Adult AIDS mortality trends in Addis Ababa

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Abstract

Background: In this study we asses trends in adult AIDS mortality in Addis Ababa. Monitoring the mortality impact of AIDS as well as examining trends is an important aspect of the response to the epidemic. Vital registration type data are most preferred sources of information in order to realize this. Ethiopia is one of those countries without a vital registration system. In the complete absence of vital registration data, alternative sources such as data from an ongoing burial surveillance can be utilized. In this study we hypothesize a decline in adult mortality from AIDS especially after the introduction of ART. However, we also expect that there is gender imbalance in benefiting from this decline.

Methods: Data for this study are obtained from two sources; burial surveillance and verbal autopsy (VA). First, we used data from the ongoing registration of burials to estimate trends in all-cause adult mortality in the period 2001-2008 using age ratio analysis. The other method we employed is based on VA interviews which contain signs and symptoms during terminal illness. Based on these information causes of death were assigned by local physicians and the InterVA model. Moreover, we also estimated logistic regression model using AIDS death as the outcome variable.

Results: A total of 158,115 persons were buried between 2001 and 2008. Absolute figure on reported deaths exhibited a decline from the peak years of 2001 and 2002 to 2008. For all years male mortality is higher than female mortality. A similar decline in cause specific mortality fraction is observed from 2001 (50%) to 2007 (close to 25%) using the reports of VA. The odd of dying due to HIV is higher among female (OR=1.43, 95%-CI: 1.16-1.78). The results from the regression model also show that compared to the reference year AIDS related deaths have declined by 42, 64, and 70 percent in 2003/04, 2006 and 2007 respectively. Those within the 30-39 age group are more likely to die of AIDS compared to the under 25 (OR=2.5, 95%-CI: 1.7-3.7).

Conclusion: The results of this study revealed that AIDS deaths have declined in Addis Ababa. Although there is an overall decline in adult mortality, women remain to have a comparatively higher mortality ratio than men. Faster decline of AIDS related mortality was observed after 2004. This time corresponds with recent scale up of ART in the city.

Key Words: HIV/AIDS, ART, mortality, surveillance, verbal autopsy, InterVA, Ethiopia

Background and objectives

In this study we asses trends in adult AIDS mortality in Addis Ababa. Ethiopia is one of the countries in sub-Saharan Africa where the HIV/AIDS epidemic has become a major public health threat. In 2005, the HIV/AIDS prevalence rate for the country was 1.4%. This figure was 4.7% for Addis Ababa.[1] Since 1986, the year where the first AIDS cases were reported for Addis Ababa, many city residents and other transients lost their lives to the epidemic. Monitoring the mortality impact of AIDS as well as examining trends is an important aspect of the response to the epidemic. Vital registration type data are most preferred sources of information in order to realize this. However, vital registration systems are notoriously difficult to set up and maintain in resource-constrained countries, not coincidentally also those that are hardest hit by the HIV/AIDS epidemic. In the complete absence of vital registration data, alternative sources such as data from an ongoing burial surveillance can be utilized.

Ethiopia is one of those countries without a vital registration system. Mortality estimates, so far, are derived from demographic and health surveys, surveillance systems, as well as mathematical models. The Addis Ababa Mortality Surveillance Program (AAMSP) is a unique undertaking which monitors citywide mortality based on burial surveillance in all cemeteries within the city boundary. The program collects further information on causes of death and other socio-demographic characteristics through verbal autopsy from cases sampled out of burial registries. This study makes use of these data.

Studying adult AIDS mortality trends help monitor the status of the epidemic as well as evaluate the effectiveness of public health interventions. Model based studies show that the mortality impact of the epidemic exhibited continued increase since the late 1980s and throughout the 1990s. At the same time, the impact has been more severe on the productive segment of the population in general and on women in particular. Even after the introduction of ART on a cost sharing basis in 2003 and for free in 2005, women show a relatively higher ratio of deaths over men which may be explained through the disproportionately higher incidence rate among women during the peak years of the epidemic and the overall lack of gender equity (Reniers et al., 2007). In the present study we hypothesize a decline in adult mortality from AIDS especially after the introduction of ART. However, we also expect that there is gender imbalance in benefiting from this decline. Hence, trends in adult AIDS and TB/AIDS specific mortality fraction is estimated for various years using both physician review and InterVA as well.

