Mortality Risk Information, Survival Expectations and Sexual Behaviors

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Abstract

Individuals in low-income settings are often overly pessimistic about their own survival, suggesting that better knowledge about survival risks might encourage investments in health. This paper provides evidence from a randomized experiment that provided mature adults aged 45+ in Malawi with information about mortality risks. Treated individuals are less likely to engage in risky sexual practices one year after the intervention, and they increase other forward-looking behaviors such as investments in agriculture. Expectations of HIV+ people living longer, which makes the pool of potential partners riskier, are a primary driver of reduced sexual risk taking in response to the intervention.

Keywords: subjective mortality expectations, HIV/AIDS, sexual behavior, lifecycle decision-making

JEL Codes: I12, J10, C8

1 Introduction

Despite the centrality of mortality expectations for health decision-making across the adult life-course, there is evidence that currently many individuals in low income countries (LICs) are overly pessimistic about their own survival. For example, mature adults aged 45+ years in the Malawi Longitudinal Study of Families and Health (MLSFH) report average subjective 5-year survival probabilities of 46–58% in the years from 2006 to 2018, compared to 83–87% suggested by current life-tables. Similar patterns of pessimistic survival expectations have been documented as part of an emerging literature in India and the Philippines, among migrants in Nepal, and in some higher-income contexts (Bago d'Uva, O'Donnell and van Doorslaer 2017; Capuno et al. 2019; Delavande and Kohler 2009; Delavande, Lee and Menon 2017; Maffioli and Mohanan 2018; Shrestha 2019).

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Theory predicts that improvements in life expectancies encourage human capital investments as individuals can reap the returns for a longer period (e.g., Becker 1993; Ben-Porath 1967). Because investments in health become an increasingly important form of human capital accumulation at older ages, the overly-pessimistic subjective assessments of survival documented in LICs therefore suggest a provocative question for health policy: Could policies achieve longer, healthier and "better" lives by simply correcting overly-pessimistic expectations about survival? In other words, is there a *benefit of knowledge* in terms of health and related life-cycle behaviors for accurately knowing mortality risks?

In this paper, we investigate this question by analyzing the impact of a randomized information intervention about population-level mortality on individuals' health investment, with a particular focus on risky sex in sub-Saharan Africa (SSA). Crucially, we have very detailed information on individuals' subjective expectations about their survival and other important health events, which allows us to study the mechanism through which the intervention influences decision-making. Existing evidence suggests that the benefits of accurate knowledge about mortality risks might be important. For example, several studies have documented that actual gains in life expectancy translate in more investments in schooling and health (Fortson 2011; Jayachandran and Lleras-Muney 2009; Oster, Shoulson and Dorsey 2013). Simulation results from Malawi have shown that an information campaign leading individuals to have accurate mortality risk perception would decrease risky sexual behavior on average, whereas accurate beliefs about HIV transmission risks (which are often overestimated) would actually increase risky sex (Delavande and Kohler 2016). MLSFH analyses have also shown that the ART roll-out in Malawi reduced perceived mortality risks, mental health and important life-cycle behaviors in the general population (Baranov and Kohler 2018; Baranov, Bennett and Kohler 2015).

Prior to this study, no population-based randomized controlled trials (RCTs) have directly evaluated hypotheses about the health and life-cycle benefits of more accurate mortality expectations. To fill this niche, we designed a *Benefits-of-Knowledge health-information intervention* ("BenKnow Intervention") that consisted of two components: First, respondents watched three videos delivering the narrative that people nowadays live longer in Malawi with an explanation for these gains (e.g., better access to health care, availability of antiretroviral treatment (ART), fewer food shortages). Second, they received visual statistical information about the survival chances of individuals of the same age and gender.

Our BenKnow intervention targets mature adults aged 45 and older in rural Malawi. The intervention and baseline data collection was implemented in 2017, and follow-up data were collected in 2018. At least three aspects make mature adults a relevant study population for the BenKnow health-information intervention: First, mature adults in HIV-affected SSA countries such as Malawi have survived through periods with significant mortality fluctuations during adult ages, making it particularly difficult for individuals to make inference about their own mortality risks. Second, mature adults contribute importantly the spread of HIV because they continue to be sexually active and often have

younger (extramarital) partners and/or risky sexual behaviors (Dana, Adinew and Sisay 2019; Dupas 2011*a*). Third, the number of mature adults in Africa is projected to more than triple between 2015 and 2050 (UN Population Division 2017), and it is critical to develop health and social policies targeted at enhancing the health and well-being of this growing subpopulation.

Our key policy-relevant finding is that the BenKnow health-information intervention resulted in statistically significant changes in a critical health behavior: *sexual risk taking*. Treated mature adults are less likely to engage in risky sexual practices one year after the intervention compared to the control group. The magnitude of the effect is substantively important. For example, the predicted probability of having multiple partners without condom is 7.6% in the control group and 6.4% in the treatment group, corresponding to a 19% reduction in the riskiest behavior in terms of HIV transmission. Similarly, the predicted probability of abstinence in the last 12 months is 33.3% in the control group and 36.1% in the treatment group, i.e., a 8% increase in the safest behavior. The results are robust to alternative specifications allowing for misreporting of sexual behavior. We also document a reduction in pregnancies and births, two outcomes not affected by misreporting of sexual behaviors, in the treatment villages subsequent to the BenKnow intervention.

The BenKnow intervention also changed several life-cycle behaviors. Individuals in the treatment villages are more likely to be married at follow-up, which is due to a 6 percentage point increase (or 8% relative increase) in the probability of getting married for respondents who are not married at baseline. Within one year of baseline, our analyses also find BenKnow treatment effects on several other life-cycle behaviors, including increased investments in agricultural inputs (tools, seeds and fertilizers) as well as livestock (in particular, small livestock for which adjustment in the short term is easier for households with limited liquidity/savings). We do not find treatment effects on subjective well-being or mental health (including depression), indicating that the information provided in the BenKnow intervention, and the behavioral responses to the intervention such as the reductions in sexual activity, did not negatively affect well-being or mental health.

The obvious interpretation of these results within an economic life-cycle framework would be that providing accurate information on mortality risks encourages health investments by debiasing too pessimistic own survival prospects. Unique MLSFH data on subjective expectations (Delavande 2014; Delavande, Gine and McKenzie 2011),[1] allow us to document a different and more complex mechanism through which the BenKnow intervention impacted sexual and other life-cycle behaviors. Our analyses document a positive

[1]Reviews of the literature on eliciting subjective expectations in developing countries ascertain that respondents provide meaningful expectations in probabilistic formats (often with visual aids, such as those developed for the MLSFH). Response rates are typically very high; the vast majority of respondents respect basic properties of probabilities; expectations vary with characteristics in the same way, at least qualitatively, as actual outcomes vary with those characteristics; past outcomes experienced by individuals are correlated with expectations about future outcomes; and the elicited expectations influence behavior in various domains including health, education, agricultural production and migration.

treatment effect of the intervention on expectations about population survival one year after the intervention: there is a 6.1% increase in the subjective probability that a healthy individual will survive in five years, given a baseline survival expectations of 70%. The magnitude of the effect is similar when looking at the survival expectations for hypothetical individuals who are HIV+ (6.6%), and individuals who are sick with AIDS but on ART (6.1%). We do not find treatment effects on the survival expectations for hypothetical individuals who are sick with AIDS and do not receive ART, which is consistent with the BenKnow intervention materials (specifically the videos) highlighting the importance of ART in improving life expectancy in Malawi.[2]

Importantly, and contrary to our priors, the BenKnow intervention did *not* change *own* survival expectations, neither in the short-run (2 weeks after the intervention) in which no compensating behaviors driven by the new information could have occurred, nor in the long-run (one year after the intervention). This null result holds even if we exclude respondents with accurate baseline expectations, or those for whom own survival expectations are different from their population survival expectations (and for whom the information may therefore be irrelevant to own survival). While we cannot rule out all alternative mechanisms, our analyses suggest that the updating of population-level survival expectations without updating of own survival expectations is explained by individuals having more private information about their own survival than about the survival of others, making expectations about own survival much less responsive to new information.

Given that BenKnow primarily resulted in updates of respondents' population-level survival perceptions, but not their own survival perceptions, an important question arises: *Why did treated individuals change their health, marriage and other life-cycle behaviors subsequent to the BenKnow intervention?* We find that the BenKnow intervention induced individuals to believe that HIV+ people live longer. This would lead mature adults in the treatment group to (accurately) infer that the pool of available partners is likely to become riskier because HIV prevalence among potential partners is bound to rise. Our analyses thus suggest that the behavioral changes subsequent to BenKnow are driven by the externalities of other people living longer. Consistent with this explanation, there is also a positive effect of the BenKnow intervention on the subjective probability of contracting HIV conditional on having multiple sex partners. There is no corresponding treatment effect on the subjective beliefs about the "technology" of HIV transmission, that is, risks of HIV infection conditional on behaviors and partner HIV status. Hence, the increase in the perceived transmission risk associated with multiple partners is driven by an increase in the perceived HIV prevalence of potential partners. The positive BenKnow treatment effect on marriage may be similarly driven by the increase in transmission risk associated with risky sex, especially if marriage is perceived by individuals as a risk-reduction strategy (as is likely the case). More generally, in a context where gains from marriage are sub-

[2]This finding is also important because it indicates that individuals were able to understand, process and memorize the information we provided during the health-information intervention.

stantial and marriage is positively associated with well-being and mental health (Chae 2016; Myroniuk, Kohler and Kohler 2020), the increased expectations of population-level survival—and thus potential marriage partners—provides an additional explanation of the rise in marriage in response to the BenKnow intervention. Our data are more limited in identifying the mechanisms of other changes in lifecycle behaviors in response to the intervention, and we conjecture that the positive treatment effects on the agricultural investments are driven by an increase in the perceived survival of other household members who may benefit from these investments for a longer period.

Our analyses hence suggest that expectations of mortality risks, and specifically too pessimistic assessments of survival, are a possibly important and modifiable determinant of health and related life-cycle behaviors. Such pessimistic assessments of survival are likely to occur in populations with rapid improvements in mortality. In contemporary high HIV-prevalence contexts such as Malawi, for example, a BenKnow health-information intervention that reduces misperceptions about mortality risks is a potentially useful policy tool to curtail HIV infection by causing individuals to adopt less risky sexual behaviors and form long-term partnerships (marriage). Interventions such as BenKnow potentially also encourage other forward-looking behaviors such as investments in agricultural inputs or livestock. These findings have potentially widespread relevance. Despite the long-term trends towards longer lives globally, adult mortality and life-expectancy in low- and middle-income countries (LMICs) often changes rapidly. In Malawi, for example, life expectancy increased to 49.7 years in the period prior 1986, it declined to 44.5 in 2000 (-5.2 years or -10%) as a result of the HIV/AIDS epidemic. The trend then reversed, importantly as a result of the expansion of antiretroviral treatments, and life-expectancy increased to 63.2 in 2017 (Bor et al. 2013; GBD Collaborators 2018). While possibly not as dramatic as in countries affected by HIV/AIDS, social, political and economic crises have also resulted in substantial increases in adult mortality rates, and subsequent rapid recoveries of life expectancy (Brainerd and Cutler 2005; Ruhm 2016). Moreover, providing information about changing mortality and survival risks should possibly be an important component of large-scale health interventions or policy changes, as in the absence of accurate survival expectations, individuals' responses to such interventions might be inefficient, thereby reducing the long-term health and well-being gains that might arise from them.

Our paper contributes to a growing literature on the role of information provision on health behavior and human-capital decisions in low income countries (for reviews, see Dupas and Miguel 2017; Dupas 2011*b*). This literature is motivated by the fact that beliefs and misconceptions are important determinants of health behavior (Banerjee and Duflo 2011; Kremer, Rao and Schilbach 2019). For example, recent studies have shown that: providing information on the relative risk of HIV infection by partner's age leads to decreases in unprotected sex and pregnancies among teenagers (Dupas 2011*a*), information about HIV status influences subsequent sexual behavior and marriage transitions (Delavande and Kohler 2012; De Paula, Shapira and Todd 2014; Fedor, Kohler and Behrman

2015; Thornton 2008, 2012), information about the true risk of HIV transmission slightly increases average sexual activity while sharply decreasing it for people with the highest risk beliefs (Kerwin 2018), and circumcision uptake is affected by information about the reductions in HIV risk resulting from male circumcision (Chinkhumba, Godlonton and Thornton 2014; Godlonton, Munthali and Thornton 2016). Information about children's ability and the returns to schooling has been shown to affect human capital investments (Dizon-Ross 2019; Jensen 2010).

Our analyses add to this literature several novel dimensions. First, we focus on a new informational content, accurate life-table information on individual's survival chances. Second, we provide evidence on *how* this information affects subjective survival expectations, and in turn, lifecycle behaviors. Beliefs are rarely measured in studies investigating the role of information on health behaviors (Kremer, Rao and Schilbach 2019). In our context, the BenKnow treatment effects on sexual behaviors appear driven by the upward revisions of the HIV transmission risk associated with risky sex, which is an aspect that the BenKnow intervention did not set out to modify directly. Our results thus underscore the usefulness of such expectations data to better understand why programs fail or succeed, and that the mechanisms underlying treatment effects might be different from those initially envisioned. Third, our findings indicate that the elasticities of beliefs may heavily depend on the extent of private information. These insights are important as they allow to adjust and modify interventions in subsequent scale-ups and follow-up studies to enhance their effectiveness.

This paper also belongs to a recent literature studying how subjective expectations are updated in response to new information. This research is often conducted with surveys that elicit priors and posteriors about outcomes such as fertility, future earnings, inflation or housing (Armantier et al. 2016; Armona, Fuster and Zafar 2018; Delavande 2008; Wiswall and Zafar 2014). The advantage of our design is that we are able to observe the revised expectations one year after the provision of information—a time lag substantially larger than other studies—and to link the change in expectations to real-life behavior, as opposed to stated behavior or behavior in incentivized lab-style experiments. Our results call for encouragement and caution: individuals in low income settings use the information we provided to make important lifecycle decisions, but not all expectations are equally malleable. Our paper builds upon a growing literature relying on expectations data to better understand investment in education and health (Attanasio and Kaufmann 2014; Delavande and Zafar 2019; Fang et al. 2007), risky sexual behaviors (Delavande and Kohler 2016), and other life-cycle behaviors such as retirement, consumption and bequest of older adults (Gan et al. 2015; Khan, Rutledge and Wu 2014).

2 Context and Motivation

Malawi's Human Development Index for 2018 is 0.485, placing Malawi at rank 172 out of 189 countries and territories, and its per-capita GDP is equal to about 2% of the global average. In rural areas, where our study is based and most Malawians (85%) live, the majority of individuals engage in home production of crops, complemented by some market activities. Life expectancy at birth was 59.6 for men and 66.9 for women in 2017, and healthy life expectancy at birth is estimated to be 52.4 years for males and 57.8 years for females (GBD Collaborators 2018). HIV prevalence among 14–49 year olds in 2018 is estimated at 10.4% (women: 12.2%; men: 8.3%) (Malawi DHS 2017).[3] HIV incidence is estimated to have peaked in the mid-1990s, and HIV incidence among adults aged 15–49 is estimated at 4.4 per 1,000 in 2018. Despite the successes in reducing HIV incidence, the HIV epidemic had, and continues to have, major effects on virtually all aspects of life, many of which were documented by the MLSFH (Kohler et al. 2015). Importantly, access to antiretroviral treatment (ART) in Malawi expanded during the past decade, attaining a 79% coverage among adults in 2018, resulting in significant reductions in adult mortality.[4]

While reductions in multiple diseases have contributed to declining infant mortality and increasing adult life expectancy (GBD Collaborators 2018), it is the widespread rollout of ART that is widely credited with reversing the decline of adult survival rates during the last decade (Bor et al. 2013).[5] During this rise, peak and subsequent decline of mortality during the HIV/AIDS epidemic, objective survival probabilities for adults changed immensely (Figure 1A): 35-year old males attained a 5-year survival probability of 95% around 1985, which dropped below 86% in 2002, having recovered to 96% by 2017.

In contrast to the recent trends that have given rise to a cautiously-optimistic outlook about curtailing the consequences of the HIV/AIDS epidemic (UNAIDS 2015), there is consistent evidence that mature adults in Malawi have distorted and overly-pessimistic survival expectations: they substantially *underestimate* their own survival probabilities (Figure 1B). This aspect is well-documented in several MLSFH studies (Baranov, Bennett and Kohler 2015; Delavande and Kohler 2009, 2016), and has also been documented in other low/middle-income study populations (Capuno et al. 2019; Delavande, Lee and Menon 2017; Maffioli and Mohanan 2018). This survival pessimism is consistent with a shortfall of 7.3 years between respondents' expected and desired age at death (9.6 years at ages 45–54), and with overestimates of salient health risks such as HIV prevalence and HIV transmission probabilities (Delavande and Kohler 2012; De Paula, Shapira and Todd 2014;

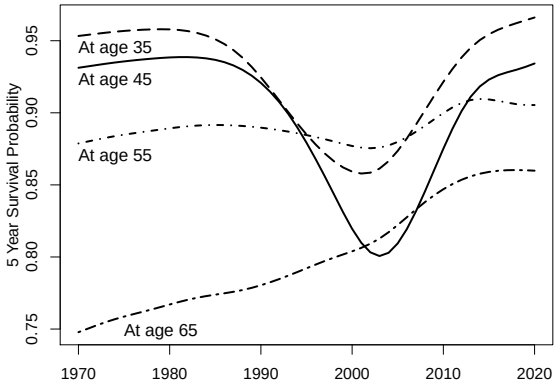
[3]HIV prevalence is lower in rural areas (7.4%), where the MLSFH study population is based, as compared to urban areas (14.6%) (Malawi DHS 2017).

[4]UNAIDS AIDSinfo Database, https://aidsinfo.unaids.org, accessed January 2020.

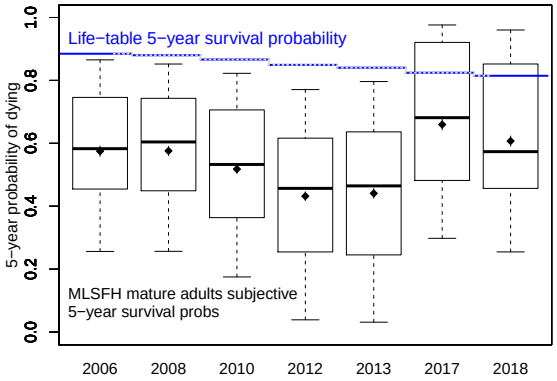
[5]For example, studies from the nearby Karonga surveillance site in North Malawi documented 42% declines in adult mortality rates (ages 15–59) subsequent to the introduction of ART (Jahn et al. 2008). Post-ART mortality declines of similar magnitudes have also occurred among the household and family members of MLSFH respondents (Payne and Kohler 2017).

