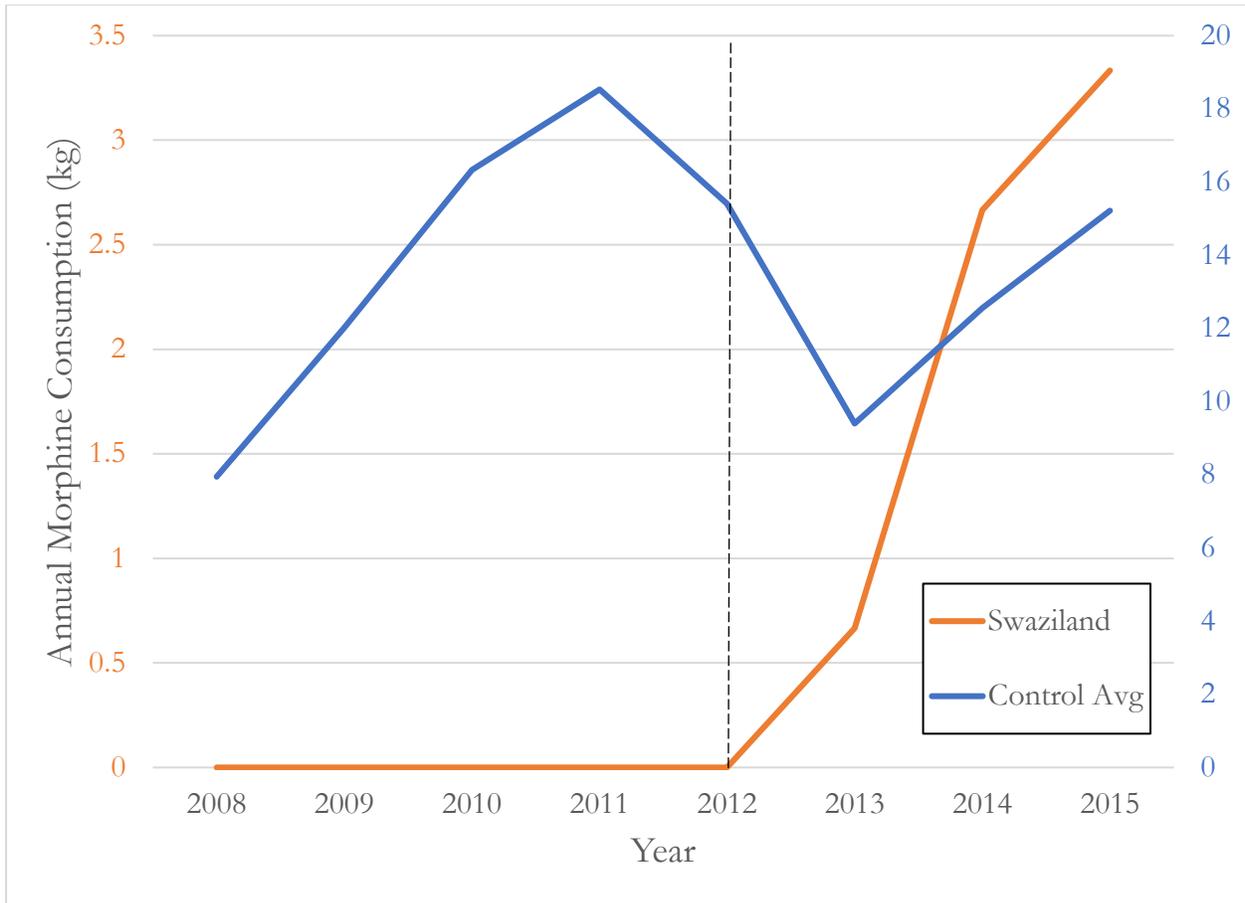
Figure 3. Rwanda vs Control



Swaziland

The ACS initiative was implemented in Swaziland starting in 2012, and as depicted in Figure 4, it appears to have had an impact from the start. Prior to program implementation, Swaziland had never submitted a report to the INCB, and in reality did not start submitting reports until 2014 (again, likely a “catch-up” report). Because of this, it is difficult to actually gauge the effect in early years of program implementation, but it does appear to have eventually reached the level of affecting government reporting.