Data and Methods

Sources of data

Data for this study are obtained from two sources; burial surveillance and verbal autopsy interviews conducted on 10% of records from burial sites. We used a range of methods, depending on the source of data to examine trends in overall mortality ratios and cause specific mortality fractions (CSMFs).

The burial surveillance was initiated at all cemeteries of Addis Ababa in February 2001 and records close to 20,000 deaths per annum. By the end of 2008, the surveillance covers 88 cemeteries of which 65 Orthodox Christian, 9 Muslim, 2 Catholic, 1 Jewish, 1 Greek Orthodox and 10 are municipal burial cities. One of the municipal cemeteries, Baytewar, buries bodies with unknown addresses and with no relatives or friends to take care of their funeral. This particular site accounts for 15.7 % of all burials in the city. However, 99 and 92 percent of cases with missing values for sex and age respectively are from this same cemetery. A detailed description of the procedures of burial surveillance can be found in the work of Araya et al. [2]

Trained cemetery clerks use a simple form to register the deceased person's socio demographic characteristics, date of burial and lay cause of death. These information are extracted from persons who were in charge of arranging the funeral on behalf of the deceased family. Despite the effort to register all burials within the city boundary, having some degree of underreporting of deaths is unavoidable. Some of the reasons for underreporting include, terminally ill residents may relocate to other parts of the country where they can get care from extended family members during their final hours alive and most likely they will get buried there, it is also not uncommon to repatriate bodies for burial to places of origin or birth beyond the city limit, and cemetery clerks could also miss to register some burials.

Our second source of data is verbal autopsy (VA) interviews conducted with next of kin or other caregiver after a culturally appropriate period of mourning (usually 2 months) has elapsed. Apart from collecting socio-demographic data on the deceased and care giver as well as on the care provided, these interviews mainly aim at eliciting information on signs and symptoms during terminal illness. Verbal autopsies are administered for randomly selected adult deaths (defined as age 12 and above) from the burial registries excluding cases from the largest of the municipal cemeteries,

Bytewar, for reasons mentioned earlier. Verbal autopsy interviewers are trained community health workers. Data quality is ensured through a well instituted system. Field supervisors check for consistency by revisiting randomly selected households. At office level a research coordinator will go through filled questionnaires, check for completeness, consistency, and help to relocate households that could not be traced by the interviewers. Finally, a data manager will conduct a through data cleaning once double data entry is completed. Verbal autopsy (VA) interview data, used to ascertain causes of death, are available for the years 2001, 2003/2004, 2006 and 2007. [3, 4]. Among the households selected for VA interview 70% of them successfully interviewed and 30% were not willing to be interviewed or households could not be located. Our analysis here considered only those completed interviews.

Age ratio analysis

First, we used data from the ongoing registration of burials to examine trends in all-cause adult mortality in the period 2001-2008. We assessed the proportion of deaths age 25-49 relative to all deaths since this group is expected to be affected by AIDS mortality. Further to this, for the lack of appropriate denominator, our approach employed age ratio analysis (ages 25-49 versus 5-14) under the assumption that in the absence of differential mortality this ratio should remain constant. The basis for our assumption is that mortality will remain relatively constant for the 5-14 age group and this group is less likely to be affected by AIDS related deaths unlike the 25-49 age group. The ratios were calculated for both sexes separately to allow comparison. Trends were assessed by examining rate of changes of the ratio of deaths for people aged 25-49 versus 5-14 over the years.

Estimating Cause Specific Mortality Fractions based on Physician Review and the InterVA model

The other method we employed to asses trends in adult AIDS mortality is based on VA interviews which contain signs and symptoms during terminal illness. Based on these information causes of death were assigned by local physicians. We then estimated CSMFs for AIDS and TB/AIDS deaths over the years and explored trends. Assigning causes of death through physician review has its own shortcomings including costliness [5-8]. The physician review of VAs and the procedures followed have been described in detail elsewhere. Algorithms such as the InterVA model have been developed to handle cause of death ascertaining in a relatively cost effective manner in terms of skilled human

power and time. The InterVA model is a Bayesian probability model that uses a set of 106 indicators to assign up to three likely causes of death with their associated probabilities. The model has been validated to estimate AIDS and TB/AIDS specific mortality fractions against an external data set containing hospital records and serostatus of decedents giving a reasonable estimate of sensitivity and specificity. We also considered the likelihood cut off points that provides the optimum sensitivity and specificity values [9]. Based on the assigned causes of death we also estimated regression model using AIDS death as the outcome variable and to discuss the effects of explanatory variables. We have merged TB and AIDS together because most of their signs and symptoms are similar and distinguishing between them may be difficult through InterVA