Figure 1: 5-year survival probabilities 1970–2020 (Malawi), and subjective prob. of surviving 5 years for MLSFH mature adults

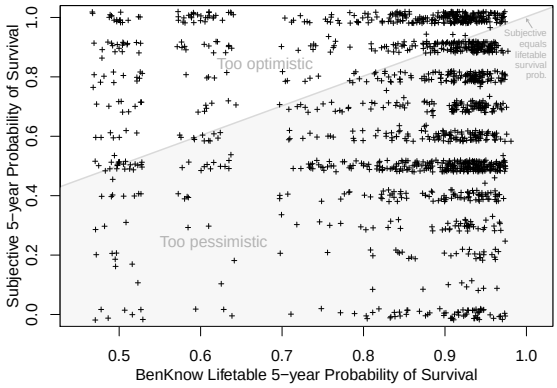
(A) 5-year survival probabilities (men, Malawi)



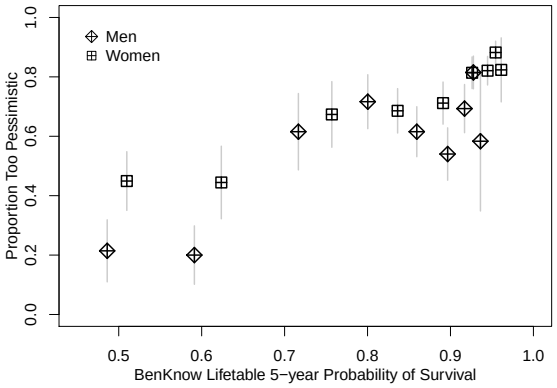
(B) MLSFH Subj. 5-year survival probabilities



(C) Subjective vs. life table survival probabilities, 2017 MLSFH mature adults



(D) Proportion 2017 MLSFH mature adults too pessimistic



Panel A: Based on 2017 UN Word Population Prospects (UN Population Division 2017). *Panel B:* For MLSFH mature adults (aged 45+) who participated in the 2012/13 and 2017/18 MLSFH mature adults data collection. The boxplot-like graph displays the mean (dot) and median (center line) of the corresponding 5-year survival expectations, as well as the 10th (lower whisker), 25th (bottom of box), 75th (top of box), and 90th (upper whisker) percentiles of the distribution. Life-table survival probabilities are merged by age and gender from the UN Malawi 2005–15 life tables (UN Population Division 2017). *Panel C:* 2017 Subjective 5-year survival probabilities vs. BenKnow (life-table based) 5-year survival probabilities (jitter added to separate markers): dots below the gray line indicate that respondents are too pessimistic regarding their survival (subj. survival $<$ life-table survival probability). *Panel D:* Proportion of 2017 MLSFH mature adults who are too pessimistic regarding their survival (with 90% confidence intervals) as a function of BenKnow (life-table based) 5-year survival probabilities. In Panels C+D, younger mature adults tend to be towards the right (relatively high survival probabilities), while older mature adults are towards the left (relatively low survival probabilities).

Kerwin 2018; Sterck 2014; Thornton 2012).[6]

[6]For instance, in 2008–10, when the MLSFH last asked the respective questions, the 2017 MLSFH mature adult reported a 63% HIV infection risk during a single intercourse without condom with a HIV+ person, as compared to an accurate average risk of less than .5% (Boily et al. 2009); MLSFH mature adults also reported a 77% annual probability of becoming infected when married to a HIV+ spouse, as compared an accurate risk of about 12% (de Walque 2007), a rate that is consistent with a large fraction of married couples in sub-Saharan Africa being HIV-discordant (conditional on having at least one HIV+ spouse) (de Walque 2007) (Kerwin 2018; Sterck 2014, for related analyses of overestimated HIV risks, see). MLSFH mature adults in 2010 also estimated an average local HIV prevalence in their communities of 37%, as compared to a prevalence among all MLSFH

Until about 2013, while adult survival was improving significantly, MLSFH mature adults became increasingly pessimistic about their survival (Figure 1B), much more than is justified due to the respondents' own aging. This trend was partially reversed in 2017 (our baseline year), possibly as a result of favorable rains and an exceptionally good harvest, reverting again to more pessimistic assessments by 2018. Despite these year-to-year fluctuations and the significant variation across individuals (Figure 1B), the basic implication has remained unchanged: the vast majority of our mature adult study participants underestimate their own survival, with pessimism being least pronounced (70%) in 2017 when our baseline was implemented. Pessimism about survival is particularly widespread at younger mature adult ages, when life-table probabilities of survival are relatively high and where most of our sample is concentrated (Figures 1C+D), and underestimation of survival becomes less common at older ages where objective survival probabilities are lower.[7]

The challenges faced by individuals to accurately perceive mortality decline are well recognized (Montgomery 2000), and these difficulties are exacerbated for mature adults who have witnessed the "roller-coaster" of adult mortality during the rise, peak and decline of the HIV/AIDS epidemic (Figure 1A). Mortality and death was a salient and frequent encounter during this period. For example, between 2010–18, about 12% of respondents in the MLSFH mature adult cohorts have died, compared to 2.7% during 2010–19 for MLSFH respondents in younger cohorts. MLSFH mature adults in 2017 have attended on average 2.6 funerals in the last month, with 12% having attended five or more funerals, as compared to 3.5 funerals in the last month during 2008–10 (with 25% attending five or more funerals). 72% report to know at least one person whom they suspect to have died of AIDS, and on average they report 2.7 individuals who they suspect have died of AIDS; 27% report a death of least one child, parent or spouse during the last five years, and 35% report losing income and/or assets in the last two years due to the death or serious illness of an adult family member or someone who provides support.

This frequent experience of poverty-related and HIV/AIDS-related mortality and socioeconomic shocks during the last two decades is likely the driving factor behind the elevated mortality expectations in our study population, and the resulting pessimism about own and population-level survival rates (Figure 1 and Table C.2). Contributing to mor-

respondents of about 6% (Kohler et al. 2015) and a DHS-estimate for adults 15–49 in rural Malawi of 8.9% (Malawi DHS 2011); mature adults also expected in 2010 a continued substantial increase in HIV prevalence within the next five years, which did not materialize as rural HIV prevalence remained approximately constant during 2010–16 (Malawi DHS 2017). *Note:* In all MLSFH analyses for 2008–10, observations are taken from 2010, and if not available, from 2008; analyses included MLSFH mature adults who participated in the 2017 baseline survey for this study.

[7]The 2018 MLSFH-MAC survey also includes data on expected age at death ("How long do you expect to live?"). We find that 5-year and 10-year subjective expectations about survival are strong predictors of the expected age at death, and expected remaining life years (Table C.1), calculated as the difference between expected age at death minus current age. Respondents reporting higher chances of survival also report older expected ages at death and more remaining life years. For instance, a 10-percentage point decrease in survival probability is associated with .6 fewer years of life expectancy.

tality misperceptions potentially are also common cognitive biases such as denominator neglect or salience biases, often documented among health-care professionals, where individuals fail to accurately relate events (such as deaths) to exposures (denominator counts or person years lived) (Reyna and Brainerd 2008; Tversky and Kahneman 1973)

3 Background: Mature Adults, Sexual Risk-taking and the HIV-AIDS Epidemic

Our study focuses on mature adults aged 45 and older for several reasons. *First*, mature adults are an essential subpopulation in SSA LICs because of their growing demographic relevance (UN Population Division 2017), their almost universal labor force participation with virtually no retirement (Malawi National Statistical Office 2010), and their important contributions to intergenerational transfers and their pivotal caretaking roles in families affected by HIV/AIDS (Payne, Pesando and Kohler 2019).

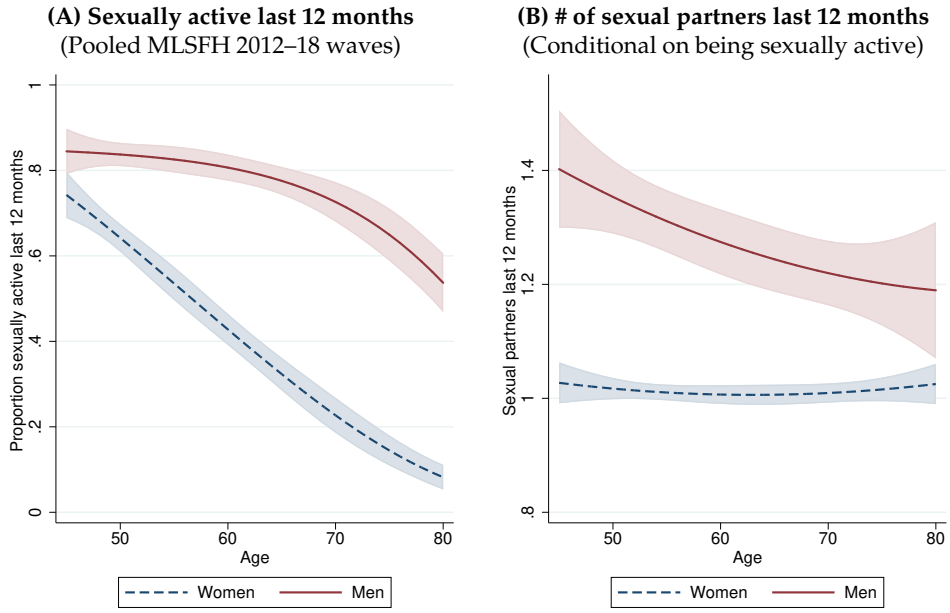
Second, the (actual) mortality risks in contexts such as Malawi continue to be relatively high at mature adult ages (Figure 1).[8] As a result, survival expectations are arguably important for life-course decision-making and well-being. Cohorts who have lived through the rise and peak of the HIV epidemic are likely cognizant of the importance of mortality risks for a broad range of life-cycle decisions, including investments in agriculture or children's human capital.

Third, and most important for this study, mature adults continue to be sexually active (Figure 2), engage in risky sexual behaviors (Freeman and Anglewicz 2012), and contribute importantly to the spread of HIV across all age groups (Vollmer et al. 2017). Only 36% of the MLSFH mature adults did *not* have sex in the last 12 months, and only 57% had sex with their spouse only. Marriage and divorce/widowhood among mature adults are common, and remarriage is often swift (Reniers 2003). In 2017, 8% of MLSFH mature adults tested HIV-positive, corresponding to an increase of 40% since 2012 that is driven by respondents aged 45-49 years: 11.8% tested HIV+ in that age group in 2017, as compared to 6.9% in 2012, and it is these "young" mature adults—who likely benefited more from the roll-out of ART and the resulting mortality reductions for HIV+ individuals—that are elevating the HIV prevalence in the MLSFH mature adults cohort.[9] Despite this HIV increasing prevalence, condom use is rare: only 2% of MLSFH mature adults used condom at last intercourse when having sex with multiple partners during the last 12 months, and

[8] In addition to HIV/AIDS-related mortality and age-related increases in mortality, heightened among mature adults due to limited ART uptake, relatively poor physical and mental health among mature adults (Kohler et al. 2017; Payne, Mkandawire and Kohler 2013), and a rising burden of NCDs (GBD Collaborators 2018), are contributing to high levels of morbidity and mortality at mature adult ages in rural Malawi.

[9] Similar patterns occur more broadly across SSA. For example, using data from 27 SSA countries, Vollmer et al. (2017) find an average annual growth rate of HIV prevalence of 4.2 percent for older adults, while HIV prevalence is decreasing at a rate of 3.5 percent for adults aged below 45 years. These dynamics are changing the 'hump-shaped' age pattern of HIV prevalence with peak HIV prevalence for "young" mature adults around age 45–50.

Figure 2: Sexual behaviors and sexual risk taking among MLSFH mature adults



Notes: Marginal means (with 95% confidence intervals) obtained by regressing the outcome variables, sexual active in last 12 months (Panel A) and number of sexual partners in last 12 months (Panel B) on a quadratic function of age, separately by sex. Analyses are pooled across the 2012, 2013, 2017 and 2018 MLSFH mature adults surveys.

there was essentially no condom use among those with a single sexual partner (= most often spouse). Compared to younger persons, mature adults are also less likely to adopt safe sexual behaviors, discuss HIV prevention with partners, or disclose a HIV-positive status within relationships (Freeman and Anglewicz 2012). Age-related physiological changes also heighten the risk of HIV transmission (Durvasula 2014), and a substantial fraction of older men ("sugar daddies") engages in sex with younger women (Dupas 2011*a*).

Fourth, the HIV risk associated with risky sexual behaviors of mature adults is further exacerbated by the fact that HIV+ mature adults are disadvantaged in terms of accessing ART. This is due to several factors. Most HIV testing campaigns, which provide a primary gateway to treatment for HIV+ individuals, focus on primary reproductive ages, and in rural Malawi, routine HIV testing of women and their partners is primarily conducted as part of pre-natal care. These programs therefore miss mature adults who are at the end of, or have completed, childbearing. As a result, only 60% of the 2012 and 82% of the 2017 HIV+ MLSFH mature adults are on antiretroviral treatment. 43% of the 2017 HIV+ mature adults have been on treatment for 4 years or less, consistent with an only relatively recent comprehensive expansion of ART to mature adults, and only 3 of the five newly-infected mature adults during 2012–17 receive treatment in 2017. On the one hand, this limited ART uptake and/or inadequate adherence contributes to mortality, as is indicted by the fact that HIV prevalence was significantly higher among MLSFH mature adults who died during 2012–17 than among those who survived (7.2% vs. 4.5%); on the other hand, and

important for our subsequent interpretation of our results, the imperfect ART uptake and adherence implies that HIV+ mature adults are often not virally suppressed. They remain sources of HIV infection to their partners, and as the HIV prevalence among mature adults increases due to increased survival of HIV+ adults, the sexual partners of mature adults face increased HIV risk.

Fifth, because antiretroviral treatment (ART) was not available throughout much of their adult lives, MLSFH mature adults have a heightened awareness about the importance of sexual and marital behaviors as a critical aspect of investing in health across the life-course. In these cohorts, HIV infection in adulthood almost always implied substantially increased mortality risks; for mature adults, more than for younger cohorts who enjoy better screening for HIV and improved access to ART, less risky sex and marital behaviors constituted primary pathways of ensuring long-term health and survival. While the relationships between behaviors and health evolved as individuals got older, epidemiological contexts changed (e.g., increased relevance of non-communicable diseases), and new technologies became available (e.g., ART), for MLSFH mature adults, the triad between sexual/marital behaviors, health and survival continues to be closely intertwined. In perceptions as well as in reality, changes in sexual risk taking continue to be a primary mechanisms of reducing HIV infection risks and ensuring long-term health amount mature adults.

4 Data and BenKnow Health-Information Intervention

4.1 Mature Adults Cohort of the Malawi Longitudinal Study of Families and Health (MLSFH-MAC)

The Malawi Longitudinal Study of Families and Health (MLSFH) is an ongoing longitudinal panel study established in 1998 that examines how families and individuals cope with the social, economic, demographic and health consequences of the HIV/AIDS epidemic (Kohler et al. 2015). Our "*Benefits of Knowledge*" (BenKnow) study is based on the MLSFH Mature Adult Cohort (MLSFH-MAC), which was established by selecting in 2012 MLSFH respondents aged 45+ years in 2012, and enrolling them as part of an extensive aging and health baseline survey with follow-up waves in 2013, 2017, and 2018 (Kohler et al. 2020).[10] In 2017 and 2018, the two waves that are primarily relevant for the BenKnow

[10]The key inclusion criteria in 2012 for enrollment in the MLSFH-MAC were twofold: (*i*) being a MLSFH respondent aged 45 years or older in 2012; and (*ii*) having been interviewed in both the 2008 and 2010 MLSFH data collection rounds. The second criteria ensured that at least three waves of mental health and subjective well-being data were available for each baseline participant in 2012. Baseline enrollment in the MLSFH-MAC included 1,266 individuals clustered in 130+ villages, representing more than 90% of the 1,402 eligible MLSFH respondents who met the enrollment criteria (= target sample). Migration out of the study areas and mortality were the primary reasons for not enrolling eligible respondents. At each follow-up, the study population was augmented with additional MLSFH respondents who newly reached eligibility. To ensure an adequate representation of HIV+ individuals in the cohort, age-eligible HIV+ respondents were enrolled if they participated in either the 2008 *or* 2010 MLSFH data collection. Though the ongoing enrollment and migration follow-ups,

Table 1: Descriptive statistics by treatment status

	All					HIV-		
	mean	obs	control	treated	p-val	control	treated	p-val
Age	59.1	1481	58.8	59.4	.300	59.3	59.9	.384
Male %	40.0	1481	40.0	40.0	1	40.5	39.3	.653
Married %	73.4	1481	74.1	72.7	.557	75.4	73.3	.391
Divorced %	8.8	1481	7.9	9.7	0.222	7.0	9.2	.148
Widow %	17.8	1481	18.0	17.6	0.821	17.6	17.5	.958
Years of schooling	3.5	1481	3.5	3.6	.547	3.5	3.6	.694
Cognitive score	20.3	1481	20.2	20.4	.415	20.2	20.3	.651
HIV+ %	7.5	1442	6.3	8.7	.088			
Expectations %								
Own survival (5 yrs)	67.0	1410	66.9	67.0	.964	67.3	67.7	.763
Own survival (10 yrs)	44.1	1407	43.6	44.6	.577	44.1	45.1	.586
Pop. survival (healthy)	70.0	1444	70.7	69.4	.321	71.0	69.9	.399
Pop. survival (HIV+)	62.0	1439	63.1	60.9	.093	63.7	61.6	.123
Pop. survival (AIDS)	49.2	1439	50.2	48.1	.212	50.9	48.7	.195
Pop. survival (ART)	56.9	1439	57.7	56.1	.266	58.4	56.6	.275
Pop survival (uncond)	69.0	1463	68.8	69.2	.746	69.0	69.2	.859
HIV probability	18.6	1469	17.1	20.1	.022	14.6	15.9	.253
HIV probability spouse	18.2	1354	16.9	19.5	.064	15.3	16.4	.387
Sexual behavior %								
no sex	35.5	1481	34.2	36.8	.294	34.0	37.4	.195
single partner	56.9	1481	57.6	56.2	.583	57.9	56.4	.586
multiple partners, condom	1.2	1481	1.5	1.0	.366	1.0	0.6	.405
multiple partners, no condom	6.3	1481	6.7	6.0	.591	7.0	5.5	.255

The table presents summary statistics for the main variables used in the empirical analysis for the whole sample and separately by treatment group and for individuals tested negative for HIV. The variables refer to the 2017 baseline survey. Control and treatment show the mean for the BenKnow control and the treatment groups. p-val shows the p-value of a t-test where the null hypothesis is that the difference in means between treatment and control group is zero. The first five columns refer to the whole sample while the last 3 refer to those tested negative for HIV during HIV Testing and Counseling (HTC).

study, the MLSFH-MAC collected a broad range of information on mental, cognitive and physical health, detailed data on probabilistic expectations, and extensive data on household structure and family change, sexual behaviors, socioeconomic well-being, household production and consumption.

Columns 1 and 2 in Table 1 report summary statistics for the MLSFH-MAC cohort in 2017, the *baseline* for our BenKnow study. Respondents are 59 years old on average, 60% are female,[11] they only have on average 3.5 years of schooling and 7.5% tested positive for HIV. Virtually all respondents have been married at least once in their lives but separations and remarriages are frequent. At baseline, 73% are married, 18% are widowed and 9% are divorced or separated.

the MLSFH-MAC cohort expanded to 1,257 respondents in 2013, 1,606 in 2017, and 1,532 in 2018. A detailed description of the data, including analyses of data quality and attrition, is provided in the MLSFH-MAC Cohort Profile (Kohler et al. 2020).

[11]The higher presence of females in the sample is related to the original MLSFH survey design that, in 1998, sampled ever-married women and their spouses. While subsequent waves have expanded the MLSFH sample, the original sampling frame continues to result in an overrepresentation of women in the sample.

The BenKnow intervention was implemented by a separate team within two weeks subsequent to the 2017 MLSFH-MAC Main Survey. Shortly after the BenKnow health-information intervention, a HIV Testing and Counseling (HTC) team visited the respondents in both the treatment and control group to administer a HIV testing and counseling sessions followed by a short survey.[12] Take-up of the HIV test was essentially universal (97.4%), and virtually all respondents opted to receive the result of the HIV test. The 2018 MLSFH-MAC study population, fielded about one year after the 2017 wave, constitutes our *follow-up* survey. Our final analyses sample includes 1,481 respondents who completed all the required surveys (the 2017 and 2018 surveys and the intervention if in treatment group). Attrition from 2017 to 2018 was less than 5%, and attrition rates are similar by treatment status.[13] Figure 3 presents the timeline of data collection.