Figure 4. Swaziland vs Control



Uganda

Uganda represents the most problematic country to analyze, because in actuality it was the country that pioneered the oral morphine solution approach, as early as 1993 (Merriman and Harding, 2010). It should be noted that before 2010, Uganda was already consuming morphine at relatively high levels, and so ACS involvement probably served more to bolster already existing resources and infrastructure. This seems to be verified by the appearance of Uganda’s morphine consumption in Figure 5, which fluctuates but generally stays around 17 kg. Bearing this theory in mind, I chose to repeat the previous analyses (time series regression and diff-in-diff analysis) utilizing all of the same data but with Uganda excluded. The results are seen in Tables 4 and 5.

Figure 5. Uganda vs Control

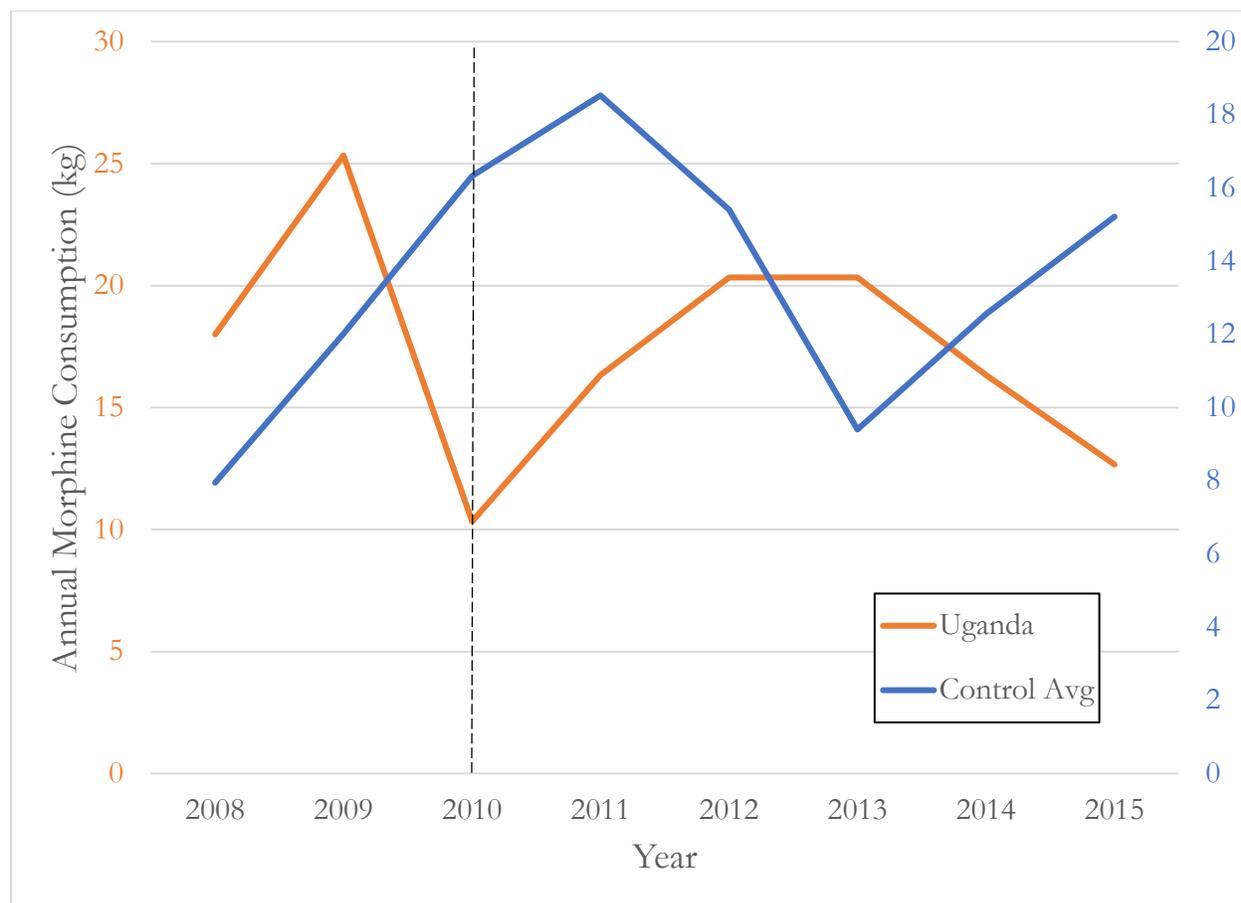


Table 4. Time Series Regression with Uganda Excluded

Variable name	Coefficient	P-value	95 % Conf. Interval
Presence of ACS program	5.08	0.514	(-10.22 – 20.38)
Codeine Consumption	-0.045	<0.001	(-0.059 – -0.030)
Corruption Perceptions Index	-7.76	0.035	(-14.95 – -0.56)
Education Index	15.90	0.823	(-123.57 – 155.37)
Population	2.01	0.001	(0.83 – 3.18)

Table 5. Diff-in-Diff Analysis with Uganda Excluded

Variable name	Coefficient	P-value	95 % Conf. Interval
Presence of ACS program	5.09	0.515	(-10.27 – 20.44)
Codeine Consumption	-0.045	<0.001	(-0.060 – -0.031)
Corruption Perceptions Index	-7.81	0.051	(-15.63 – 0.02)
Education Index	-118.16	0.245	(-317.88 – 81.56)
Population	1.74	0.005	(0.52 – 2.97)

The results of this analysis seem to confirm that Uganda was influencing the ability to observe a treatment effect. While the ACS program is still not demonstrating a statistically significant effect, the p-value is much lower than in the previous analyses and the coefficient is much greater in magnitude.

Discussion

Assessing the Analysis