Results

Age ratio analysis

A total of 158,115 persons were buried between 2001 and 2008. As the surveillance program was launched in February 8 of 2001, data for the year missed five weeks of records which can be estimated through a simple linear assumption (~2100 records). Absolute figure on reported deaths exhibited a decline from the peak years of 2001 and 2002 to 2008 except the slight increase it showed in 2005 after which the decline was significant. In terms of absolute figures, for all years male mortality is higher than female mortality. The sex composition of registered burials shows that 53 percent were male decedents versus 47 percent females. Similarly, the average age at death was 40.5 years. Considering adult deaths separately this figure rose to 48.3 years. Average age at death has increased from 45.7 years in 2001 to 53.1 in 2008. Though it is difficult to ascertain causes of death from lay reports obtained from burial surveillance the proportion of AIDS related death declines as of 2006. A similar comparison of lay reports against marital status reveals that AIDS death is higher among the widowed followed by divorced or separated. The graph below shows the trend in the proportion of adult deaths age 25-49 relative to all deaths in Addis Ababa over the years for both sexes and separately.

Proportion of deaths age 25-49 by sex and year
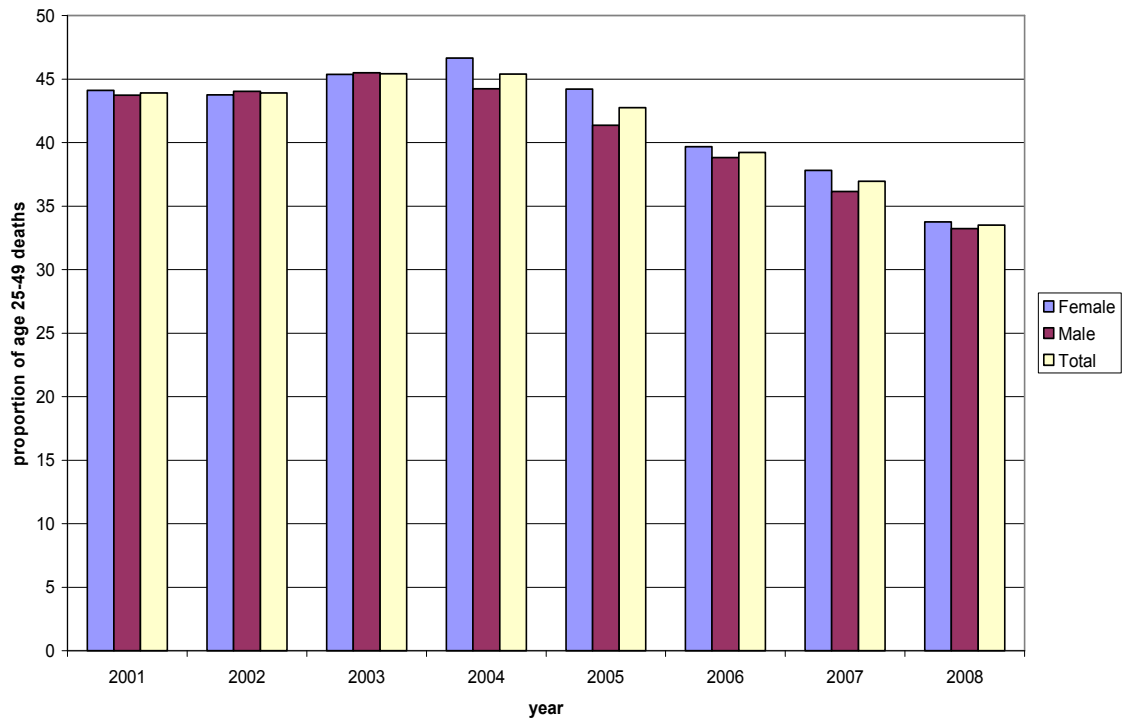
As seen in the figure above the proportion of deaths age 25-49 has been increasing between 2001 and 2004 before it began exhibiting a reverse tend from 2005 onwards. This proportion declined from 44 % in 2001 to 33% in 2008. The proportion of female deaths is higher compared to male deaths especially after 2005 the time when the government scaled up its ART provision.