4.2 Benefits-of-knowledge (BenKnow) Health Information Intervention

The BenKnow intervention randomly assigned 2017 MLSFH-MAC respondents to a treatment and a control group, with randomization occurring at the village-level to avoid spillover effects between treatment and control group. Within each of the three study regions, villages were paired by size starting from the two biggest villages, followed by the two second biggest, etc. Then we randomly assigned treatment status to one village in each pair. The procedure guaranteed a similar sample size in the treatment group ($N = 779$) and control group ($N = 774$). The response rate for the BenKnow intervention was more than 98% (among 2017 survey respondents), resulting in 770 respondents enrolled in the treatment group.

The BenKnow health-information intervention started by reminding the respondent about the 5-year and 10-year own mortality expectations that s/he had reported in the 2017 Main Survey, followed by introductory questions about whether respondents were aware of recent changes in mortality levels. About 45% of respondents reported noticing that people lived longer than they did five or ten years ago (Table C.3), and among those, the most common reasons for these improvements were that AIDS treatment have become available nearby (44% of respondents) and that health services have improved (36%). The BenKnow intervention then consisted of the following two core components, with the complete interviewer scripts and additional information provided in the Appendix:

a) Narratives about changing mortality provided by video clips: Respondents were initially shown 3 video clips with a duration of about four minutes each. In these short video clips, individuals (trained local actors following a prepared script) explained how they no-

[12] In 2013 and 2017, the HTC team also screened for blood pressure before the HIV test and for blood sugar a day after. Those who were measured with high blood pressure or high blood sugar were given a referral card for seeking care. Around 17% of the respondents received this card. The share of respondents who got the referral card for the first time in 2017 is not statistically different between treatment and control (a t-test for equality of the means gives a p-value equal to 0.19).

[13] The p-value of a t-test for equality of means between the treatment and control group for being interviewed in 2018 is 0.15.

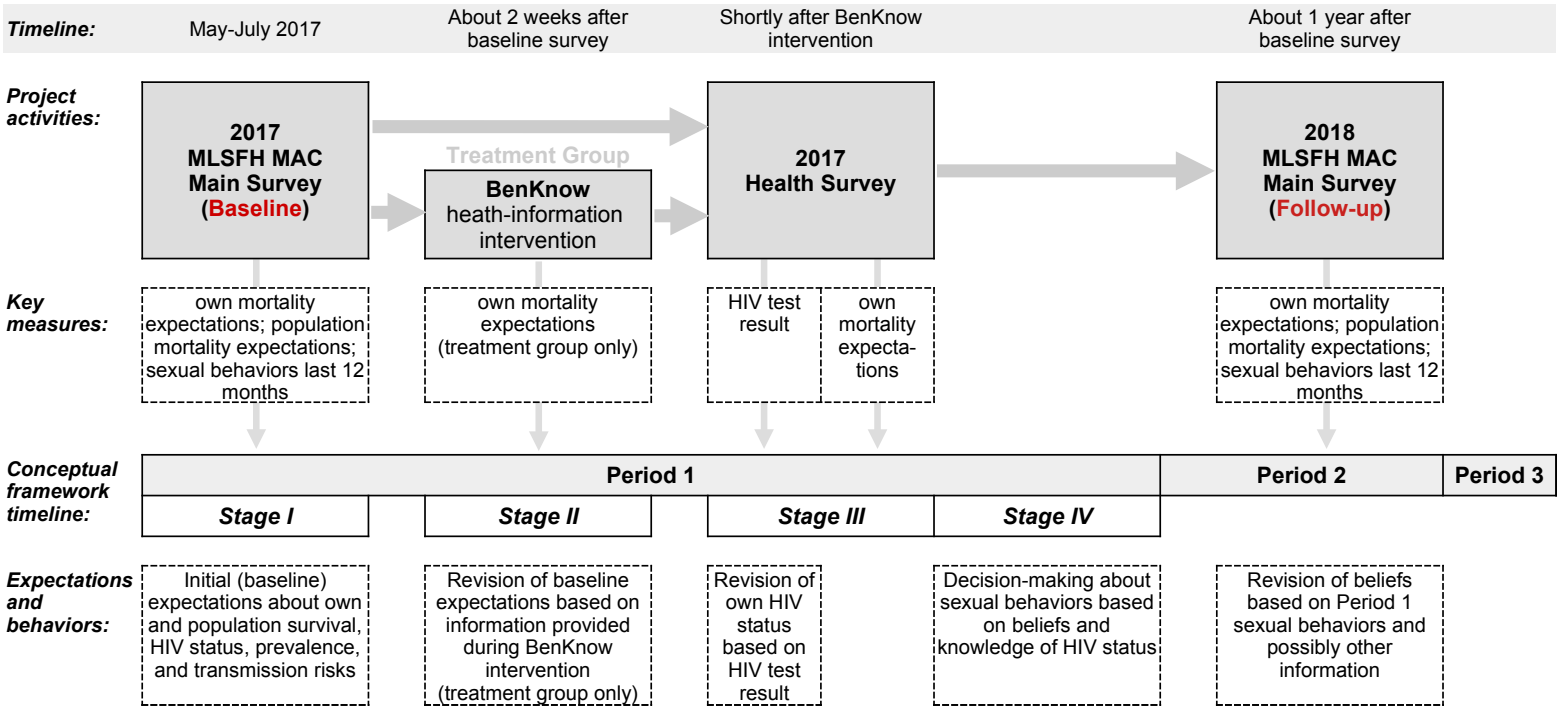


Figure 3: Research design and sequence of study activities

ticed that people nowadays live longer in rural Malawi. The first video depicts a carpenter in his workshop, the second a female tailor in her shop sitting at a sewing machine and the third an old man sitting in front of his house. The videos emphasize overall that people live longer due to better access to food, health care, and availability of ART. Studies support that video narratives are a useful way to convey scientific information to non-experts by increasing comprehension, interest, and engagement (Bruner 2009; Dahlstrom 2014). Evidence presented via such narratives are also more likely to be memorized (Avraamidou and Osborne 2009; Schank and Berman 2002).

b) Life-table survival probabilities conveyed via visual aids: Subsequent to the videos, respondents were shown a health-information sheet with visual information on 5-year and 10-year life-table survival probabilities for individuals of the same gender and within the same 5 year age group, with different figures conveying how many persons, out of 10 alive at the time of the intervention, could be expected to be alive five or ten years in the future.[14] A BenKnow health-information sheet is illustrated in (Figure B.1), and Table B.1 reports the complete set of BenKnow age- and gender-specific 5 and 10 year survival and death probabilities. The statistics purposely emphasized both the survival and mortality risk to avoid anchoring. While the videos conveyed a general narrative of improved survival, the life-table probabilities provided precise statistical information about mortality risk.

4.3 MLSFH Data on subjective expectations

Detailed subjective expectations data has been a hallmark of the MLSFH since 2006 (Delavande and Kohler 2009, 2012, 2016), including expectations about mortality (own and population), HIV infection and transmission, and the experience of socioeconomic shocks. These expectations were elicited by asking respondents to allocate up to ten peanuts (prior to 2017, beans) on a plate to express the likelihood that an event will occur, allowing respondents to split 1/2 when stating their expectations.[15,16] The following MLSFH expectations are of particular relevance for the present study, with Appendix A providing the full text of the 2018 MLSFH expectations module and Figure 3 showing when these various expectations were collected.

[14] Life table survival probabilities were obtained from the Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2016 (GBD 2016) Results. Seattle, United States: Institute for Health Metrics and Evaluation (IHME), 2017. Available from http://ghdx.healthdata.org/gbd-results-tool.

[15] Prior to 2017, respondents allocated up to 10 beans, thus being able to state probabilities in 10 percentage point increments. Peanuts, which can be split in half, were introduced since 2017 to allow respondents to express subjective probabilities in 5 percentage point increments.

[16] This interactive approach for eliciting expectations has been applied to several other contexts (Delavande, Lee and Menon 2017; Delavande, Gine and McKenzie 2011), and the method yields similar results that alternative approaches using touchscreen technology on tablets and "sliders" to indicate relative probabilities (Maffioli and Mohanan 2018). Questions about 5-year or 10-year mortality expectations are also preferable to alternative questions about perceived life expectancy, as in Godlonton, Munthali and Thornton (2016), as the former, but not necessarily the latter, reflect critical variation in perceived short- to medium-term mortality risks that determine current life-course behaviors (as is illustrated in our theoretical framework; see Section 5).

a) Own mortality expectations, reflecting respondents' subjective expectations that they would die within a 5-year and 10-year time horizon from the day of the interview ("*Pick the number of peanuts to express the likelihood that you will die with a 5-year [10-year] period beginning today.*"). Own mortality expectations were elicited up to four times: during the 2017 MLSFH-MAC Survey, during the BenKnow intervention (treatment group only), during the HTC survey shortly after the intervention (treatment and control groups) and about one year after the BenKnow intervention during the 2018 MLSFH-MAC survey.

b) Population mortality expectations, measuring respondents' perceived likelihood that the following hypothetical individuals would die within 5-year period: (*i*) a woman/man who is healthy and does not have HIV; (*ii*) a woman/man who is infected with HIV; (*iii*) a woman/man who is sick with AIDS; (*iv*) a woman/man who is sick with AIDS and is treated with ART; (*v*) a woman/man will die in the 5 years (not conditional on a specific health outcome/status). All hypothetical individuals were described as being of the same age and gender as the respondent ("*Pick the number of peanuts that reflects how likely you think it is that one of the following persons will die within a five-year period beginning today: A man [woman] your age who is healthy and does not have HIV?*," and variations thereof for *ii–iv*). Population mortality expectations were elicited during the 2017 MLSFH-MAC Survey and during the 2018 MLSFH-MAC survey.

c) HIV-related expectations, measuring (*i*) the subjective probability of the respondent being currently infected with HIV; (*ii*) the perceived likelihood that his/her spouse is currently infected with HIV; and in 2010 and 2018 also (*iii*) the subjective expectation of becoming infected with HIV within the next 12 months conditional on various sexual behavior, including if married to someone who is infected with HIV/AIDS and if one has several sexual partners in addition to the spouse ("*Pick the number of peanuts that reflects how likely you think it is that you are infected with HIV/AIDS now*," and variations thereof for *ii–iv*).[17]

The above mortality expectations are converted to survival probabilities (= 1 minus mortality probability) and respectively referred to as *own survival* probabilities and *population survival* probabilities. Survival probabilities are generally consistent with each other in terms of time horizon and health status (Column 1 in Table 1). Respondents reported in 2017 on average a 67% chance of surviving for the next 5 years, and a 44% chance of surviving in the next 10 years. They expect a hypothetical healthy individual to have a 70% chance to survive in the next 5 years, compared to 62% for someone who is HIV+, 49% for someone who is sick with AIDS and 57% for someone who is treated with ART. The chance of surviving not conditional on health status is 69% which is just below the average reported survival for healthy individuals. There is substantial variation in survival probabilities with answers taking all values between 0 and 1 (Figure 1), with some heaping at 0.5 and 1 for the 5-year and 0 and 0.5 for the 10-year horizon, and few respondents took advantage of the possibility to split the bean (less than 3%) to indicate probabilities at five

[17] Expectations about HIV transmission risk were not collected in 2017.

percentage point intervals (Figure C.1). Importantly, there is important information conveyed in these probabilistic expectations: respondents who reported a lower probability of surviving to the next 5 or 10 years in 2010 are less likely to be alive in 2017 (Figure C.2), and respondents in 2018 who reported lower survival probabilities also report a lower expected age at death and fewer remaining life years (Table C.1).

4.4 MLSFH Data on sexual behavior

Sexual behavior in the MLSFH MAC is captured via questions about whether the respondent had sex in the last 12 months, the number of sexual partners in the last 12 months, and whether condom was used in the last sexual intercourse.[18] Based on these questions, we construct three indicators of risky sexual behavior to look at both the extensive (being sexually active) and the intensive margin (multiple partners and condom use). Summary statistics for the variables entering the sexual risk indices are reported in Table 1.

Sexual Risk Index 1 (SRI1): 0 = not sexually active in the last 12 months, 1 = sexually active in the last 12 months.

Sexual Risk Index 2 (SRI2): 0 = not sexually active in the last 12 months, 1 = sex with one partner, 2 = sex with multiple partners.

Sexual risk index 3 (SRI3): 0 = not sexually active in the last 12 months, 1 = sex with one partner, 2 = sex with multiple partners and condom at last intercourse, 3 = sex with multiple partners and no condom at last intercourse.

Self-reported sexual behavior questions have been consistently shown to correlate with biomarker-based or pregnancy-based indicators of sexual behavior (McClelland et al. 2011). Yet, we recognize the fact that self-reported sexual behavior is often difficult to measure through self reports, and the above variables may be subject to measurement error. We discuss the robustness of our results to potential misreporting in Section 6.1, using analytic approaches that allow for measurement error in the reporting of sexual behaviors as well as newly-collected 2020 MLSFH data on pregnancy outcomes in the BenKnow treatment and control villages.

4.5 Balance at baseline

Columns 3 and 4 in Table 1 confirm that the treatment and control groups are comparable on baseline observable characteristics. Importantly, own and population survival prob-

[18] Prior validity studies suggest that, while the level of these risky behaviors is potentially to be misreported, the self-reported indicators of risky behavior very likely discriminate between respondents with different levels of risky behaviors. Moreover, while a quasi-experimental design in Kenya and Malawi in which respondents were randomly allocated to one of three interviewing modes—face-to-face interviews, paper and pencil self-administered interviews, and audio computer-assisted self-interviewing (audio-CASI)—documented significant differences in reported rates of premarital sex across interview modes (Mensch, Hewett and Erulkar 2003; Mensch et al. 2008), the analyses could not conclude a ranking of different methods in terms of measurement error. In particular, respondents reported twice as much sexual activity in the interviewer mode as in the audio-CASI mode, contradicting the hypotheses that interviewer-administrated survey question result in a underreporting of sexual behaviors.

abilities are very similar, and the sample is well balanced according to age, gender, sexual behavior, marital status, years of schooling and cognitive ability.[19] HIV prevalence is higher in the treatment group (8.7% versus 6.3%, statistically significant at the 10% level), and as a result, we observe a slight imbalance in the subjective probability of being infected with HIV and also in the survival probability conditional on being HIV+. This imbalance is likely due to chance. When we restrict our analysis to individuals tested negative to HIV in 2017, all variables are well balanced at conventional statistical levels, including beliefs about HIV status and survival probabilities conditional on being HIV+ (columns 6 and 7 of Table 1). In most of our analysis, we show results for the entire sample with and without interaction of HIV status with treatment as well as for HIV– individuals only.

5 Conceptual framework

We conduct our analysis building on a conceptual framework that highlights the interrelations between subjective survival expectations and sexual behaviors within a lifecycle framework similar to the one developed in Delavande and Kohler (2016). The periods and stages in this theoretical framework closely mirror the various steps from the data collection and are presented in Figure 3.

5.1 Sexual behaviors, survival perceptions and mortality information

Consider an individual living for three periods. In period 1, which is divided in four stages, the decision-maker is endowed with prior beliefs that may be updated upon receipt of new information (Stages I to III), and engages in sexual behavior a based on updated beliefs (Stage IV). For tractability we consider two levels of sexual behavior: safe sex (such as sex with spouse only) denoted by $a = 0$, and risky sex (such as sex with extra-marital partners in addition to spouse) denoted by $a = 1$. The decision-maker enjoys utility $V(a)$ in period 1. In period 2 and 3, the decision-maker makes no further decision and enjoys utility if still alive. The period 2 and 3 utility is health-dependent and equal to $U^- > 0$ if the individual is HIV-negative and $U^+ = U^- - c$, with $0 < c < U^-$, if the individual is HIV-positive.

At Baseline (***Stage*** I ***in Period 1***), each individual is endowed with a set of individual-specific subjective expectations about the following three aspects: **(1)** ***Survival to the next period***, including: (*i*) own survival S_{I}^{+} conditional on being currently HIV+ and own survival S_{I}^{-} conditional on being currently HIV–; and (*ii*) population survival S_{I}^{pop+} conditional on being currently HIV+ and population survival S_{I}^{pop-} conditional on being cur-

[19]Cognitive ability is measured via a modified version of the International Cognitive Assessment score that has been adapted to a low schooling population and covers six cognitive domains: basic language ability, orientation, visual/constructional skills, attention/working memory, executive functions, and delayed memory recall. See Kohler et al. (2020) for additional detail.

rently HIV–.[20] **(2) *HIV status and prevalence***, including: (*i*) the probability f_{I} of being currently infected with HIV; and (*ii*) the probability f_{I}^{s} that the spouse/main partner is infected with HIV; (*iii*) HIV population prevalence f_{I}^{pop}. **(3) *HIV transmission risks***, including (*i*) the probability $\pi_{\mathrm{I}}(a)$ of becoming HIV+ in the next period associated with sexual behavior a; and (*ii*) the probability Π_{I} of contracting HIV if having regular sex with an HIV+ partner, which captures the technology of HIV transmission when holding the HIV+ status of the partner constant. The transmission risk $\pi_{\mathrm{I}}(0)$ is a function of f_{I}^{s} and Π_{I}, while the transmission risk $\pi_{\mathrm{I}}(1)$ may be a function of beliefs about the population HIV prevalence (which itself may depend on population survival conditional on being HIV+ and HIV– ; i.e., HIV prevalence may be perceived to be higher for individuals who think HIV+ people live longer). In a Bayesian set-up, we would expect the baseline own survival expectations to be given by $S_{\mathrm{I}} = f_{\mathrm{I}} S_{\mathrm{I}}^{+} + (1 - f_{\mathrm{I}}) S_{\mathrm{I}}^{-}$.

The set of all of the above Stage I expectations is denoted P_{I}. To conceptualize the role of new information on expectations, it is useful to further distinguish expectations Ψ_{I} regarding outcomes about which an individual has *no* control, and expectations Θ_{I} regarding outcomes about which individuals have at least partial control through their behaviors. For example, the first set Ψ_{I} includes expectations about population survival conditional on various health status, HIV prevalence, and the transmission risk if one has regular sex with a HIV+ individual. The second set Θ_{I} includes expectations about own survival, and the probability of being infected with HIV, which may be shaped by sexual behavior.

At the BenKnow Intervention Stage (***Stage*** II ***in Period 1***), individuals in the treatment group T receive information about survival. This information may lead individuals to revise any of his/her baseline beliefs P_{I} to P_{II}^{T}. Taking HTC results into account, individuals' Stage III subjective expectations differ by both HIV test result and BenKnow treatment assignment.

Subsequent to HTC, individuals make decisions about sexual behaviors during the remaining time in Period 1 (***Stage*** IV ***of Period 1***). Subjective expected lifetime utility at the end of Stage III then depends on Stage III subjective expectations and the decision about sexual risk a, and is given by

$$V(a) + (1 - f_{\mathrm{III}})\, S_{\mathrm{III}}^{-} \left[U^{-} + (1 - \pi_{\mathrm{III}}(a)) \left(S_{\mathrm{III}}^{-} U^{-} \right) + \pi_{\mathrm{III}}(a) \left(S_{\mathrm{III}}^{+} U^{+} \right) \right] + f_{\mathrm{III}} S_{\mathrm{III}}^{+} \left[U^{+} + S_{\mathrm{III}}^{+} U^{+} \right]. \tag{1}$$

Within the above framework, risky sex may increase the direct pleasure from sex in period 1 but, by potentially increasing the (subjective) risk of becoming HIV-positive $\pi_{\mathrm{III}}(a)$, it may also decrease the (subjective) probability of surviving to in the future, and therefore of enjoying future period utility at all, while also decreasing the probability of enjoying U^{-} rather than U^{+}.