Although the ACS program did not appear to demonstrate statistical significance with the data available, it is worth discussing what may have prevented such an outcome. One potential problem is the small number of instances of program implementation: Of the 41 countries included in the analysis, only 5 of them (12.2%) fully implemented the program, and for a total of only 30 years of demonstrated experience out of a possible 410 years (7.3%). From among the treatment countries, Uganda presents an interesting case to analyze for the fact that it had a primitive version of the ACS program prior to 2010. It is very possible that 2010 represented less of a change and more of a bolstering of the program already in place. Indeed, looking at the graph of Uganda's morphine consumption, it would appear to be in more of a plateau phase than an upward slope. This likely diminished the observed effect of program implementation. Removing Uganda from the equation does noticeably change the results, but accentuates the problem of having too few instances of program implementation by narrowing the treatment countries to four. Additionally, it is difficult to account for the countries partially implementing the program (Benin, Botswana, DRC, Togo) by receiving technical assistance from ACS.

The idea of a treatment and control group in this particular analysis is also somewhat of a flawed concept. In speaking with individuals at ACS, there was a calculated process involved in choosing some of the initial countries where the program was implemented. Generally speaking, they selected countries with relative stability, cooperative governments, and a willingness to

implement the program, indicating a mentality already primed for program implementation. In other words, the treatment group was not by any means randomly selected, and there are likely inherent differences between treatment and control countries. I attempted to account for this by including the CPI variable and including regionally similar countries in the analysis, but it should be noted that this is far from a randomized experiment.