Turning to the ratio of deaths age 25-49 vs 5-14 the graph below portrays a declining trend from 2001 to 2008 although the pattern is somehow less smooth in the years between. Despite that the magnitude of the ratios is still high for females, the rate of change over the years is showing a relatively faster decline (-1.10 for females vs -0.65 for males).

Ratio of deaths (ages 25-49 vs 5-14 years) by sex & year, Addis Ababa, 2001-2008
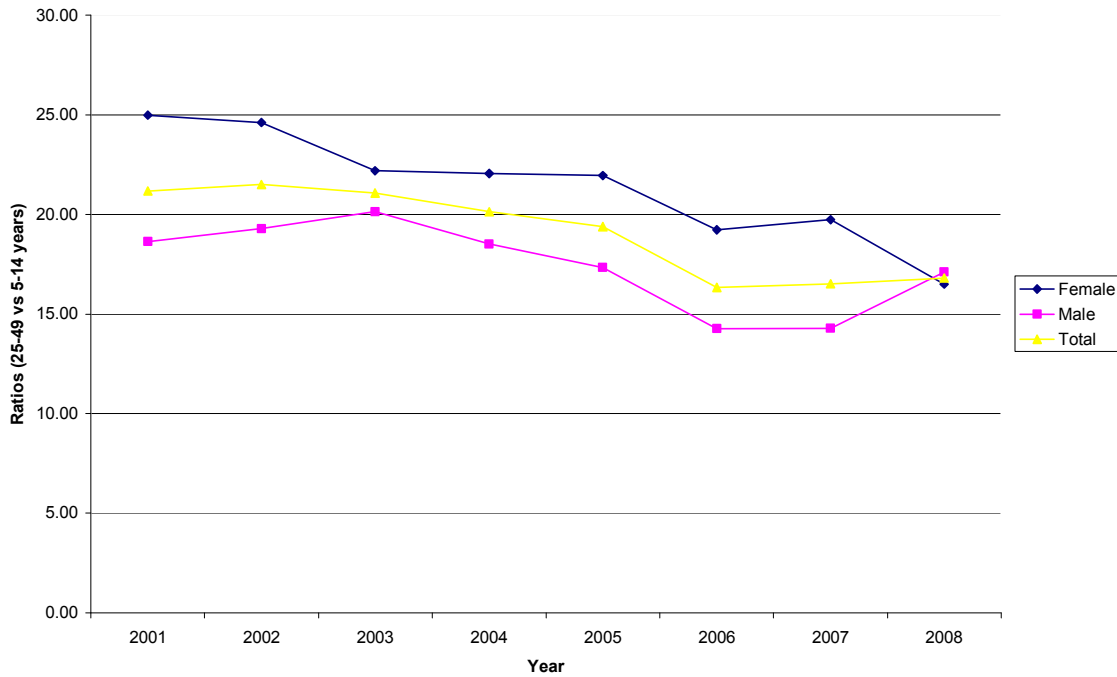

Verbal Autopsy

A total of 2247 VAs are reviewed by physicians. While assigning causes of death, it was observed that the first two physicians has assigned similar causes for 80% of cases, in recent years while close to 86% consistencies are observed with the third physician. The sex composition of completed VAs shows equal proportion for males and females. This seems contradictory to the sex composition that we stated earlier from the burial surveillance. However, this is due to the exclusion criteria that we set for the *Baytewar* cemetery. Among registered burials in this particular cemetery nearly 40% of cases had missing values for sex. These cases have been excluded from our analysis. Of the remaining cases 17.3% were females and 43.1% were males. The mean age at death is 51 years with values of 47 and 54 years in 2001 and 2007 respectively indicating a parallel increment with the burial surveillance data. All completed VAs (n=2522) since year 2003/2004 were fitted in to the InterVA model setting the prevalence of HIV and malaria as high and low, respectively. For few cases (2.5%) causes of death is indeterminate using the InterVA model. The mean likelihood of the most likely and second likely causes of death are 81% and 33%, respectively. On average 1.3% of the records have a third likely cause of death with a mean likelihood of 20%.