[20] We abstract from aging for simplicity so the subjective survival to the next period is the same in period 1 and in period 2.

At Stage IV of Period I, individuals will choose risky sex $a = 1$ if and only if the subjective expected lifetime utility associated with risky sex is greater than that associated with safe sex, i.e.:

$$V(1) - V(0) > (1 - f_{\text{III}})\, S^{-}_{\text{III}}\, (\pi_{\text{III}}(1) - \pi_{\text{III}}(0))\, \left((S^{-}_{\text{III}} - S^{+}_{\text{III}})U^{-} + S^{+}_{\text{III}}c\right). \tag{2}$$

We maintain the assumptions that (i) the perceived HIV transmission risk associated with safe sex is smaller than that associated with risky sex (i.e. $(\pi_{\text{III}}(1) - \pi_{\text{III}}(0)) \geq 0$), and ($ii$) the subjective survival conditional on being HIV- is larger than that conditional on being HIV+ ($(S^{-}_{\text{III}} - S^{+}_{\text{III}}) \geq 0$), to ensure that the right-hand-side of Eq. (2) is positive.

In ***Period 2***, individuals make no further decisions, but they revise their beliefs to P_2^T for the treatment group and P_2^C for the control group and enjoy a period-specific utility that depends on HIV status. Expectations in the set Θ will be revised as a result of past behavior—which may vary by treatment status—as well as other possible new information that becomes available to both treatment and control groups. For example, the probability of being infected with HIV, and hence own survival, may be updated as a result of Period 1 (Stage IV) sexual behavior. In our data, these updated Period 2 beliefs P_2^C and P_2^T are measured at the 2018 MLSFH-MAC follow-up survey. In ***Period 3***, the final period of the life course in this model, individuals enjoy a period-specific utility that depends on HIV status.[21]

5.2 Predicted BenKnow treatment effects on sexual behaviors

Within the above framework where individuals update their subjective expectations and make decisions about sexual behavior based on survival and HIV-related expectations, we delineate three potential channels through which the BenKnow intervention could affect sexual behaviors and the propensity to engage in risky sex:

a) Revisions of overall own survival expectations: The BenKnow life-table survival information was age- and gender-specific, but not HIV-status specific, and individuals with too pessimistic own survival expectations might have equally updated their perceptions of own survival conditional on being both HIV– and HIV+, S^{-}_{III} and $-S^{+}_{\text{III}}$. A joint increase in perceived survival probabilities, leaving $(S^{-}_{\text{III}} - S^{+}_{\text{III}})$ unchanged, increases the right-hand-side of Eq. (2), reducing the propensity to engage in risky sex. Intuitively, an overall improvement in survival risk increases the weight of future utility and hence the benefits from safe sex.

b) Revisions of expectations about own relative survival conditional on HIV status: The BenKnow intervention may have generated an increase in own survival risk conditional on being both HIV– and HIV+ of a different magnitude, potentially increasing the relative survival risk $(S^{-}_{\text{III}} - S^{+}_{\text{III}})$ if the gains in survival conditional on being HIV– were perceived

[21] The period 3 simply serves the purpose of having period-2 survival expectations in the future.

as larger than the gains conditional on being HIV+. Such a revision would again increase the right-hand-side of Eq. (2), reducing the propensity to engage in risky sex.

c) Revision of expectations about HIV transmission risk (conditional on sexual behaviors): The BenKnow intervention may have generated an increase in the subjective expectation about the population-level survival chances of HIV+ persons. This in turn may have led to an upward revision of the subjective local HIV-prevalence (as HIV+ persons are not dying so fast upon infection).[22] This rise in the perceived HIV prevalence among the potential pool of partners would lead to an increase in the subjective transmission risk of HIV associated with having multiple partners $\pi_{\text{III}}(1)$. Such an increase in $\pi_{\text{III}}(1)$ would increase the right-hand-side of Eq. (2), reducing the propensity to engage in risky sex.

5.3 Predicted BenKnow treatment effects on subjective expectations

In addition to the above BenKnow treatment effects on sexual behaviors, of central interest for our analyses are also the treatment effects on subjective expectations. In particular, revisions of expectations in response to BenKnow will help identify the mechanisms that motivate individuals to update their behaviors, which in turn are important for assessing the potential of scaling up the BenKnow intervention or applying it to other contexts.

For own survival expectations, our data allow us to measure a *short-run* treatment effect between Baseline (Stage I in Period 1) and HTC (Stage III in Period 1). For own survival expectations and all other expectations, we can also measure a *long-run* treatment effect between Baseline (Stage I in Period 1) and the 2018 follow-up survey (Period 2). The revisions of expectations induced by the information treatment is complex as, depending on the outcomes considered and timing, the revision may capture updating solely due to the exogenously provided information or due to a combination of the exogenously information and behavioral change. These short-run and long-run treatment effects on expectations therefore allow us to distinguish two separate pathways through which BenKnow affected subjective expectations:

a) Revision of expectations from the BenKnow intervention only: We expect a positive long-run treatment effect of the intervention on the population survival expectations conditional on health status. As discussed in the previous section, the increase in beliefs about the survival of HIV+ individuals may lead to an increase in beliefs about the HIV preva-

[22] Note that a positive BenKnow treatment effect on the survival of HIV+ individuals that is of similar *absolute* magnitude (in percentage points) as the treatment effect for HIV– individuals would also lead to a perceived increase in HIV prevalence. Suppose individuals live for two periods: period 1 and period 2. In period 1, there are n HIV+ individuals and the population of healthy individuals is standardized to 1. Then in period 2, assuming for simplicity no births and no new HIV infections, the proportion of HIV+ individuals in the population will be $\frac{nS^+}{nS^+ + S^-}$. Suppose now individuals revise their perceptions and increase both survival probabilities by α. Then the proportion of HIV+ individuals will be $\frac{n(S^+ + \alpha)}{n(S^+ + \alpha) + S^- + \alpha}$. Let $S^- = S^+ + c$, then the proportion will be $\frac{1}{\frac{n+1}{n} + \frac{c}{n(S^+ + \alpha)}}$. The proportion of HIV+ individuals is increasing in α if and only if $c > 0$. If people believe that healthy individuals live longer, an increase in both survival probabilities will make the pool of potential sexual partners more risky. The data show that individuals generally believe that $c > 0$.

lence in the pool of potential partners, which would result in a positive long-run treatment effect on the transmission risk of HIV conditional on having multiple partners $\pi(1)$. The information intervention provided no information on the biological pathways of transmission so we expect a zero treatment effect on the probability Π of contracting HIV if having regular sex with an HIV+ partner.

While expectations about own survival may be affected by behavioral change in the long run, we can take advantage of the extra measurement of expectations during the survey that was conducted by the HTC team after the HIV testing for both treatment and control groups. Because the HTC and baseline were separated by less than two weeks, it is reasonable to assume that there are not (yet) feedbacks from individual behavior on beliefs about own survival. Due to the new information provided by the HIV test, the short-treatment effect about own survival differs by HIV status. Under the assumption that individuals believe the HIV test result, the treatment effect among respondents who learned they were HIV-negative at Stage III provides the effect of the intervention on own survival conditional on being HIV–, while the treatment effect among respondents who learned they were HIV+ provides the effect of the intervention on own survival conditional on being HIV+. Since there is a general underestimation of survival risk in the population, we expect overall a positive treatment effect for both groups in the short-term.

b) Revision of expectations based on combined effect of the BenKnow intervention and feedback from behavior: Revisions of expectations about outcomes for which the decision-maker has *some* control are the joint result of the BenKnow health information combined with past endogenous decision-making about behaviors (e.g., risky sex) that took place after the BenKnow intervention at Period 1 and Period 2. Because of BenKnow, these behaviors may be different between the control and treatment group. If the intervention reduced risky sexual behavior, we expect a positive treatment effect on own survival in the long-run, and a negative treatment effect on the probability of being HIV+.

6 Results

The BenKnow intervention had significant effects on sexual risk taking (Section 6.1), which are robust in analyses that allow for misreporting of sexual behaviors (Sections 6.1.1–6.1.2). The mechanisms through which the BenKnow intervention affected sexual behaviors are explored in Section 6.2, and additional effects of BenKnow on life-cycle behaviors are documented in Section 6.3.

6.1 Sexual behaviors

The Sexual Risk Indices 1–3 (SRI1–SRI3; see Section 4.3) are our primary categorical outcome variables for identifying BenKnow effects on sexual behaviors. Specifically, we estimate an ordered probit model for the 2018 Sexual Risk Index $a_{ij(2018)}$ for individual i in

Table 2: BenKnow treatment effects on sexual behaviors

	Sexual Risk Index (SRI)					
	Had sex		Number of partners (0,1,2+)		Sex and condom (no sex, 1 partner, 2+ w/ condom, 2+ w/o condom)	
	(1)	(2)	(3)	(4)	(5)	(6)
BenKnow treatment effect	-0.140**	-0.136*	-0.156***	-0.135**	-0.159***	-0.136**
	(0.067)	(0.077)	(0.057)	(0.067)	(0.056)	(0.066)
HIV+		0.007		0.168		0.149
		(0.343)		(0.268)		(0.264)
Treatment effect × HIV+		-0.253		-0.445		-0.421
		(0.408)		(0.350)		(0.337)
Observations	1,479	1,440	1,479	1,440	1,479	1,440

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: Estimates are based on (ordered) probit specification in Eq. (3). All analyses additionally control for randomization strata (village pair) fixed effects, dummies for age groups, gender and years of schooling. Standard errors are clustered at village level. Sexual Risk Indices are defined as: Had Sex: 0 = not sexually active in the last 12 months, 1 = sexually active in the last 12 months; Number of Partners: 0 = not sexually active in the last 12 months, 1 = sex with spouse only, 2 = sex with multiple partners; Sex and Condom: 0 = not sexually active in the last 12 months, 1 = sex with spouse only, 2 = sex with multiple partners and condom at last intercourse, 3 = sex with multiple partners and no condom at last intercourse.

village j as

$$P(a_{ij(2018)}) = \Phi\left(\beta T_j + \sum_k \delta_k a^k_{ij(2017)} + X_{ij}\gamma + \sum_{s=1}^{S} \tau_s I_{j\epsilon s}\right), \tag{3}$$

where T_j is a dummy equal to 1 if village j is assigned to the BenKnow treatment group, and 0 otherwise, and β is the BenKnow treatment effect on sexual behaviors. The model also includes dummies $a^k_{ij(2017)}$ for each category k of the 2017 sexual risk index to control for baseline sexual behaviors, a vector of observed predetermined individual characteristics X_{ij} (age group, gender and years of schooling),[23] and fixed effects for the randomization strata s (within-region village pairs) (Bruhn and McKenzie 2009), where τ_s denotes strata fixed effects, $I_{j\epsilon s}$ is an indicator for whether village j is in strata s, and S is the total number of strata. Because the strata s are within the three MLSFH study regions, the strata dummies also control for all region-specific differences. Standard errors are clustered at the level of the randomization, i.e., at the village level.

Table 2 reveals our key result: the BenKnow health-information intervention significantly reduced the propensity to engage in risky sexual behavior across all three indices of risky sex (SRI1–SRI3), as is evidenced by a negative and precisely estimated treatment ef-

[23]The age-group dummies correspond to the same 5-year age groups that were used in BenKnow for to provide age- and gender-specific life table survival information.

Table 3: Predicted probabilities of sexual risk taking, by BenKnow assignment

	BenKnow Assignment		
	Control	Treatment	Difference
No sex (SRI3 = 0)	.333	.361	.028
Single partner (SRI3 = 1)	.579	.564	-.015
Multiple partners with condom (SRI3 = 2)	.013	.011	-.002
Multiple partners without condom (SRI3 = 3)	.076	.064	-.012

Notes: Predicted probabilities based on Model 5 in Table 2 for each of the for categories in SRI3.

fect. There are no significant interactions of the treatment effect with HIV status (bearing in mind that the number of HIV+ respondents in our sample is small). Our main results hold even if we exclude polygamous men, which constitute 6.7% of our sample (Table C.4). We do not find any treatment effect on subjective well-being (Table C.5) suggesting that lower sexual activity did not reduce respondents welfare, and find no effect on the frequency of sex conditional on having sex (table not shown).

To better assess the magnitude of the treatment effect, Table 3 provides the predicted probabilities of sexual risk taking based on Table 2, Column 5, showing that the intervention had a large impact on risky sex. Importantly, the BenKnow intervention was therefore effective at changing behavior both at the extensive margin (being sexually active) and intensive margin (number of partners and condom use). For example, the predicted probability of having multiple partners with no condom is 7.6% in the control group and 6.4% in the treatment group, a reduction of 1.2 percentage points or 19%. Similarly, the predicted probability of not having sex is 33.3% in the control group and 36.1% in the treatment group, an increase of 3 percentage point or 8%. Focusing on HIV– respondents, we get a 12% reduction in the predicted probability of having multiple partners with no condom and a 7% increase in abstinence (Table C.6).

Splitting the sample by gender reveals that while men act on both margins as a response to treatment (Table C.7), women only adjust their extensive margin (Table C.8). Interacting the BenKnow treatment effect with individual characteristics, and controlling for multiple-hypothesis testing, also reveals some limited heterogeneity in treatment effects by age, schooling and cognitive ability (Table C.9 and C.10).[24]

6.1.1 Misreporting in sexual behavior

Misreporting of sexual behavior is a possible concern for the interpretation of our key findings about the BenKnow treatment effect on sexual risk taking. To evaluate the robustness

[24] Age, schooling and cognitive ability are the three individual characteristics indicated in our pre-analysis plan in addition to gender. Table C.9 looks at interactions of treatment with individual characteristics while Table C.10 looks at subsamples. The Q-values reported in the tables to correct for multiple hypothesis testing can be interpreted the same way as P-values (Benjamini, Yekutieli et al. 2001).

of our results to misreporting, we follow Hausman, Abrevaya and Scott-Morton (1998) to correct for misclassification error in a binary choice model. This strategy was adopted in a similar context by De Paula, Shapira and Todd (2014) and Delavande and Kohler (2016). We focus on two binary indicators for sexual behavior: having sex and having multiple partners. We assume that individuals report truthfully when they engage in safe sex practices, and misreport about risky sex. Our results are reported in Table C.11 and show a negative treatment effect, statistically significant at the 10% level.[25] Column 2 focuses on having sex under the assumption that individuals misreport about having sex, while Column 4 presents the results for having multiple sex partners under the assumption that individuals misreport about multiple sex partners. The magnitude of the coefficients is larger than in the same specification without misreporting (shown in Columns 1 and 3), suggesting that misreporting leads to a downward bias of the treatment effect. Based on this model, we find a predicted probability of misreporting of having multiple partners of 9.4%.

6.1.2 Pregnancies

In addition to the above analytic approach that allows for misreporting of sexual behaviors, we can also corroborate our findings with an objective measure of sexual activity such as pregnancies. MLSFH mature adults, i.e., the population to whom BenKnow intervention was targeted, are generally too old to become pregnant. Instead, our robustness tests based on pregnancy outcomes focuses on younger members of the MLSFH cohort who have been interviewed in 2019 (one year after the 2018 MLSFH-MAC follow-up on which our primary results are based).[26]

The primary mechanism allowing us to identify BenKnow treatment effects on pregnancies among female MLSFH respondents younger than 45 years (and who were therefore not eligible for enrollment in the BenKnow study) is as follows: if MLSFH mature adults have sex with younger spouses or partners in their villages, as a substantial fraction in all likelihood does, then changes in sexual behaviors among mature adults in response to BenKnow can potentially affect pregnancy risks among women < 45 years old. Our earlier finding that BenKnow reduced sexual risk taking therefore leads to an hypothesis of a negative BenKnow treatment effect on pregnancies in the treated villages. Specifically, since only 2 years have passed between the 2017 BenKnow intervention and the 2019 MLSFH survey, we expect a treatment effect on being pregnant in 2019 or having a baby less than a year old, while there should not be any treatment effect on having an infant who is 1 year or older.

[25] For having sex, the set of controls include gender, age, schooling and village pair fixed effects. For multiple partners, we substitute pair effects with region fixed effects. Standard errors are always clustered at the village level.

[26] The 2019 sample includes respondents less than 45 years old, plus some older respondents that were excluded from the original mature adults sample because they did not meet the MLSFH-MAC eligibility criteria of having completed both the 2008 and 2010 MLSFH surveys; see Kohler et al. (2020) for additional details.

Table 4: BenKnow treatment effects on pregnancies or recent births among women aged < 45 years

	(1) Respondent is pregnant or has baby aged < 1 year	(2) Respondent has infant aged 1–2 years	(3) Respondent has infant aged 3–4 years
BenKnow treatment effect	-0.039**	0.027	0.002
	(0.016)	(0.024)	(0.022)
Observations	998	998	998

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table report regression coefficients for the BenKnow treatment effect on births and pregnancies using a probit specification. The sample includes all women in reproductive age (<45) who participated in the 2019 MLSFH survey. The dependent variable in column 1 is a dummy for being currently pregnant or having a baby less than 1 year old at the time of the interview in the 2019 MLSFH survey. Dependent variables in columns 2 and 3 are dummy variables for having a baby of the specified age range. The controls include age, schooling and village pair fixed effects. Standard errors are clustered at the village level.

Our results in Table 4 confirm this hypothesis and provide additional support for the robustness of key results. Specifically, Column 1 of Table 4 shows the treatment effect on being currently pregnant or having a baby less than a year old for women in the 2019 survey. We find a precisely estimated negative treatment effects of 3.9 percentage points (baseline of 16%).[27] Reassuringly, we do not find any significant treatment effects for infants 1–2 years or 3–4 years old (Columns 2 and 3).

Overall, our main result of a negative Benknow treatment effect on risky sex seems robust to potential misreporting. Marriage is also unlikely to suffer from reporting bias, and may be perceived by respondents as a risk-reduction strategy by acting as a commitment device to maintain an exclusive sexual relationship (Greenwood et al. 2017). The positive BenKnow treatment effect we describe on marriage in Section 6.3 is another potential robustness check of our main result on self-reported sexual behavior

6.2 BenKnow treatment effect on subjective expectations

To better understand the mechanisms underlying the behavioral changes subsequent to the BenKnow intervention, our analyses in this section build on our theoretical model in Section 5 and utilize the extensive MLSFH-MAC data on probabilistic expectations.

Our analyses for the BenKnow treatment effect on subjective expectations are specified as follows: Let $\Delta y_{ij} = y_{ij(2018)} - y_{ij(2017)}$ be the difference between follow-up and baseline

[27] We acknowledge that the point estimates are fairly large and are unlikely to be the sole consequence of sexual behavior among mature adults in our sample. At least partially, the effect could be explained by diffusion of information to other individuals in the treatment villages.