All things considered, the most significant weakness in this analysis lies in the morphine consumption data itself. As mentioned previously, there is substantial variability in how the data is reported, resulting in a lack of confidence that the numbers in the report accurately reflect consumption. The potential bias resulting from countries failing to report anything presented a considerable challenge because of not knowing how to treat the information. The intended purpose in the creation of INCB was to prevent abuse and diversion of controlled substances, and in countries where use is so low (as is the case in much of Africa) the organization tends to take a hands off approach, allowing the countries to import their small quantities of opioids but without close supervision. As a result, accountability for data reporting is extremely low and consequences for a failure to report are non-existent. In all there were 126 incidences of a failure to report out of a possible 410 opportunities to report. Countries failing to report across the entire 10 years observed were, of necessity, excluded from the dataset, but this again potentially introduces bias into the analysis.

All of this led me to the calculation of 3-year consumption averages to better reflect what I believe may actually be occurring. However, this choice also likely diluted out the effect of any sudden spike in opioid consumption at the time of program implementation. Ideally, more robust consumption data would be required to obtain a high-confidence analysis and result, such as compiled prescription data from physician practice sites or hospice programs. Considering that the focus of this initiative is on improving palliative care, what would be even more useful would be

knowledge of the diagnoses for which an opioid is being prescribed, a count of untreated cases of painful suffering, and quantification of opioid use not related to surgery or childbirth. As medical data systems advance and improve in Africa, it will be increasingly important to include such opportunities for data collection to better assess quality of care and outcomes.

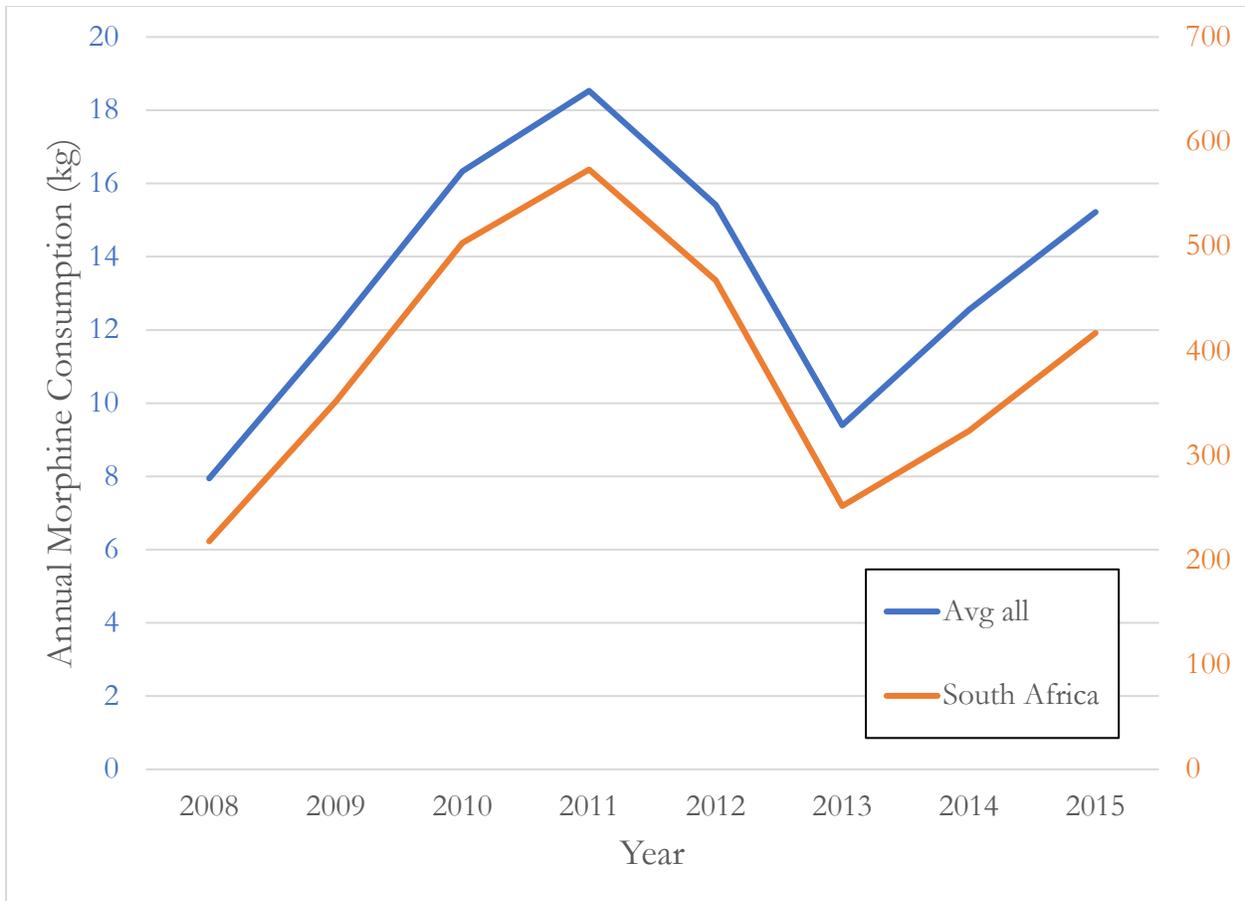
This problem with the unavailability of high-quality data is a frustration for researchers in many parts of the world, but it is particularly apparent in the context of African research. Ideally for this analysis, I would have liked to include some measure of disease burden to represent the need for palliative care, which I believe would influence the amount of morphine consumption. When searching through published data, however, I quickly discovered that there is simply no information being collected or reported throughout the vast majority of the African continent. A yearly publication known as GLOBOCAN reports the incidence of cancer for countries around the world, but they readily admit that there is simply no data available for nearly all of Africa – in 2012, there were only 2 countries (Egypt and South Africa) with any cancer data to speak of (Ferlay et al, 2015). Much of this problem stems from the lack of access to care, or a lack of effort to access the care that is available, and therefore many cases of disease go undiagnosed. It would also appear, however, that even in cases where care is administered, there is a lack of detailed documentation of the encounter. This sort of information will be key to Africa's ability to recognize and address problems such as this crisis of palliative care that would otherwise go undetected.