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In all the observation years HIV/AIDS related death is the major cause of death using physician review and InterVA, as well. The proportion of AIDS related death among females (36.3%) higher than males (28.9%). Similarly, TB/AIDS death accounts for 33.3% and 39.2% for males and females, respectively. High proportion of AIDS specific death (62.2%) is observed in the age category 30-39. The InterVA model also reveals the same trend but more steady than physician review for the recent years. The mean likelihood of AIDS specific death is 79.2% while there is a slight decline for the TB/AIDS classification (78.7%). In general there is an overall decline in AIDS specific death with significant decline since year 2003/2004 (see fig 2 and fig 3).

Fig 2 Trend in AIDS specific mortality fraction

Fig 3 Trend in AIDS specific mortality fraction by age
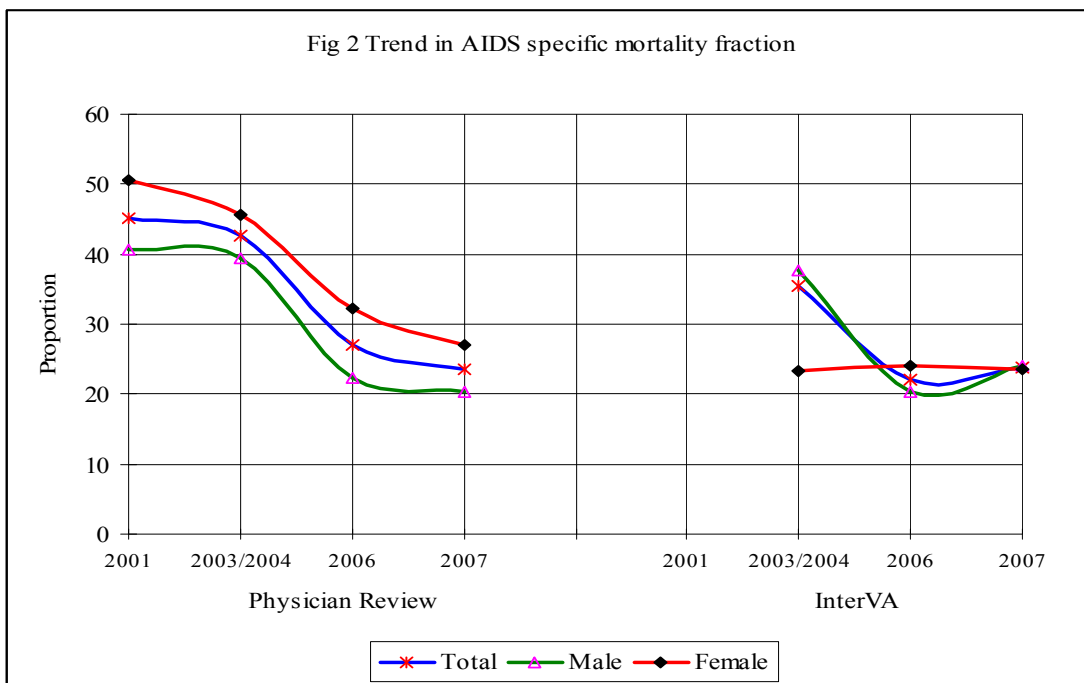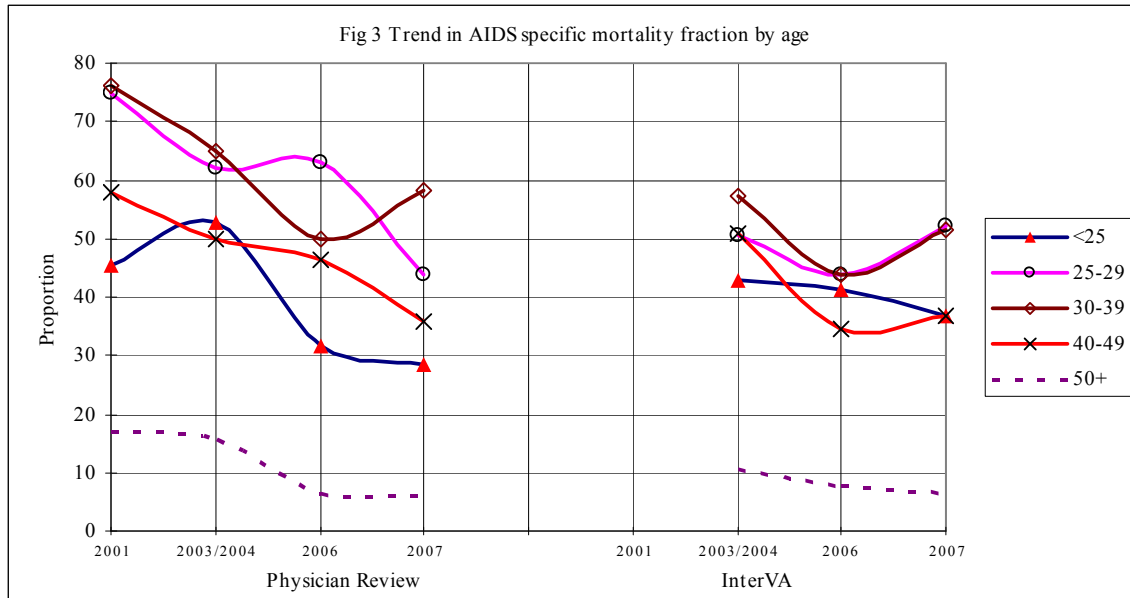
Based on the cause specific mortality fractions obtained through physician review and the InterVA model we also fitted logistic regression models in order to asses whether AIDS deaths have declined over the years and also see differentials by sex, education and age. We report only explanatory variables that are significant at P=0.05. The odd of dying due to HIV is higher among female (OR=1.43, 95%-CI: 1.16-1.78). Compared to the year 2001, which is our reference year, AIDS related deaths have declined by 42, 64, and 70 percent in 2003/04, 2006 and 2007 respectively. In terms of age, those age 25-29 (OR=2.0, 95%-CI: 1.3-3.1) and 30-39 (OR=2.5, 95%-CI: 1.7-3.7) are more likely to die of AIDS than those age less than 25. However, those age 50 and above have a lesser risk of dying due to AIDS (OR=0.2, 95%-CI: 0.1-0.3). Though not statistically significant those educated are more likely to die of AIDS than those who did not attend school.