Table 5: BenKnow treatment effects on population survival expectations

	Conditional Subj. Survival Probabilities: Prob. of surviving for individuals who are				Unconditional Surv. Prob.
	Healthy (1)	HIV+ (2)	Sick with AIDS (3)	Sick with AIDS and on ART (4)	(no health status specified) (5)
BenKnow treatment effect	0.043***	0.041***	0.017	0.035**	-0.012
	(0.011)	(0.013)	(0.016)	(0.014)	(0.011)
Observations	1,382	1,382	1,382	1,382	1,382

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: Analyses are based on relation (4). All subjective survival probabilities are based on questions about hypothetical individuals, of the same age and gender as the respondent, with the specified health status; see Section 4.3 for additional detail. All analyses additionally control for age group, gender, years of schooling and strata. Standard errors are clustered at the village level.

expectation y for individual i in village j, and T_j is a dummy that equals 1 if village j is in the BenKnow treatment group. We then estimate

$$\Delta y_{ij} = \beta_0 + \beta T_j + \sum_{s=1}^{S} \tau_s I_{j \in s} + X_{ij}\gamma + \varepsilon_{ij} \tag{4}$$

where, as in our previous analyses, β is the BenKnow treatment effect, τ_s are strata fixed effects, $I_{j\epsilon s}$ is an indicator for whether village j is in strata j and S is the total number of strata and X_{ij} include individual baseline characteristics. Standard errors are clustered at the village level.

We discuss the results separately for the two sets of subjective survival expectations that are measured in the MLSFH-MAC, population survival and own survival, as well as for HIV-related expectations.

a) Population survival: Table 5 documents a positive, sustained and statistically significant BenKnow treatment effect on the 2018 population-level survival probabilities for individuals who are healthy, are HIV+ or are sick with AIDS and on ART. In the treatment group, all of these subjective population-level survival probabilities increase by approximately 4 percentage points, displaying an approximately 6–7% increase with respect to the baseline survival probabilities. There is no treatment effect on the perceived survival of individuals who are sick with AIDS (not on ART), consistent with the fact that the BenKnow intervention videos emphasized the contributions of ART to recent increases in life expectancy.

Somewhat surprisingly, there is no significant treatment effect on the subjective population-level survival probability unconditional on any particular health status (Column 5 in Table 5). A potential explanation for this result is that respondents understand that if more

HIV+ individuals survive, the HIV prevalence increases, which potentially compensates for the gains in overall population survival as long as there is differential survival between HIV– and HIV+ individuals (as is the case in our sample: Table 1 shows an average 8 percentage-point advantage of being healthy in terms of 5-year survival compared to being HIV+).[28]

The average treatment effect presented in Table 5 potentially combines a mixture of upward revisions among respondents whose prior beliefs were below the new statistical information, downward revisions among respondents whose prior beliefs were above the new statistical information and no revisions among respondents whose prior beliefs were very similar to the new statistical information. We therefore investigate whether there are heterogeneous treatment effects depending on the accuracy of prior beliefs (i.e., the gap between the objective population survival probability presented in the statistical information and the baseline unconditional subjective population survival). Table C.12 shows results where we add to our main specification: (*i*) an interaction between treatment and an indicator for the intervention presenting "good news," i.e., a positive gap (odd columns); and (*ii*) an interaction between the treatment and the gap (even columns). These interaction terms are never precisely estimated, which shows that the BenKnow treatment effects are not systematically different according to prior accuracy or whether the BenKnow life-table information provided "good" or "bad" news. These findings suggest that the overall narrative of the BenKnow intervention about changing survival patterns in Malawi had more impact on individual's revision of survival expectations than the specific life-table information about age- and gender-specific survival probabilities.

There is also no difference in the BenKnow treatment effect on population-survival expectations by HIV status (Table C.13), and we do not find any substantial difference in these effects by age, gender and cognitive ability (Table C.14 and Table C.15). We only find some heterogeneity by schooling with those with no schooling updating more the survival for individuals who are healthy, who are HIV+ and those with ART.

b) Own survival: The first column in Table 6 shows the BenKnow treatment effect on the revisions to own survival expections between 2017 and 2018 for the 5-year time horizon. This is the analog of the treatment effect on population survival probabilities from Table 5 since the variables are measured at the same waves and refer to the same survival horizon. Importantly, there is *no effect* of the intervention on own survival expectations with a coefficient precisely estimated at zero (treatment effect for own survival is 0.004 (0.014) as opposed to 0.043 (0.011) for healthy population survival). We find similarly no treatment effect on the 10-year own survival expectations (Column 3). Interactions of treatment with HIV status reveal similar patterns of limited revisions (Columns 2 and 4). There is also no

[28]To illustrate the possibility of no change in unconditional population-level survival probability as a result of differential survival of HIV+ and HIV– individuals and corresponding changes in HIV prevalence, let $S^{pop} = p_{HIV} S^{pop+} + (1 - p_{HIV}) S^{pop-}$ where S^{pop} is the survival expectations in the population and p_{HIV} is the expectations about the HIV prevalence. An increase in p_{HIV}, S^{pop+} and S^{pop-} may result in no increase in S^{pop}.

Table 6: BenKnow treatment effects on own survival expectations

	Subjective probability of surviving							
	Long run (measured in 2018)				**Short run** (measured post-intervention 2017)			
	5 years		10 years		5 years		10 years	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BenKnow treatment effect	0.004	-0.008	0.018	0.007	0.016	0.019	0.014	0.028
	(0.014)	(0.014)	(0.016)	(0.016)	(0.013)	(0.014)	(0.016)	(0.017)
HIV+		-0.070		-0.023		-0.003		0.059
		(0.052)		(0.065)		(0.041)		(0.050)
Treatment effect × HIV+		0.096		0.042		-0.002		-0.102
		(0.064)		(0.080)		(0.061)		(0.080)
Observations	1375	1340	1375	1340	1388	1366	1388	1366

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table reports regression coefficients for the treatment effect on own subjective survival probabilities. In the first four columns, the dependent variables are the update of each probability from baseline to the 2018 follow-up. In the last four columns, the dependent variables are the update of each probability from baseline to the HTC stage. HIV+ is a dummy for being tested positive during the HTC exercise. All analyses additionally control for age group, gender, years of schooling and strata. Standard errors are clustered at the village level.

treatment effect for respondent's expected age at death and their expected remaining life years (results not shown).

As illustrated in our conceptual framework (Section 5), own survival expectations measured one year after the intervention may be influenced by both the intervention and feedback effect from own behavior. The negative treatment effect on risky sex should therefore have magnified the positive effect of the BenKnow intervention on own survival. Indeed, and consistent with the fact that people adopted HIV risk-reduction strategies, we find a negative treatment effect of the BenKnow intervention on the subjective probability of being infected with HIV (see next section). As of 2018, however, these revisions in the subjective probability of being HIV+ have not yet translated into gains in expected survival. While we cannot fully exclude the possibility that individuals engage in risky behavior in other domains that would compensate those gains, our analyses below find no treatment effect on alcohol and tobacco expenditures (Section 6.3).

To gain a better understanding in the process through which respondents update own survival expectations in response to BenKnow, we can further leverage the expectations measured approximately two weeks after the BenKnow intervention. Within this short time horizon subsequent to the intervention, it is very unlikely that any feedback effect from behavior on own survival beliefs has occurred. These short-run revisions in survival expectations are thus solely from the information provided by the BenKnow intervention, and treatment effects on these short-run revisions of survival expectations identify the

"pure" effect of the BenKnow intervention on survival perceptions. Similar to the findings for the long-run revisions of survival expectations measured in 2018, Columns 5–8 in Table 6 reveal no treatment effect. BenKnow therefore neither affected short-run nor long-run revisions of own survival expectations.

This limited effect of the intervention on own survival expectations is puzzling, especially when contrasted with the sustained revisions of population survival expectations. We investigate the possible underlying reasons by looking at three different sources of heterogeneity for both the short and long-run revisions. First, we investigate whether there are heterogeneous treatment effects depending on the *accuracy of prior beliefs*, as we have done for population survival expectations. Individuals with downward-biased priors might update upward while individuals with upward-biased priors might update downward, resulting in a close to zero average treatment effect. However, Table C.16 shows no heterogeneous effect by prior accuracy or by receiving good news. A second explanation focuses on heterogeneity due to the *relevance* of information. The information we provided may be less relevant to the own survival expectations of people who feel they are different from the general population. However, when restricting our sample for whom the information is likely to be relevant, i.e., the initial difference between own and population survival is small enough,[29] we still do not find a positive treatment effect (Table C.17).

The third explanation is related to the extent of *private information* about own survival. Individuals with more private information should have tighter priors about their own survival and any new information would lead to only limited updating. Unfortunately, we do not have direct information on private information or the tightness of the prior. We nevertheless take advantage of the panel aspect of the data to construct a proxy. We speculate that individuals who repeatedly report 0 and 1 have more private knowledge about their health.[30] We construct a binary indicator for reporting extreme beliefs (0 or 1) at least half of the time in the past waves of the MLSFH either for the 5-year or 10-year survival (individuals with less than 3 observations are excluded). When looking at the treatment effects excluding the 20% of the sample who have "private information" according to this definition (Table C.17), we identify a precisely estimated treatment effect of 4 percentage points for the 10-year time horizon. There is however no effect for the 5-year time horizon. We acknowledge that this indicator is crude but interpret these results as suggestive evidence of the importance of private information in the lack of updating of own survival expectations.

Finally, we investigate heterogeneity in treatment effects by individual characteristics that may be related to individuals ability to understand and/or process the information provided as part of BenKnow. The analyses in Tables C.18–C.19, however, fail to find sys-

[29] To directly compare own and population survival, we construct a baseline population survival as follows: $(1 - f_I)\, S_I^{pop-} + f_I S_I^{pop+}$, i.e. we fix the HIV prevalence in the population to the respondent's subjective risk of being HIV+.

[30] For example, a terminally ill respondent is likely to report a zero chance of survival in 5 or 10 years and is unlikely to move her prior based on the BenKnow information.

Table 7: BenKnow treatment effect on expectations about being HIV+ (in 2018) and expectations about HIV transmission conditional on sexual behaviors

	Probability of being HIV+		Prob. of contracting HIV if sex with HIV+ partner		Prob. of contracting HIV if sex with multiple partners	
	(1)	(2)	(3)	(4)	(5)	(6)
BenKnow treatment effect	-0.042***	-0.034**	0.017	0.019	0.048***	0.039**
	(0.013)	(0.014)	(0.020)	(0.020)	(0.016)	(0.017)
HIV+		0.002		0.043		0.020
		(0.070)		(0.055)		(0.063)
Treatment effect × HIV+		-0.070		-0.105		0.039
		(0.084)		(0.075)		(0.072)
Observations	1454	1417	1417	1383	1418	1384

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the treatment effect on the update of beliefs over HIV-related probabilities from baseline to the 2018 follow-up. HIV probability is the subjective probability of being currently HIV+. HIV+ is a dummy for being tested positive during the HTC exercise. HIV+ partner is the update from baseline MLSFH survey in 2010 to the follow-up survey in 2018 in the probability of becoming infected with HIV having sex with an HIV+ spouse over a year. Multiple parrtners is the update from baseline MLSFH survey in 2010 to the follow-up survey in 2018 in the probability of becoming infected with HIV having sex with multiple partners over a year. All analyses additionally control for age group, gender, years of schooling and strata. Standard errors are clustered at the village level.

tematic differences in the revision of own survival probabilities by age, gender, schooling and cognitive ability once p-values are adjusted for multiple hypothesis testing.[31] This lack of evidence for heterogeneous treatment effect may also be related to the extensive pre-testing of the BenKnow intervention ensuring that the videos and BenKnow information about age/gender-specific mortality risks was comprehensible and accessible for an aging study population with limited schooling.

Overall, our analysis in this section document that own survival expectations have not been modified by the BenKnow information. This finding is robust across short-run and long-run revisions, and across different subgroups of the study population. It is therefore unlikely that an overall improvement in own survival expectations is the main driver of the changes in sexual behaviors that we have documented in Section 6.1 in response to the BenKnow intervention. We also do not find any evidence of a treatment effect on the relative survival expectations of HIV– and HIV+ persons: the treatment effect on population survival for healthy and HIV+ individuals are of the same (absolute) magnitude (Table 5), and there is no differential treatment effect by HIV status for own survival (Table 6). Combined, these results suggest that an improvement in relative survival of HIV– individuals is an unlikely mechanism underlying the behavioral changes resulting from BenKnow.

[31] We do find a positive effect for males 5-year survival probability in the short run and for individuals with no schooling in the 10-year survival in the long run. No consistent story emerges from these results.

c) HIV-related expectations: Finally, Table 7 investigates the BenKnow treatment effect on the revision of HIV-related expectations. First, the reduction in risky sex may have added a feedback effect on individual's expectations about own HIV status. We do indeed find a negative and precisely estimated treatment effect about the chance of being infected with HIV (Column 1 in Table 7) from baseline to the 2018 follow-up, which is consistent with the reduction in risky sexual behavior documented in the previous section. The magnitude is of 4.2 percentage point, or 23% of baseline belief. We do not find significant differences in the treatment effect between those tested HIV+ or HIV-.

Table 7 investigates the BenKnow treatment effect on the revision to the risk of becoming HIV+, conditional on specific patterns of sexual behaviors. Because HIV transmission risk related expectations were not elicited in the 2012 and 2017 MLSFH mature adult surveys, these analyses use 2010 expectations as baseline. Column 3 in Table 7 documents a lack of a treatment effect on the subjective probability Π of contracting HIV if married to a HIV+ spouse. This suggests that, as anticipated, there has been no change in the perception of the "technology of transmission of HIV" when holding constant the partner's HIV status.[32]

There is, however, a positive and precisely estimated treatment effect on the subjective probability that one would become HIV+ when having multiple sex partners (Column 5 in Table 7). The magnitude of the treatment effect is 5 percentage point, or 7% of the average baseline survival.[33] These two results combined suggest that individuals perceive that the pool of potential sexual partners includes more HIV+ individuals, or becomes "riskier." The information intervention thus increased individual's expectations about the transmission risk associated with multiple sex partners. This is likely to be an important channel through which individuals engaged in HIV risk-reduction strategy as a result of the BenKnow intervention.[34]

The mechanism driving the above perception of increased "riskiness" of the sexual partner pool is consistent with respondents' updates of survival expectations in response to the BenKnow intervention. Specifically, there is a positive BenKnow treatment effect on

[32]Derksen and van Oosterhout (2019) show that individuals in Malawi are relatively uninformed about the consequences of ART on viral load and its associated reduction in HIV transmission risk. Similar results are found from studies in South Africa, even among younger and more educated populations (Bor et al. 2018).

[33]Note that the 2010 subjective transmission risks are not well balanced between treatment and control groups (Table C.21). We therefore assess the robustness of the main results in the paper in two different specifications that ensure balance of the 2010 subjective transmission risks. First we drop a village pair that cause most of the imbalance (Table C.21). Second, we reweight the sample using entropy weights to balance the sample on transmission risk. In both cases, the treatment effects on sexual behavior and expectations are very similar to the ones from our current specification (Table C.22 and C.23).

[34]Our theoretical framework emphasizes that it is the relative transmission risk between risky and safe sex $(\pi(1) - \pi(0))$ that matters for behavior. In Table C.20 we show the treatment effects on the difference in the change in transmission risk for having sex with multiple partners and the transmission risk of having sex with the spouse which we construct as $\pi(0) = f^s \times \Pi$. where f_2^s is the probability of the spouse being HIV+ at baseline and Π is the transmission risk of having sex with an HIV+ partner. We find a statistically significant positive treatment effect of just above 5 percentage points which is very similar to what we observed for the simple change in transmission risk with multiple partners that we presented in Table 7.

the survival of HIV+ individuals that is of similar *absolute* magnitude (in percentage points) as the treatment effect for HIV– individuals (Table 5). This implies an expected increase in HIV prevalence over time for several reasons. First, the baseline survival probability for HIV+ persons (62%) is lower than for HIV– persons (70%), which entails that the *relative* BenKnow treatment effect is larger for HIV+ as compared to HIV– individuals (6.6% vs. 6.1% increase of respective baseline survival probabilities). The higher relative increase in survival for HIV+ as compared to HIV– individuals implies an increase in expected future HIV prevalence.[35] Second, respondents may consider the survival expectations for individuals sick with AIDS when they infer the HIV prevalence in their potential pool of sexual partners. The BenKnow treatment effect implies a relative increase of 6.1% (of baseline survival) in the survival probability for individuals sick with AIDS *and* on ART. Additionally, respondents may also revise upward the proportion of people sick with AIDS who receive (or are going to receive) treatment with ART. In fact, respondents may correctly infer from the BenKnow videos that gains in survival for HIV+ individuals followed from the expansion of ART which now covers the majority of individuals sick with AIDS.[36] In this case, there is an additional effect on HIV prevalence of the expected survival gains from ART (7.7 percentage points at baseline).[37] Third, individuals may believe that the gains in survival for HIV+ are larger than that for HIV- among younger cohorts, where their sex partners also belong, as younger persons are less affected by non-HIV-related morbidity. Finally, the increase in the survival of HIV+ persons might be particularly salient to respondents who may link it to HIV prevalence, due to availability bias (Tversky and Kahneman 1973) or the tendency to overestimate the probability of negative events (Harris, Corner and Hahn 2009).

Overall, our in-depth analysis in this section of the subjective expectations data suggest that the behavioral effect from the BenKnow health-information intervention is not driven by an improvement in own survival expectations, but rather by an upward revision of the HIV transmission risk associated with risky sex. This risk was already over-estimated prior to the BenKnow intervention (Delavande and Kohler 2016), and it was not directly targeted by the BenKnow intervention. Yet, the upward revision of the HIV transmission risk associated with risky sex in response to the BenKnow intervention is consistent with the upward revision in subjective survival expectations of HIV+ individuals which makes the pool of sexual partners more likely to include HIV+ individuals and thus riskier.

[35] See conceptual framework in Section 5.2.

[36] As mentioned in Section 2, access to ART in Malawi expanded during the past decade, attaining a 79% ART coverage among adults in 2018 (Section 2). These trends are mirrored in our study population. Only 60% of the 2012, but 82% of the 2017 HIV+ MLSFH mature adults are on antiretroviral treatment. Consistent with a rapid expansion of ART, many (43%) of the 2017 HIV+ mature adults have been on treatment for 4 years or less.

[37] This may initially look at odds with an update of only 4 percentage points for HIV+ individuals. However, It is possible that respondents associate survival expectations for HIV+ individuals to newly infected individuals and already assume these persons are treated with ART.

6.3 Treatment Effects for other forward-looking decisions

In this final section we expand our analysis of BenKnow treatment effects to a broader set of outcomes, including savings and investments, labor supply in weekly hours, income, expenditure for children, whether respondents consume alcohol or tobacco, own consumption, and marriage.

There are several mechanisms through which the BenKnow treatment effects on population survival can affect life-cycle behaviors such as savings and investments, even in the absence of treatment effects on own survival. For example, while the information provided during the BenKnow intervention was focused on people who have the same age and sex of the respondents, it is possible that respondents extended the conveyed gains in life expectancy and survival also to other demographic groups. It is actually true that gains in life expectancy have been particularly high for young adults who were more affected by the AIDS epidemics and who benefited the most from the rollout of ART. We hence speculate that the BenKnow intervention led respondents to believe other household members would live longer, inducing more investments and savings.

Baseline descriptive statistics and the detailed description of each measure of forward-looking behaviors are reported in Table C.24. Savings and investments are captured using a factor score composed using monetary savings, expenditure on agricultural inputs and animals.[38] Analyses of these outcomes are based on a specification that is similar to our empirical model for risky sex (Equation 3) and estimates the BenKnow treatment effects on outcomes measured in 2018, while controlling for the 2017 baseline, individual characteristics and strata fixed effects. Q-values are reported to adjust for multiple hypothesis testing (Benjamini, Yekutieli et al. 2001). To evaluate significance of the BenKnow treatment effects across all key outcomes considered in this paper, we include sexual behaviors in the adjustment for multiple hypothesis testing.