The Effect of South Africa

It is worth noting the impact of South Africa on this analysis. As noted in Table 1 in which the data is summarized, the average morphine consumption for the continent is around 12 kg per year. Table 1 further reveals that the maximum value for morphine consumption was 573 kg, which occurred in South Africa in 2011 (note that this is actually a value based on a 3 year average – the actual number reported to INCB that year was 962 kg, but which was diluted out by lower numbers

in 2010 and 2012). Compared to the other countries in the analysis, South Africa is an extreme outlier, which strongly impacted the shape of the curve for the control group, as depicted in Figure 6 (note the extreme differences in scale of the vertical axis between the control average and South Africa's consumption).

Figure 6. Comparison of South Africa and Control Group



When South Africa is excluded from the control group, the shape of the curve changes dramatically both in magnitude and shape, as depicted in Figure 7, and a summary of the data without South Africa reveals a changed dataset in terms of opioid consumption (Table 6).

Figure 7. Control Averages, with and without South Africa

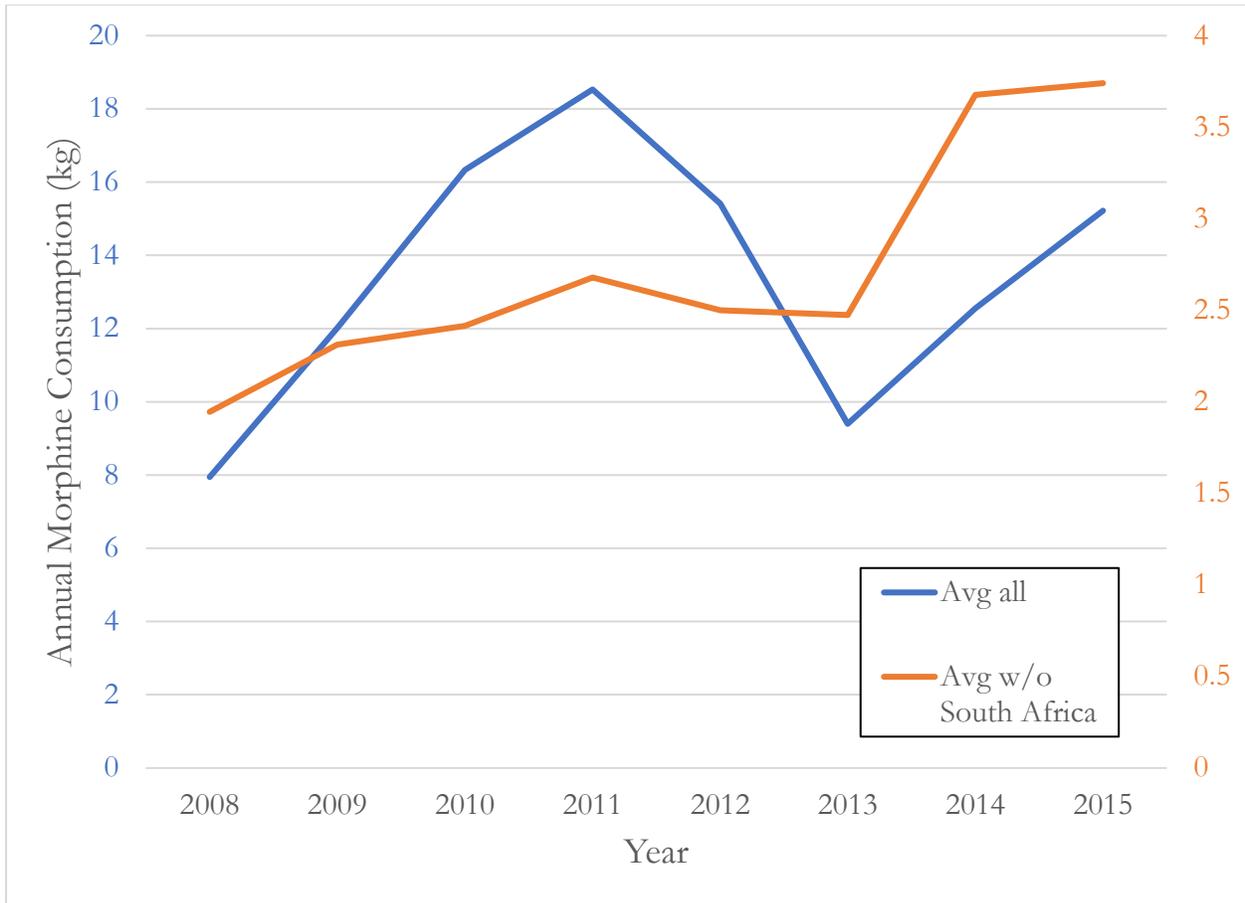


Table 6. Summary of Dataset without South Africa

Variable	Mean	Std. Dev.	Min	Max
Morphine Consumption (kg)	3.2	6.8	0	48.7
Codeine Consumption (kg)	121	400.3	0	2980
Corruption Perceptions Index	3.2	1.1	1.1	6.5
Education Index	0.45	0.12	0.16	0.73
Population (millions)	24.6	31.2	0.49	181

It was my desire to remove South Africa from the analysis altogether, but doing so presented several problems in and of itself. In terms of its consumption behavior, South Africa more strongly resembles European levels, and of all of the countries in the analysis, its data is the most believable

and likely the most accurate. Removing South Africa from the dataset accentuates the problem of having far too many countries with poor reporting. Furthermore, it leaves mostly countries with very low levels of consumption, making changes in consumption trends more nuanced and difficult to observe. These concerns were verified in my attempts to perform analyses without South Africa, which left virtually every variable as statistically insignificant, as shown in Table 7.