Findings of the logistic regression using based on outputs from the InterVA model reveals similar trend. Since the reference year for the model is 2003/4 we did not observe a rapid decline like the physician review. Significant decline of AIDS death is observed for the last year of observation 2007 (OR=0.70, 95% CI: 0.57-0.86). A high proportion of AIDS death is observed for the 30-39 age group (OR=1.76, 95% CI: 1.23 -2.5). A similar decline is observed for the second classification TB/AIDS. Sex differential is significant when TB and AIDS are merged. Unlike physician review, AIDS specific death among females is lower than males (OR=0.72, 95% CI: 0.59-0.87).

Conclusion

This study examined whether AIDS mortality in Addis Ababa has declined between 2001 and 2008, and whether any decline varies by gender, age and educational status. The results revealed that AIDS deaths have declined in Addis Ababa since 2001, especially after 2003/2004. Anti-retroviral treatment was started in 2003 as fee based, in March 2005 for free for the poor who can produce poverty certificate from the local administration and later on (August 2005) for all who need it. The impact of anti-retroviral therapy on AIDS mortality in Addis Ababa is very marked. Although there is an overall decline in adult mortality in the city, women remain to have a comparatively higher mortality ratio than men. Nevertheless, differences observed by gender and age groups may be due to previous differences in exposure to the epidemic or different levels of access to the treatment offered by the public health system. Further analysis is necessary to assess the role of more explanatory factors. Considering the period that Anti-retroviral treatment introduced in the city, the study captures the role of ART in averting AIDS related deaths. Moreover, it highlights the importance of synthesizing data from verbal autopsy to provide a more complete picture of trend in AIDS related mortality.

Ethics

Data for this study have been collected with ethical clearance from the Addis Ababa University Faculty of Medicine (Faculty Research and Publications Committee), the Ethiopian Science and Technology Agency, the Institutional Review Boards of the University of Pennsylvania and the Centers for Disease Control and Prevention, the Research Ethics Review Committee of the WHO, and the Human Research Committee of the University of Colorado at Boulder.

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