The BenKnow treatment effects for forward-looking life-cycle behaviors are reported in Table 8. Adjusting for multiple hypothesis testing, the analyses document statistically significant treatment effects for sexual behaviors and savings and investments. The treatment effect on labor supply and alcohol and tobacco have p-values below 5%, but significance is diminished once Q-values adjust for multiple hypothesis testing.

Because of the importance of savings and investments as a critical life-cycle behavior for mature adults, we expand on the analyses in Table 8 by investigating the BenKnow treatment effect for each variable entering the savings and investments index separately (Table 9 Panel A). Note that all investment variables are related to agriculture, the main activity. There is no treatment effect on monetary savings (which are, however, not widespread in our study populations). But during 2017–18, the intervention resulted in

[38]Specifically, using factor analysis that allows to reduce multiple variables to a latent factor that explains most of the common variation, we construct a factor score using the inverse hyperbolic sine transformation of monetary savings, the inverse hyperbolic sine transformation of expenditure on agricultural tools, seeds and fertilizers and the number of animals owned by the respondent.

Table 8: BenKnow treatment effects on other forward-looking life-cycle behaviors

Outcome:	(1) **Savings and investments**	(2) **Labor supply**	(3) **Income**	(4) **Child expenditures**
Benknow treatment effect	0.072	2.072	0.246	0.096
	(0.020)	(0.988)	(0.237)	(0.126)
Q-value	(.011)	(.166)	(1)	(1)
Observations	1,450	1,479	1,478	1,478
Outcome:	(5) **Own expenditures**	(6) **Alcohol and tobacco**	(7) **Married**	(8) **Risky sex**
Benknow treatment effect	-0.073	-0.030	0.016	-0.159
	(0.137)	(0.012)	(0.007)	(0.056)
Q-value	(1)	(.105)	(.165)	(.047)
Observations	1,478	1,479	1,479	1,479

Notes: This table shows regression coefficients for the treatment effect on several outcomes. All regressions include village pair fixed effects, dummies for age categories used in the intervention, gender and years of schooling. We additionally control for the outcome at baseline. Standard errors are clustered at village level. Risky sex is a dummy variable taking value 0 if sexually passive, 1 if having sex with the spouse only, 2 if having multiple sexual partners and using condom during the last intercourse, 3 if having multiple sexual partners and not using condom during the last intercourse. Savings and investments is a factor score constructed using the inverse hyperbolic sine transformation of monetary savings, the inverse hyperbolic sine transformation of expenditure on agricultural tools, seeds and fertilizers and the number of animals owned by the respondent. Labor supply is the number of hours worked during the last week. Income is the inverse hyperbolic sine transformation of annual income. Children expenditure is the inverse hyperbolic sine transformation of medical expenditure, school fees and clothes for children. Alcohol and tobacco is a dummy equal to 1 if the respondent currently smokes or consumes alcohol. Own expenditure is the inverse hyperbolic sine transformation of medical expenditure and expenditure in clothes for the respondents themselves. All monetary variables are measured in Malawian Kwacha. Q-values for multiple testing are calculated using Benjamini, Yekutieli et al. (2001).

increased expenditures in tools by 24%, and 1.4 more animals (from a baseline average of 9.3). Panel B of Table 9 shows the effect separately for the different types of animals. As chicken is the least expensive livestock, it is the component that is most likely to respond within a relatively short 1-year time span to the information provided during the BenKnow intervention in 2017. Consistent with this fact, chicken account for 1.2 out of an overall of 1.4 additional farm animals—or 86% of the average overall increase in livestock—among mature adults in the BenKnow treatment group. Because livestock is an important asset in rural Malawi, these treatment effects indicate that the BenKnow intervention might have sustained effects on life-cycle behaviors for mature adults.

Table 9: BenKnow treatment effects on savings and specific components of agricultural investments (tools and livestock)

Panel A: Savings and Investments				
	(1)	(2)	(3)	(4)
Outcome:	**Savings**	**Tools**	**Seeds and fertilizers**	**Total livestock**
Benknow treatment effect	0.248	0.245**	0.242	1.435***
	(0.211)	(0.114)	(0.176)	(0.386)
Observations	1479	1478	1476	1454
Panel B: Livestocks				
	(5)	(6)	(7)	(8)
Outcome:	**Goats**	**Pigs**	**Chicken**	**Cattle**
Benknow treatment effect	-0.106	0.121	1.183***	0.130
	(0.067)	(0.104)	(0.315)	(0.098)
Observations	1477	1478	1459	1476

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the treatment effect on several measures of savings and investments in agriculture. We use an inverse hyperbolic sine transformation for agriculture expenditure to not exclude observations with zero. Total livestock is the number of goats, cattle, pigs, chicken owned by the household. All regressions include village pair fixed effects, dummies for age categories used in the intervention by gender and level of schooling. We additionally control for the outcome at baseline. Standard errors are clustered at village level.

Table 10: BenKnow treatment effects on marriage

	Outcome: being married in 2018			Divorced in 2018
	(1)	(2)	(3)	(4)
treatment	0.016**	0.069***	-0.003	0.003
	(0.007)	(0.018)	(0.007)	(0.005)
Sample	All	Not married in 2017	Married in 2017	Married in 2017
Observations	1,479	389	1,087	1,087

p-values * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the treatment effect of the intervention on the likelihood of being married. Estimates are based on a linear probability model. Outcome variable $y_{ij(2018)}$ is being married (yes/no) in 2018, controlling for marital status (married yes/now) $y_{ij(2017)}$ in 2017. All analyses additionally control randomization strata (village pair) fixed effects, dummies for age groups, gender and years of schooling. Divorced includes divorced and separations.

We conclude our analyses by investigating BenKnow treatment effects on marriage, where marriage represents an important life-cycle behavior affecting a multitude of aspects such as health, well-being, and social and economic situations for mature adults (Chae 2016; Myroniuk, Kohler and Kohler 2020). It is possible that the BenKnow intervention affected marriage rates during 2017–18 for several reasons, including because marriage is perceived as a HIV risk-reduction strategy (Greenwood et al. 2017) and higher survival rates of potential partners increase the benefits of marriage.

Consistent with these hypotheses, the Column 1 of Table 10 shows a positive BenKnow treatment effect of 1.6 percentage points on the probability of being married in 2018 controlling for 2017 marital status. Splitting the sample according to 2017 marital status shows that the results is entirely driven by transition into marriages for unmarried respondents (Columns 2 and 3). Indeed, there is no effect on being divorced in 2018 for those who were married in 2017 (Column 4).[39,40] In addition to its substantive relevance, the positive BenKnow treatment effect on marriage is another potential robustness check of our main result on self-reported sexual behavior, as marriage is unlikely to suffer from reporting bias and respondents are likely to perceive marriage as a HIV-risk reduction strategy.

7 Conclusions

While the centrality of survival expectations for a broad range of health, human-capital and other life-cycle behaviors is undisputed, there is evidence that many individuals have distorted survival perceptions and are overly pessimistic about their own survival. This is particularly the case in populations experiencing rapid changes in socioeconomic development or health, or in populations affected by major epidemics (such as HIV/AIDS) or political upheavals. In such contexts where individuals have inaccurate mortality perceptions, survival expectations are a potentially modifiable determinant of health behaviors that can be targeted by health interventions. Yet, to date, there is only limited evidence about whether more accurate survival expectations, and better knowledge about recent gains in health and survival in countries having experienced rapid gains in life expectancy, have the potential to improve individuals' decision-making, health and economic outcomes.

Focusing on a high-mortality context where survival has been rapidly improving, yet pessimism about survival is widespread due to individuals' experience of a devastating HIV/AIDS epidemic, this paper fills this essential knowledge gap: Our BenKnow study among mature adults in rural Malawi provides the first RCT-based evidence about possi-

[39]The BenKnow treatment effect on marriage is statistically significant in the individual analysis in Table 10, while significance disappears when marriage is included with the other outcomes in Table 8. Yet, given the importance of marriage in the lives of mature adults in rural Malawians, we investigate and report the BenKnow treatment effect on marriage separate from the other life-course behaviors.

[40]Moreover, analyses by gender reveals that the treatment effects results come from single women getting married, where our sample included very few unmarried men in 2017 whose marriage transitions could be affected by the BenKnow intervention (Tables C.25–C.26).

bilities to (*i*) improve the accuracy of survival perceptions by providing information about current mortality risks through a health-information intervention, and (*ii*) test the hypothesis that more accurate survival expectations improve health, human capital investments, and related life-course decision-making.

Importantly, the BenKnow intervention improved healthy behaviors by reducing sexual risk taking, and it had sustained life-course effects by increasing agricultural investments, and marriage. In terms of sexual behaviors, BenKnow increased the likelihood of sexual abstinence, and reduced the likelihood of having multiple sex partners. These treatment effects on sexual behaviors are robust to alternative specifications that allow for misreporting of sexual behaviors or use pregnancies/births in the study villages as alternative outcomes. In terms of agricultural investments, BenKnow increased total livestock through increased holdings of chicken, a common livestock in which accumulation is realistic within a 1-year time horizon, and it increased the 1-year likelihood of marriage (particularly among unmarried women). The magnitudes of these BenKnow treatment effects are conceptually plausible and substantively relevant.

In addition to documenting these policy-relevant treatment effects on key health behaviors and lifecycle decisions, the extensive information on subjective expectations in our data allowed us to document the mechanisms through which the BenKnow intervention affected individuals' behaviors. Contrary to our own priors, our analyses did not find BenKnow treatment effect on own survival expectations, neither in the short-term nor after one year, possibly because of private information about one's own health status. Instead, the behavioral responses to BenKnow seem to be driven by sustained increases in expectations about population-level survival expectations. Survival expectations particularly increased for healthy persons, persons infected with HIV, and HIV+ individuals on ART, while BenKnow had no effect on subjective survival probabilities of HIV+ persons sick with AIDS. These updates of survival perceptions are empirically accurate, and occurred despite the fact that BenKnow provided only age- and gender-specific population mortality information that was not conditional on health or HIV status. Overall, our analyses of subjective expectations in response to the BenKnow intervention suggest that the above treatment effect on sexual behavior is not driven by updates of own survival probabilities, but instead, by perceptions that HIV+ people living longer, which in turn implies an increase in HIV prevalence in the pool of potential sexual partner that renders risky sexual behavior more "costly" in terms of HIV infection risks.

These findings highlight the importance of incorporating detailed subjective expectations data in field experiments of health and health behaviors, as our study would not have been able to identify the pathways through which BenKnow affected sexual and other life-course behaviors in the absence of such data. Our study also illustrates that, even if a specific health-information intervention is effective in terms of affecting the hypothesized outcomes, the actual pathways through which the intervention affects these outcomes may be different from the prior beliefs of the investigators. Information about the pathways,

however, is critical for assessing the scope of potential scale-up of intervention subsequent to initial feasibility and efficacy analyses, as are provided by our present BenKnow study, and an understanding of mechanisms is essential for future fine-tuning of study designs and information of follow-up, replication and/or effectiveness studies.

The external validity of our results is limited to mature adults in a low-income country. This study population is pertinent for the aims of the BenKnow health-intervention in that mature adults in rural Malawi experience relatively high mortality that varies significantly across individuals due to their health status, behavior and socioeconomic contexts. As a result, mortality expectations are important determinants health and other life-cycle behaviors among mature adults. Separate studies are necessary to investigate the effect of a BenKnow health intervention on younger age groups. Additionally, even though the sample size for the BenKnow study was sufficient for documenting average treatment effects across the complete study population, follow-up studies with larger sample sizes will need to revisit our general lack of evidence for significant heterogeneity of treatment effects. More extensive data on expectations, including for example perceptions of current and future HIV prevalence among potential partner pools, might also provide further evidence on the mechanisms through which BenKnow affected sexual behaviors and other lifecourse outcomes, and follow-up data collections on the BenKnow cohort need to establish if treatment effects are sustained and lead to improvements in individual's well-being over time. Additional studies may also be necessary to refine how health-information interventions can effectively and credibly convey information about complex aspects such as survival probabilities in populations with low levels of literacy and numeracy.

Overall this BenKnow study is important in that it represents the first RCT focused on survival perceptions, and it innovates by documenting that survival expectations are a potentially malleable determinant of health and lifecycle behaviors for populations that face high objective and/or perceived mortality risks. Our findings are novel in that we show, for the first time, that a relatively simple BenKnow health-information intervention can help individuals obtain more accurate survival expectations, and as a consequence, can encourage individuals to invest more in their health and adopt more forward looking lifecycle behaviors. Our analyses thus lend strong support to the development and further testing of cost-effective health-information programs focused on survival expectations. Such BenKnow-inspired interventions are highly pertinent in HIV-affected countries sub-Saharan Africa, where mortality levels and disease conditions/treatments have changed swiftly and non-monotonically in recent years, and this relevance may extend more generally to older individuals who are likely to underestimate their longevity given recent global reductions of mortality at older ages.

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A Online Appendix A: Expectations Questions

2018Main Questionnaire. Chewa RESPONDENT ID:[_____] 16-38

Section 12: Expectations Questions

INTERVIEWER: Recount the number of peanuts and check that you have 10 peanuts in the plate [__]. As you provide the explanation below, add the peanuts into the plate to illustrate what you say.

Ndikufunsani mafunso angapo okhudzana mwayi wa momwe zinthu zina zitha kuchitikira. Apa pali mtedza khumi. Ndikupemphani kuti mutenge wina mwa mtedzawu ndipo muuyike mu mbale. Mtedza omwe mutayike mbalemu uyimilira mwayi wakuti chithu china chake chitha kuchitika. Mtedza umodzi ukutanthawuza kuti pali mwayi wochepa zedi kuti chithu chinachake chitha kuchitika. Ngati simuyika mtedza wina uliwonse mbalemu zikutanthawuza kuti mukudziwa kuti palibiletu mwayi wina uliwonse kuti chithu chinachake chitha kuchitika. Mukamawonjezera mtedza mbalemu ndiye kuti mwayi wakuti chithu china chake chitha kuchitika ukuwonjezekeranso. Mwachitsanzo, ngati muyike m'mbalemu mtedza umodzi kapena uwiri, zikutanthawuza kuti pali kutheka kochepa kuti chinthucho nkuchitika ngakhale kuti mwayi woti chinthucho chitha kuchitika ngochepa. Ngati muyike mtedza usanu zikutanthawuza kuti pali kutheka kofanana kuti chinthu chitha kuchitika kapena ayi. Ngati mwayika mtedza usanu ndi umodzi (6) zikutanthawuza kuti pali mwayi ochulukirapo pang`ono kuti chinthu chitha kuchitika kuyelekezera ndi kusachitika. Ngati muyike mtedza onse, khumi, zikutanthawuza kuti muli ndichikhulupiriro kuti chinthu chichitika basi. Palibe yankho lokhoza kapena lolakwa, ndingofuna ndiwone m'mene mumaonera zinthu.

Mwachitsanzo ngati inu ndi ine tikusewera bawo ndipo mwafunsidwa kuti ndi kotheka bwanji kuti mutha kuwina bawoyo ndipo mwayika mtedza usanu ndi uwiri (7) m'mbalemu ndiye kuti zikutanthawuza kuti pa bawo khumi (10) zinazilizonse zomwe tisewere mukukhulupirira kuti mupambanapo bawo zisanu ndi ziwiri (7), titasewera kwa nthawi yayitali. Ngati mukukhulupirira kuti mupambana bawo zopitilira pang'ono zisanu ndi ziwiri koma zochepera bawo zisanu ndi zitatu, mutha kuswa mtedza umodzi pakati-ndi-pakati ndipo muika mtedza usanu ndi uwiri komanso ndi theka la mtedza womwe mwaswa uja m'balemu

"I will ask you several questions about the chance or likelihood that certain events are going to happen. There are 10 peanuts in the cup. I would like you to choose some peanuts out of these 10 peanuts and put them in the plate to express what you think the likelihood or chance is of a specific event happening. One peanut represents one chance out of 10. If you do not put any peanuts in the plate, it means you are sure that the event will NOT happen. As you add peanuts, it means that you think the likelihood that the event happens increases. For example, if you put one or two peanuts, it means you think the event is not likely to happen but it is still possible. If you pick 5 peanuts, it means that it is just as likely it happens as it does not happen (fifty-fifty). If you pick 6 peanuts, it means the event is slightly more likely to happen than not to happen. If you put 10 peanuts in the plate, it means you are sure the event will happen. There is not right or wrong answer, I just want to know what you think.

Let me give you an example. Imagine that we are playing Bawo. Say, when asked about the chance that you will win, you put 7 peanuts in the plate. This means that you believe you would win 7 out of 10 games on average if we play for a long time. If you think that you will win slightly more than 7 games but less than 8 games on average, then you can break the peanut in half and put 7 ½ peanuts on the plate.

INTERVIEWER: Report for each question the NUMBER OF PEANUTS put in the PLATE. After each question, replace the peanuts in the cup (unless otherwise noted).

Interviewer: Remind respondent that he/she can put ½ bean if respondent wants to pick value between two whole peanuts (e.g., respondent thinks 1 and 1/2 peanuts (1.5) is the best answer). If respondent is not able to break the peanut in ½, help him/her with this.

For question X1: If respondent puts 10 (or 0) peanuts, prompt "Are you sure that this event will almost surely (not) happen?" CIRCLE 1 in column P if you prompted the respondent, and report the final answer only.

X1 **Tengani mtedza womwe uyimire m'mene mukuganizira kuti….** *Pick the number of peanuts that reflects how likely you think it is that…*	**# of peanuts in plate**	**Prompt for 0 or 10?**
For men: **Mwamuna wofanana naye zaka mudera lanu lino amwalira mkatikati mwa zaka zisanu** **For women:** **Mzimayi wofanana naye zaka mudera lanu lino amwalira mkatikati mwa zaka zisanu** *A person of your sex and age in your community will die within 5 years.*	[_____]	1

For the subsequent questions, no longer prompt for "0" and "10" answers

X2 **Tengani mtedza womwe uyimire m'mene mukuganizira kuti….** *Pick the number of peanuts that reflects how likely you think it is that…*	**# of peanuts in plate**
a) **Muli ndi kachilombo koyambitsa EDZI pakalipano.** *you are infected with HIV/AIDS now*	[_____]
b) **INTERVIEWER**: for polygamous men, ask for most recent spouse **Amuna/akazi anu kapena wachikondi wanu ali ndi kachilombo koyambitsa matenda a EDZI panopa** *your spouse or romantic partner is infected with HIV/AIDS now* **(INTERVIEWER: If no spouse or romantic partner, write 66)**	[_____]

X3 Tsopano tiganizire za mamuna/mkazi wathanzi wa m'mudzi mwanu yemwe alibe kachilombo koyambitsa EDZI. Tengani mtedza omwe uyimire m'mene mukuganizira kuti mwamunayu atenga kachilombo koyambitsa matenda a EDZI. **Consider a healthy man/woman in your village who currently does not have HIV. Pick the number of**	**# of peanuts in plate**

peanuts that reflects how likely you think it is that he will become infected with HIV...	
c) **Ngati akwatirane ndi munthu yemwe ali ndi kachilombo koyambitsa EDZI m'miyezi khumi ndi iwiri(12)ikubwerayi** *within the next 12 months if he/she is married to someone who is infected with HIV/AIDS*	[_____]
d) **M'miyezi khumi ndi iwiri(12) ikubwerayi ngati pali anthu ena omwe amagonana nawo kuphatikizirapo akunyumba kwawo** *within the next 12 months if he/she has several sexual partners in addition to his/her spouse*	[_____]

Ndikufuna kuti muganizire kuti ndi kotheka bwanji kuti inuyo mumwalira mtsogolo muno. Tili ndichikhulupiliro kuti palibe chilichonse choipa chimene chikuchitikireni, komabe, zoipa zina zitha kuchitika m'zaka zikubwerazi ngakhale mutapewa kuti zisachitike. Ngati simukufuna, mutha kukana kuyankha funso limeneli.