Table 7. Time Series Regression, without South Africa

Variable name	Coefficient	P-value	95 % Conf. Interval
Presence of ACS program	-0.044	0.980	(-3.49 – 3.40)
Codeine Consumption	-0.003	0.281	(-0.007 – 0.002)
Corruption Perceptions Index	0.36	0.666	(-1.27 – 1.99)
Education Index	-18.56	0.244	(-49.88 – 12.76)
Population	0.63	<0.001	(0.35 – 0.91)

I chose to include South Africa mainly because of the quality of the data it provided. While I acknowledge that it strongly influenced the outcome, I am somewhat reassured by a careful comparison of the different averages depicted in Figure 7. In general, the trends are at least similar: the lowest point is in 2008, and there is a local maximum in 2011, a local minimum in 2013, and an upward trend in 2014 through 2015.

Recommendations and Future Directions

The results of this research do not allow me to confidently recommend the program for widespread implementation. In no case did this concept spiral out of control or result in systemic overuse or misuse of morphine. Thus the risk of harm appears to be minimal, particularly in the African context, where opioids are so woefully underutilized. There are currently too few instances to truly gauge the full effect of the program, and therefore it is worth further experimentation to observe possible outcomes. As previously mentioned, improved data collection and reporting will be important going forward.

From my research on this situation, I believe that the most significant roadblock to improving palliative care in Africa exists with the doctors themselves. While my experiment was limited to available data and focused more on a measurement of program outputs (i.e. morphine consumption), I feel that it would be more useful to determine program outcomes. Specifically, is the training being administered by the ACS program having an impact on prescriber attitudes and behaviors? This could be achieved by administering a survey to program participants, both prior to training to determine baseline attitudes and upon completion of the program. The survey should gauge attitudes toward opioids, knowledge of situations where it is appropriate to prescribe them, knowledge of how to dose them, and knowledge of necessary monitoring parameters. This is important because no matter how much morphine supply is increased, it will not have an impact unless prescribers are willing to utilize what is made available.

It is also important to determine government attitudes towards palliative care. The majority of African countries administer healthcare from the national level, and much of the healthcare provided is driven by standard treatment guidelines (STGs) which essentially serve as treatment protocols describing how to respond to a particular clinical scenario. An interesting topic of study would be to determine how many countries in Africa have an established palliative care STG that includes morphine for the treatment of severe pain.

A great deal of work remains to be done in regards to this crisis. This capstone paper represents a first attempt at program evaluation and hopefully serves to shed light on an unacceptable situation that merits immediate attention. This is a humanitarian catastrophe that has led to unnecessary suffering for many thousands, if not millions, of Africans who are left to die ignominious deaths. The resources exist to rectify this situation in an affordable manner, but it will require the concerted efforts of international organizations, governments, and healthcare providers to adequately address the problem.

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Appendix A

Countries included in the analysis:

Algeria	Mali
Angola	Mauritania
Benin	Mauritius
Botswana	Morocco
Burkina Faso	Mozambique
Burundi	Namibia
Cameroon	Niger
Cape Verde	Nigeria*
Chad	Rwanda*
Congo, Democratic Republic of	Senegal
Cote d'Ivoire	Sierra Leone
Egypt	South Africa
Eritrea	Sudan
Ethiopia	Swaziland*
Gabon	Tanzania
Ghana	Togo
Kenya*	Tunisia
Lesotho	Uganda*
Libya	Zambia
Madagascar	Zimbabwe
Malawi	

* - Indicates a treatment country

Countries excluded from the analysis:

- Due to a failure to report across all years of the analysis (2007-2016):
 - Central African Republic, Djibouti, Equatorial Guinea, Gambia, Republic of Congo, Somalia, South Sudan
- Due to a failure to report morphine consumption across all years of the analysis (2007-2016):
 - Guinea, Liberia
- Due to an inability to obtain other data for the analysis:
 - Ascension Island, Saint Helena, Sao Tome and Principe, Seychelles, Tristan da Cunha

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