I want you to think how likely it is that you will die in the near future. We believe that there is nothing bad that will happen to you. But something bad might happen in the near future years to come, even though you prevent it to happen. If you don't want, you can refuse to answer these questions.

INTERVIEWER: If respondent refuses to answer, skip to **GS1**

PICK THE NUMBER OF PEANUTS THAT REFLECTS HOW LIKELY YOU THINK IT IS THAT YOU WILL:	**# OF PEANUTS in plate**
X7 **Tengani mtedza womwe uyimire m'mene inu mukuganizira kuti** *Pick the number of peanuts that reflects how likely you think it is that you*	
a) mumwalira m'zaka zisanu (5) zikubwerazi kuyambira lero *will die within a five-year period beginning today* **(LEAVE PEANUTS ON PLATE)**	[_____] **if 10 → SKIP to X8a**
Add the number of peanuts that reflecs how likely you think it is that you: b) **wonjezerani mtedza m'balemu womwe uyimirire m'mene inu mkuganizira kuti mumwalira m'zaka khumi(10) zikubwerazi kuyambira lero** *will die within a ten-year period beginning today* **(IT IS POSSIBLE TO ADD ZERO ADDITIONAL PEANUTS)**	[_____]

Pomaliza, ndikufuna muganizire kuti nkotheka bwani kuti munthu wina amwalire pamene nthawi ikudutsa. Ndikufunsani zokhudza munthu ongopeka yemwe akukhala mdera lanu, ndipo ndimulongosola munthuyu kwa inu.

Finally, I would like you to consider the likelihood that somebody else dies as time goes by. I am going to ask you about an imaginary person living in the same context like you, and I am going to describe him/her to you.

INTERVIEWER: For each of questions X8a to X8d start with an empty plate and 10 peanuts. Do not leave peanuts on plate.

Tengani mtedza umene uyimire mmene mukuganizira kuti nkotheka bwanji kuti mmodzi mwa anthu awa akhoza kumwalira mu zaka zisanu kuchokera lero: *Pick the number of peanuts that reflects how likely you think it is that one of the following persons will die within a five-year period beginning today:*	**# of peanuts in plate**
X8a **For men:** **Mwamuna wa zaka ngati inu wa thanzi ndipo alibe kachilombo ka HIV?** *A man your age who is healthy and does not have HIV?* **For women:** **Mkazi wa zaka ngati inu wa thanzi ndipo alibe kachilombo ka HIV?** *A woman your age who is healthy and does not have HIV?*	[_____]
X8b **For men:** **Mwamuna wa zaka ngati inu amene ali ndi kachilombo ka HIV koma sanayambe kudwala?** *A man your age who is infected with HIV?* **For women:** **Mkazi wa zaka ngati inu amene ali ndi kachilombo ka HIV koma sanayambe kudwala?** *A woman your age who is infected with HIV?*	[_____]

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X8c **For men:** **Mwamuna wa zaka ngati inu amene ali ndi kachilombo ka HIV ndipo akudwala Edzi?** *A man your age who sick with AIDS?* **For women:** **Mkazi wa zaka ngati inu amene ali ndi kachilombo ka HIV ndipo akudwala Edzi?** *A woman your age who is sick with AIDS?*	[_____]
X8d **For men:** **Mwamuna wa zaka ngati inu amene akudwala Edzi ndipo akulandira mankhwala otalikitsa moyo a ARV?** *A man your age who is sick with AIDS and who is treated with antiretroviral treatments (ART)?* **For women:** **Mkazi wa zaka ngati inu amene akudwala Edzi ndipo akulandira mankhwala otalikitsa moyo a ARV?** *A woman your age who "is" sick with AIDS and who is treated with antiretroviral treatments (ART)?*	[_____]

	# of peanuts in plate
Pa funso lomalizira, ndinakufunsani za mpata woti mamuna [mkazi] wa msinkhu wanuwu amene ali wa thanzi ndipo alibe HIV angamwalire mu zaka zisanu [5] zikubwerazi. Ndipo mwayika mtedza okwana XX [=answer from X8a] mu mbale. In a previous question I asked you about the chances that a man [woman] your age who is healthy and does not have HIV dies within 5 years. You have put XX peanuts [=answer from X8a] on the plate. **[INTERVIEWER: Put XX peanuts [=answer from X8a] on the plate]** **Tsopano ndikufuna kukufunsani za mpata okuti munthu ameneyu angamwalire mu zaka zisanu [5] zikubwerazi atakhala kuti alibe HIV koma ali ndi matenda ena.** I'd now like to ask you about the chances of dying within 5 years for this person if he [she] is HIV negative but has some other diseases. **Tengani mtedza umene uyimire mmene mukuganizira kuti nkotheka bwanji kuti mmodzi mwa anthu awa akhoza kumwalira mu zaka zisanu kuchokera lero:** Pick the number of peanuts that reflects how likely you think it is that one of the following persons will die within a five-year period beginning today:	
X8e **For men:** **Mwamuna wa zaka ngati inu amene amadwala kuthamanga kwa magazi [high blood pressure] koma samamwa mankhwala a matendawa?** A man your age who has hypertension or high blood pressure and does not take medication for this condition? **For women:** **Mkazi wa zaka ngati inu amene amadwala kuthamanga kwa magazi [high blood pressure] koma samamwa mankhwala a matendawa?** A woman your age who has hypertension or high blood pressure and does not take medication for this condition?	[_____]
X8f **For men:** **Mwamuna wa zaka ngati inu amene amadwala kuthamanga kwa magazi [high blood pressure] ndipo amamwa mankhwala a matenda a kuthamanga kwa magazi?** A man your age who has hypertension (or high blood pressure) and now takes medication to treat high blood pressure? **For women:** **Mkazi wa zaka ngati inu amene amadwala kuthamanga kwa magazi [high blood pressure] ndipo amamwa mankhwala a matenda a kuthamanga kwa magazi?** A woman your age your age who has hypertension (high blood pressure) and and now takes medication to treat high blood pressure?	[_____]
X8g **For men:** **Mwamuna wa zaka ngati inu amene amadwala shuga koma samamwa mankhwala a matendawa?** A man your age who has diabetes or high blood sugar and does not take medication for this condition? **For women:** **Mkazi wa zaka ngati inu amene amadwala shuga koma samamwa mankhwala a matendawa?** A woman your age your age who has diabetes or high blood sugar and does not take medication for this condition?	[_____]

Benefits of Knowledge **Respondent ID [_____]**

The Benefits of Knowledge: Mortality risk, Mental health and Life-cycle behavior

Protocol and Questionnaire for Health Information Intervention

Section 1---Background Information Pre-Intervention

Pamene a kafukufuku anabwera tsiku lina, anafunsa mafunso okhudza chiyembekezo cha mmene anthu ena kapena inu mungayembekezere kumwalira pamene nthawi ikudutsa pogwiritsa ntchito mtedza khumi (10).
When the survey team came to your house the other day, they asked you some questions about the chances that some people or you might die as time goes by using 10 peanuts.

BK0	**Kodi mukukumbukila mafunso amene aja?** *Do you remember those questions?*	**Inde** Yes……1 **Ayi** No……2

Tiyeni tione mayankho anu limodzi
Let's look at your answers together.

INTERVIEWER: Verify the number of peanuts that respondent put when previously interviewed. Put the corresponding number of peanuts in the cup for 5 years probabilities and the corresponding number of peanuts in the cup for 10 years probabilities. Show the respondent the cup with [M9_X7A] peanuts for the 5 years probabilities and the cup with [M9_X7B] peanuts for the 10 years probabilities. Do not remove the peanuts from the cups and keep them in front of the respondent during the whole time of the interview!

Munayika mtedza [___], kutanthauza kuti pali kuthekera kokwana [__] pa maulendo khumi (10) aliwonse, pamene munafunsidwa za kuthekera koti mukhoza kumwalira mu zaka zisanu (5) zikubwerazi. [Interviewer lay out M9_X7A peanuts for 5-year mortality risk on flat surface]
*You allocated [M9_X7A] peanuts, meaning [M9_X7A] chances out of 10, when asked about the chances that you might die in the next **5 years**. [Interviewer: lay out M9_X7A peanuts for 5-year mortality risk on flat surface]*

Munayika mtedza [___], kutanthauza kuti pali kuthekera kokwana [__] pa maulendo khumi (10) aliwonse, pamene munafunsidwa za kuthekera koti mukhoza kumwalira mu zaka khumi (10) zikubwerazi. [Interviewer lay out M9_X7B peanuts for 10-year mortality risk on flat surface, below the M9_X7A peanuts]
*You allocated [M9_X7B] peanuts, meaning [M9_X7B] chances out of 10, when asked about the chances that you might die in the next **10 years**. [Interviewer lay out M9_X7B peanuts for 10-year mortality risk on flat surface, below the M9_X7A peanuts]*

BK1	**Kodi mwaonako kuti anthu okhala kumudzi ku Malawi kuno akukhala moyo nthawi yaitali kuyelekeza ndi mmene zinalili zaka zisanu kapena khumi zapitazo?** *Have you noticed lately that people in Malawi living in villages like yours tend to live longer than they used to 5 or 10 years ago?*	**Inde** Yes ..... 1 **Ayi** No ..... 2→ continue with videos following the exact sequence below; start with Video 1 (Story 1)
BK2	**Kodi munazindikira bwanji kuti anthu akukhalitsa kusiyana ndi mmene zinalili zaka zisanu kapena khumi zapitazo?** *How did you notice that people tend to live longer than they used to 5 or 10 years ago?* ***[check all answers that apply]*** *Interviewer: probe if the respondent does not provide*	**Ndimapita ku maliro owelengeka** I go to fewer funerals.....1 **Ndinaona kuti anzanga ndi abale anga ochepa ndi amene akumwalira** I noticed that fewer of my friends and relatives are dying .....2 **Ndaona kuti anthu akumwalira atakalamba** I notice that

Benefits of Knowledge **Respondent ID [_____]**

initially a response.	people are dying when they are older ……..……3 **Chithandizo cha Edzi chikupezeka pafupi** AIDS treatment has become available nearby.……4 **Ntchito zaumoyo zapita patsogolo, ndipo izi ndizothandiza anthu** Health services have improved, and this helps individuals.……5 **Zina** Other [_____].....6

Section 2---Videos

[CONTINUE WITH VIDEOS:]

Tsopano ndikufuna ndikuonetseni kanema amene akuonetsa kuti masiku ano anthu ku Malawi akukhalitsa ndi moyo kuyelekeza ndi zaka zisanu kapena khumi zapitazo. Kanemayu wajambulidwa ndi anthu a zisudzo ndipo nkhani zili mkatimu zikugwilizana ndi mmene za umoyo ndi imfa zikuyendera ku Malawi kuno.

*I would like to show you a video showing that people in Malawi are living longer nowadays than 5 or 10 years ago. These videos have been recorded by **actors** and the information in these videos is consistent with recent health and mortality trends in Malawi.*

Video 1 (Story 1---Davie the carpenter):

A middle-aged man, working it his carpenter's shop, talks: Hi, my name is Davie and I have a bit of land where I grow maize. I also know how to work with wood. I am lucky because both my parents are still alive. They are both in their 70ies and are doing well. They are taking care of themselves: they have enough food, they are in good health and they don't need to go often to the hospital and they actively participate in village activities. They also teach important things about life to me and my children. They knew that they could live longer than their parents and with the little they were earning they bought some livestock to support themselves in their old days. My brothers and I also help them sometimes. My aunties and uncle also died very old. They were more than 65. And I see a lot of other families in our village with old family members that are still alive. My grand-parents were not so lucky and they were dead when they were my age. Yes, I really notice that people are living longer nowadays. And it is a good thing for everyone.

A middle-aged man, working in his carpenter's shop, talks: Moni, dzina langa ndine Davie ndipo ndili ndi malo pang'ono omwe ndimalimapo chimanga komanso ndili ndi luso lopala matabwa. Ndili ndi mwayi chifukwa makolo anga onse adakali moyo. Onse ali mu zaka za mma 70 ndipo ali ndi moyo wabwino. Akuzisamalira okha, ali ndi chakudya chokwanira, umoyo wao ndi wabwino, sapita kuchipatala pafupipafupi, ndipo amatenga nao gawo kwambiri muzochitika za mmudzi muno. Amatiphunzitsanso makhalidwe abwino ine ndi ana anga. Ankadziwa kuti atha kukhala moyo wautali kuyelekeza ndi makolo awo ndipo ndi ndalama zochepa zomwe amapeza anagula ziweto zoti zidzawathandize akadzakalamba. Ine ndi azibale anga timawathandiza nthawi zina. Atsibweni ndi azakhali anga anamwaliranso atakalamba. Anali ndi zaka zoposera 65 zakubadwa. Komanso, ndimaona mabanja ambiri mmudzi mwathu muno amene ali ndi achibale okalamba omwe adakali moyo. Agogo anga sanachite mwayi okhala ndi moyo nthawi yayitali ndipo anamwalira ali ndi msinkhu ngati wangawu. Inde, ndikutha kuona kuti anthu masiku ano akukhalitsa ndi moyo wautali. Ndipo ichi ndi chinthu chabwino kwa wina aliyense.

Interviewer: continue with Video 2 --Rose

Video 2 (Story 2 -- Rose):

Benefits of Knowledge **Respondent ID [_____]**

A middle-aged woman, working in her tailoring shop , talks: Hi, my name is Rose. I work in the field to plant cassava. When I have time, I do a bit of tailoring. I am married and I have four children who also help me in the field. The younger two go to school if they do not help at home. Five years ago, my husband got tested for HIV and he found out that he was HIV-positive. This was really a shock, and I was worried about the future of the family. How could we manage if my husband died soon? However, we have been lucky because my husband has had access to antiretroviral treatment (ART) in the local clinic. He takes his medicine regularly as the doctor explained him and I make sure he does not forget. He also often goes to the clinic for refill and check-ups. He looks really healthy and fit and does not show any sign of the disease. We do not know what will happen but we are very grateful for the availability of treatment. Ten years ago, my brother had HIV and he became very sick very quickly and died rapidly. Nowadays, there is more hope for people with HIV thanks to the availability of treatment. They can expect a longer life.

A middle-aged woman, working in her tailoring shop , talks: Moni. Dzina langa ndiine Rose. Ndimagwira ntchito ya ulimi ndipo ndimalima chinangwa. Ndikakhala ndi nthawi, ndimasoka zovala. Ndili pa banja ndipo ndili ndi ana anayi amene amandithandizanso kulima. Ana awiri aang'ono amapita ku sukulu pa nthawi imene samandithandiza pakhomo. Zaka zisanu zapitazo, amuna anga anakayezetsa HIV ndipo anapezeka kuti ali ndi kachilombo ka HIV. Ichi chinatizizimutsa kwambiri ndipo ndinali ndi nkhawa ndi tsogolo la banja lathu. Kodi tidzakwanitsa bwanji ngati amuna anga angamwalire posachedwa? Komabe, takhala ndi mwayi chifukwa amuna anga anapeza mwayi olandira mankhwala otalikitsa moyo a ARV kuchokera ku chipatala cha mdera lino. Iwowa amamwa mankhwala pafupipafupi molingana ndi mmene a dokotala amawalangizila ndipo ndimaonetsetsa kuti asaiwale. Amapitanso ku chipatala kukatenga mankwala ena komanso kuti akawaunike m'thupi. Iwowa amaoneka a thanzi ndi mphamvu ndipo samaonetsa zizindikilo zina zilizonse za matendawa. Sitikudziwa kuti kudzachitika chiani kutsogoloku koma tili othokoza chifukwa cha kupezeka kwa mankhwala otalikitsa moyo. Zaka khumi zapitazo, mchimwene wanga anali ndi kachilombo ka HIV ndipo anayamba kudwala mofulumira mpaka anamwalira mosachedwetsa. Masiku ano pali chiyembekezo kwa anthu amene ali ndi kachilombo ka HIV chifukwa cha kupezeka kwa mankhwala otalikitsa moyo. Anthuwa akhoza kukhala moyo wautali.

Interviewer: continue with Video 3 – the old man

Video 3 (Story 3 – old man):

An old man seating at home: I am lucky because I am more than 60 years old and I am still alive and feel healthy. I am not the only luck one. My neighbor next door is more than 70. And think about the popular musician Giddes Chalamanda. He is over 85 years old, and is still performing for the people. Last year, he even made is long-held dream of going to America come true, giving several shows across the USA. My parents were not so lucky because they died when they were in their 40ies. I think things are better nowadays. The kids, they do not die so frequently anymore. They get their immunization and many sleep under bed nets. They do not get sick so often. The adults, they do not die from HIV so rapidly anymore. The treatments, they really help. Also, people are not so hungry anymore and they eat more. When I was a kid, we were often hungry. My children and grand-children, they have almost always their meal on the table. It helps to build your health and keep you strong and prevent you from being unwell. Yes, things have changed quite a lot and people are less sick and live longer.

An old man seating at home: Ndiine odala chifukwa ndili ndi zaka zopyola 60 ndipo ndikadali moyo komanso ndimdziona wa thanzi. Sindili ndekha odala. Anzanga oyandikana nawo ali ndi zaka zopyola 70. Ndipo taganizilani za oyimba uja Giddes Chalamanda; ali ndi zaka zopyola 85 koma akadaimbilabe anthu. Chaka chatha, anakwanilitsa maloto ake a nthawi yaitali popita ku America, ndipo anakaimba madera osiyanasiyana ku America. Makolo anga analibe mwayi umenewu chifukwa anamwalira ali ndi zaka za mma 40'chakuti. Ndikuona kuti zinthu zili bwino masiku ano. Ana anasiye kumwalira pafupipafupi masiku ano. Amalandira katemera ndipo amagona m'masikito. Sadwaladwala kawirikawiri. Pamene akuluakulu samwalira mwamsanga akakhala ndi kachilombo ka HIV masiku ano. Mankhwala otalikitsa moyo akuthandiza kwambiri. Komanso, anthu sakukhala a njala ndipo akumadya muchulukirapo. Pamene ndinali wang'ono, timakhala a njala kawirikawiri. Ana ndi zidzukulu zanga amalandira chokudya pafupifupi nthawi zones. Izi zimathandiza kuti thupi likhale la thanzi ndi la mphamvu komanse kuteteza kuti usadwale. Inde, zinthu zasintha kwambiri ndipo anthu sadwaladwala komanso akukhala moyo wautali.

END OF VIDEO

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Section 3--- Provision of Updated Mortality Information

[INTERVIEWER: SELECT THE MORTALITY INFORMATION SHEET CORRESPONDING TO THE RESPONDENT'S AGE AND SEX. USE THE INFORMATION ON THIS SHEET WHEN WE REFER TO 'MORTALITY INFO SHEET' BELOW]

Gulu lathu la kafukufuku linayang'ana zotsatila za kafukufuku zoonetsa mmene anthu ku Malawi akumwalilira komanso mmene anthu aakazi/aamuna a zaka ngati inu akuyembekezekera kukhala moyo. Kuchokera ku zotsatira za kafukuzi, ndi zotheka kuyerekeza mmene anthu aakazi/aamuna a zaka ngati inu angayembekezere kumwalira mu zaka zisanu kapena khumi zikubwerazi
Our research team has looked at some recent data showing how many individuals in Malawi are dying, and how long individuals your age and sex are likely to live. From these findings, it is possible to estimate how likely a person of your age and sex will die within five or ten years.

Tikufuna tikuonetseni zimenezi poonetsa zithunzi. Pa zithunzizi, anthu a blue ndi chizindikilo cha anthu amene ali moyo pamene anthu ofiila ndi chizindikilo cha anthu amene amwalira.
We would like to illustrate this to you with some pictures. In these pictures, blue persons indicate people who are alive, and red persons indicate people who have died.

Tiyamba ndi anthu khumi aakazi/aamuna a zaka ngati inu. Anthu khumi amenewa ali moyo pakadali pano ndipo akukhala m'Malawi muno mu dera ngati lanuli. Mukuona anthu khumi mu chithunzichi amene onse ali a blue, kapena kuti amoyo [INTERVIEWER: SHOW FIRST GRAPH ON THE MORTALITY INFO SHEET].
*We begin with 10 hypothetical persons who are about your age and are of the same sex. These 10 persons are alive today, and they live in Malawi in a similar context as you do. You can see these 10 persons in this figure that shows 10 blue, or alive, persons [INTERVIEWER: SHOW **FIRST GRAPH** ON THE MORTALITY INFO SHEET].*

Tsopano tiyeni tione zaka zisanu zikubwerazi ndipo tiunike kuti ndi anthu angati mwa anthu amene ali pa chithunzipa adzakhale ndi moyo zaka zisanu kuchokera lero. Mmene mukuonera pa chithunzipa [SHOW SECOND GRAPH "5 YEARS FROM TODAY" ON THE MORTALITY INFO SHEET], ena mwa anthuwa adzakhala atamwalira, ndipo akuoneka ofiila, pamene ena adzakhala ali moyo, ndipo akuoneka a blue, zaka zisanu kuchokera lero. Chiwerengero cha anthu ofiila mu chithunzichi chikuonetsa kuti nkotheka bwanji kuti munthu wa mkazi/mwamuna wa zaka ngati inu atha kumwalira mu zaka zisanu zikubwerazi; pamene chiwerengero cha anthu ofiila chikukwera, zikuonetsa kuti kuthekera ndi kochuluka kuti munthu akhoza kumwalira.
*We can now look five years into the future, and ask how many of the persons in the first figure will still be alive **5 years from today**. As you see on this picture [SHOW SECOND GRAPH "5 YEARS FROM TODAY" ON THE MORTALITY INFO SHEET], some of the persons will have died, and are shown in **red**, and others will still be alive, and are shown in **blue**, five years from today. How many persons are in red in this graph tells the chance out of 10 that a person your age and sex will die within the next **five** years: the more people we show in red (or the more red a person is), the higher is the risk of dying.*

Kutengera pa zimene tikudziwa lero, tikuona kuti [READ RED LINE IN 5-YEARS FROM TODAY SECTION] mu zaka zisanu zikubwerazi kuchokera lero, pamene [READ BLUE LINE IN 5-YEARS FROM TODAY SECTION].
Based on our knowledge today, we predict that [READ RED LINE IN 5-YEARS FROM TODAY SECTION] within 5 years from today, while [READ BLUE LINE IN 5-YEARS FROM TODAY SECTION] within 5 years from today.

Tikhonzanso kuwunika zaka khumi zikubwerazo kuchokera lero ndikuonanso kuti ndi anthu angati mu chithunzi choyamba amene adzakhale akadali moyo zaka khumi kuchokera lero. Mmene mukuonera pa chithunzipa [SHOW THIRD GRAPH "10 YEARS FROM TODAY" ON THE MORTALITY INFO SHEET] ena mwa anthuwa adzakhala atamwalira, ndipo akuoneka ofiila, pamene ena adzakhala ali moyo, ndipo akuoneka a blue, zaka khumi kuchokera lero. Chiwerengero chan anthu ofiila mu chithunzichi chikuonetsa kuti nkotheka bwanji kuti munthu wa mkazi/mwamuna wa zaka ngati inu atha kumwalira mu zaka khumi zikubwerazi; pamene chiwerengero cha anthu ofiila chikukwera, zikuonetsa kuti kuthekera ndi kochuluka kuti munthu akhoza kumwalira.
*We can also look ten years into the future, starting today, and how many of the persons in the first figure will still be alive **10 years from today**. As you see on this picture [SHOW THIRD GRAPH "10 YEARS FROM TODAY" ON THE MORTALITY INFO SHEET], some of the*

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*persons will have died, and are shown in **red**, and others will still be alive, and are shown in **blue**, ten years from today. How many persons are in red in this graph tells you is the chance out of 10 that a person your age and sex will die within the next **ten** years. The more people we show in red (or the more red a person is), the higher is the risk of dying.*

Kutengera pa zimene tikudziwa lero, tikuona kuti [READ RED LINE IN "10-YEARS FROM TODAY" SECTION] mu zaka khumi zikubwerazi kuchokera lero, pamene [READ BLUE LINE IN "10-YEARS FROM TODAY" SECTION] mu zaka khumi zikubwerazi kuchokera lero
Based on our knowledge today, we predict that [READ RED LINE IN "10-YEARS FROM TODAY" SECTION] within 10 years from today, while [READ BLUE LINE IN "10-YEARS FROM TODAY" SECTION] within 10 years from today.

Inde, palibe amene angalosere zimene zingamuchitikire munthu wina, koma zotsatira za kafukufuku wathu zikhoza kukuonetserani kuti nkothekwa bwanji kuti chinthu chikhoza kuchitika powunika gulu lalikulu la anthu aakazi/aamuna ofanana nao zaka. Ndipo zotsatirazi ndi zothandiza kwa inu poona kuti nkotheka bwanji kuti mukhoza kumwalira mu zaka zisanu kapena khumi zikubwerazi. Izi ndi zimene takhala tikuchita. Choncho, tikawunika anthu khumi aakazi/aamuna a zaka ngati inu, tikuona kuti:
Of course, nobody can predict what will happen to a specific individual, but this information can tell you about what is likely to happen if we look at a large group of people of your age and sex. And this information is helpful for you to think how likely you might die within the next 5 or 10 years. So, let's summarize this information: if we look at 10 persons your age and sex:

- **[READ RED LINE IN "5-YEARS FROM TODAY" SECTION] mu zaka zisanu zikubwerazi kuchokera lero, pamene [READ BLUE LINE IN "5-YEARS FROM TODAY" SECTION] mu zaka zisanu zikubwerazo kuchokera lero, ndipo**
- *[READ RED LINE IN "5-YEARS FROM TODAY" SECTION] within 5 years from today, while [READ BLUE LINE IN "5-YEARS FROM TODAY" SECTION] within 5 years from today; and*
- **[READ RED LINE IN "10-YEARS FROM TODAY" SECTION] mu zaka khumi zikubwerazo kuchokera lero, pamene [READ BLUE LINE IN "10-YEARS FROM TODAY" SECTION] mu zaka khumi zikubwerazo kuchokera lero**
- *[READ RED LINE IN "10-YEARS FROM TODAY" SECTION] within 10 years from today, while [READ BLUE LINE IN "10-YEARS FROM TODAY" SECTION] within 10 years from today*

Choncho potsatira zomwe ndakuuzanizi, nditati nditenge mtedza omwe uyimire kuti nkotheka bwanji kuti munthu wa mkazi/mwamuna wa zaka ngati inu angamwalire mu zaka zisanu, ndingaike mtedza [INTERVIEWER: PICK THE NUMBER OF BEANS THAT CORRESPONDS TO THE NUMBER OF RED PEOPLE ON THE FIGURE WITH 5-YEARS MORTALITY INFO] m'balemu.
So based on this information, if I were to pick the number of peanuts that reflects how likely it is that a person your age and sex would die within 5 years, I would put **[INTERVIEWER: PICK THE NUMBER OF BEANS THAT CORRESPONDS TO THE NUMBER OF RED PEOPLE ON THE FIGURE WITH "5-YEARS FROM TODAY" MORTALITY INFO]** *peanuts on the plate.*
Interviewer: Put the number of beans infront of the cup with the 5-years chances of dying. Do not remove the peanuts but leave on the ground. So the respondent can see original answer in the cup, and new information on the ground until the end of the interview.

Choncho potsatira zomwe ndakuuzanizi, nditati nditenge mtedza omwe uyimire kuti nkotheka bwanji kuti munthu wa mkazi/mwamuna wa zaka ngati inu angamwalire mu zaka khumi, ndingaike mtedza [INTERVIEWER: PICK THE NUMBER OF BEANS THAT CORRESPONDS TO THE NUMBER OF RED PEOPLE ON THE FIGURE WITH 10-YEARS MORTALITY INFO] m'balemu.
So based on this information, if I were to pick the number of peanuts that reflects how likely it is that a person your age and sex would die within 10 years, I would put **[INTERVIEWER: PICK THE NUMBER OF BEANS THAT CORRESPONDS TO THE NUMBER OF RED PEOPLE ON THE FIGURE WITH "10-YEARS FROM TODAY" MORTALITY INFO]** *peanuts on the plate.*

Interviewer: Put the number of beans infront of the cup with the 5-years chances of dying. Do not remove the peanuts but leave on the ground. So the respondent can see original answer in the cup, and new information on the ground until the end of the interview.

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[Interviewer: *The following is an example how to use ½ peanuts and whole peanuts if the figures are partially colored in red. 1) If the instructions on the mortality info* ***sheet say "less than 1 person will have died" put ½ a peanut; 2) If the instructions on the mortality info sheet say "Between 2 and 3 persons will have died" or "About 2 and 3 persons will have died" then put 2½ peanut. In all other cases put a whole peanut*** *(for example, if instructions say "almost [#] persons will have died", "about 1 person will have died", "approximately[#] persons will have died", "almost [#] persons will have died", "slightly more [#] persons will have died".*

BK3: **Kodi mukumvetsetsa nkhaniyi?** *Do you understand this information?*	**Inde** Yes .....1 → SKIP BK3a **Ayi** No.....2 → go back to beginning of Section 3 above, and explain again to respondent and ask BK3a;
BK3a. Kodi mukumvetsetsa nkhaniyi? *Do you understand this information?*	**Inde** Yes .....1 **Ayi** No.....2
BK3b. Kodi mukuganiza kuti mfundo zomwe zakambidwazi zikusonyeza molondola zomwe zimachitika kwa anthu a zaka ngati inu omwe akumamwalira mmudzi muno masiku ano? Do you think this information reflects correctly what happens to people of your age and sex dying in your community nowadays?	**Inde, zikusonyeza molondola** Yes, reflects correctly.....1 **Inde, zikusonyeza pang'ono** Yes, reflects somewhat.....2 **Ayi, sizikusonyeza molondola** No, does not reflect correctly.....3 **Sindikudziwa** Dont' Know.....4

Zindikirani kuti kutengera mmene mulili umoyo wanu komanso mmene lilili banja lanu ndi kapezedwe kanu, zikhozakupangitsa kuti kukhale kotheka kapena kosatheka kuti mumwalire kuyerekeza ndi munthu wa mkazi/mwamuna amene ali mu gulu lalikulu la anthu

Of course, depending on your health and depending on your own family and economic context, you might be more or less likely to die than the average person your age and sex in a large group.

Tsopano, ndikufuna ndikufunseninso zokhudza kuthekera koti inu mukhoza kumwalira mu zaka zisanu kapena khumi zikubwerazi. Taonani mtedza omwe munaika poyamba paja kuimirira kuthekera koti inu mukhoza kumwalira ku zaka zisanu kapena khumi zikubwerazi. Kutengera zinthu zomwe ndakuuzani, komanso zomwe mukudziwa zokhudza umoyo wanu, banja lanu ndi kapezedwe ka pakhomo panu, chonde yankhaninso mafunso otsatirawa. Kumbukirani kuti mutha kuswa mtedza pakatikati ndipo mutha kuika theka la mtedza moonjezera mtedza watunthu ngati mukufuna kusankha nambala ya pakati pa mtedza uwiri watunthu.

Now, I would like to ask you again about what you think about the chances that you might die in the next five or ten years. Look at the peanuts that you had put earlier for the chances that you will die within 5 years and 10 years. Based on what I have told you, and based on what you know about your own health, family and economic context please answer again the following questions below. Remember that you can break a peanut in ½ and put ½ peanut in addition to the whole peanuts if you want to pick a value between two whole peanuts.

Interviewer: Provide respondent with the empty 3rd cup in front of him/her. Give respondent 10 peanuts. Remind respondent that he/she can put ½ bean if respondent wants to pick value between two whole peanuts (e.g., respondent thinks 1 and 1/2 peanuts (1.5) is the best answer). If respondent is not able to break the peanut in ½, help him/her with this. If respondent used ½ peanut, do not substitute with a whole peanut.

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Tengani mtedza womwe uyimire m'mene inu mukuganizira kuti *Pick the number of peanuts that reflects how likely you think it is that you*	**# OF PEANUTS in plate**
BK_X7a: mumwalira m'zaka zisanu (5) zikubwerazi kuyambira lero *will die within a five-year period beginning today* **(LEAVE PEANUTS ON PLATE)**	[_____] **If 10 → ask BK_X8a, or BK_X8b, or BK_X8c, or BK_X8d and if the answer is yes and the respondent does not revise his/her answer then continue to BK4.**

BK_X8a: If BK_X7a>M9_X7A: Mayankho anu akusonyeza kuti panopa mukuganiza kuti kuthekera kwanu koti mutha kumwalira muzaka zisanu zikubwerazi ndikwakukulu kusiyana ndi komwe munanena poyamba paja ndisanakuonetseni mauthengawa. kodi izi ndi zomwe zinali mmaganizo mwanu? Your answers show that you now think that the chance of dying within the next 5 years are larger than what you said before I gave you the information. Is that what you had in mind?	Yes 1 No 2 If No, go to **BK_X7a2** If Yes, go to **BK_X7b**
BK_X8b: If BK_X7a<M9_X7A: Mayankho anu akusonyeza kuti panopa mukuganiza kuti kuthekera kwanu koti mutha kumwalira muzaka zisanu zikubwerazi ndikwakung'ono kusiyana ndi komwe munanena poyamba paja ndisanakuonetseni mauthengawa. kodi izi ndi zomwe zinali mmaganizo mwanu? Your answers show that you now think that the chance of dying within the next 5 years are smaller than what you said before I gave you the information. Is that what you had in mind?	Yes No If No, go to **BK_X7a2** If Yes, go to **BK_X7b**
BK_X8c: If BK_X7a=M9_X7A: Mayankho anu akusonyeza kuti panopa mukuganiza kuti kuthekera kwanu koti mutha kumwalira muzaka zisanu zikubwerazi ndikofanana ndi komwe munanena poyamba paja ndisanakuonetseni mauthengawa. kodi izi ndi zomwe zinali mmaganizo mwanu? Your answers show that you now think that the chance of dying within the next 5 years are equal to what you said before I gave you the information. Is that what you had in mind?	Yes No If No, go to **BK_X7a2** If Yes, go to **BK_X7b**
Tengani mtedza womwe uyimire m'mene inu mukuganizira kuti Pick the number of peanuts that reflects how likely you think it is that you	# OF PEANUTS in plate
BK_X7a2: mumwalira m'zaka zisanu (5) zikubwerazi kuyambira lero will die within a five-year period beginning today **(LEAVE PEANUTS ON PLATE)**	[_____] if 10 go to BK4 or BK5 depending if they changed their answer compared to the initial number of peanuts in the main questionnaire

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Add the number of peanuts that reflects how likely you think it is that you: **BK_X7b. wonjezerani mtedza m'balemu womwe uyimirire m'mene inu mkuganizira kuti mumwalira m'zaka khumi(10) zikubwerazi kuyambira lero** *will die within a ten-year period beginning today* **(IT IS POSSIBLE TO ADD ZERO ADDITIONAL PEANUTS)**	[_____]
BK_X8d: If BK_X7b>M9_X7B: Mayankho anu akusonyeza kuti panopa mukuganiza kuti kuthekera kwanu koti mutha kumwalira muzaka khumi zikubwerazi ndikwakukulu kusiyana ndi komwe munanena poyamba paja ndisanakuonetseni mauthengawa. kodi izi ndi zomwe zinali mmaganizo mwanu?Your answers show that you now think that the chance of dying within the next 10 years are larger than what you said before I gave you the information. Is that what you had in mind?	Yes No If No, go to **BK_X7b2** If Yes, go to BK4
BK_X8e: If BK_X7b<M9_X7B: Mayankho anu akusonyeza kuti panopa mukuganiza kuti kuthekera kwanu koti mutha kumwalira muzaka khumi zikubwerazi ndikwakung'ono kusiyana ndi komwe munanena poyamba paja ndisanakuonetseni mauthengawa. kodi izi ndi zomwe zinali mmaganizo mwanu?Your answers show that you now think that the chance of dying within the next 10 years are smaller than what you said before I gave you the information. Is that what you had in mind?	Yes No If No, go to **BK_X7b2** If Yes, go to BK4
BK_X8f: If BK_X7b=M9_X7B: Mayankho anu akusonyeza kuti panopa mukuganiza kuti kuthekera kwanu koti mutha kumwalira muzaka khumi zikubwerazi ndikofanana ndi komwe munanena poyamba paja ndisanakuonetseni mauthengawa. kodi izi ndi zomwe zinali mmaganizo mwanu? Your answers show that you now think that the chance of dying within the next 10 years are equal to what you said before I gave you the information. Is that what you had in mind?	Yes No If No, go to **BK_X7b2** If Yes, go to BK4

Tengani mtedza womwe uyimire m'mene inu mukuganizira kuti *Pick the number of peanuts that reflects how likely you think it is that you*	**# OF PEANUTS in plate**
BK_X7b2: mumwalira m'zaka zisanu (5) zikubwerazi kuyambira lero *will die within a ten-year period beginning today* **(LEAVE PEANUTS ON PLATE)**	[_____] go to BK4 or BK5 depending if they changed their answer compared to the initial number of peanuts in the main questionnaire

Interviewer: Confirm if the respondent has changes the number of beans on the plate compared to his/her initial answer. If the respondent did NOT change his/her answer, continue with question BK4. If the respondent did change his/her answer, continue with question BK5.

BK4 Kodi ndi chifukwa chiyani simunafune kusintha yankho lanu? Why did you not want change your answer: **(select all that apply)**	**Ndimadziwa kale kuti anthu akukhala ndi moyo kwa nthawi yayitali, choncho sindinaphunzirepo china chilichonse chatsopano** I already knew that people live longer so I did not learn anything new ……1 **Sindikukhulupirira za nkhani zomwe mwandiuzazi** I do not believe the information you gave me …… 2

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Benefits of Knowledge **Respondent ID [_____]**

	Nkhani zomwe mwandiuzazi sizinamveke kwenikweni The information you provided was not very clear ..... 3 **Palibe amene angalosere za imfa yake** Nobody can predict their mortality ..... 4 **Zina** Other [_____]..... 5
BK5. Kodi ndi chifukwa chiyani mwasintha yankho lanu? Why did you change your answer? **(select all that appy)**	**Sindimadziwa kuti anthu akukhalitsa ndi moyo** I did not know that people live longer ..... 1 **Ndikukhulupirira za nkhani zomwe mwandiuza** I believe the information you gave me .....2 **Nkhani zomwe mwandiuza ndizogwira mtima kwambiri** The information you provided to me was very convincing .....3 **Zina** Other 4

Pomaliza, ndikufuna muganizire kuti nkotheka bwanji kuti munthu wina amwalire pamene nthawi ikudutsa. Ndikufunsani zokhudza munthu ongopeka yemwe akukhala mdera lanu, ndipo ndimulongosola munthuyu kwa inu.

Finally, I would like you to consider the likelihood that somebody else dies as time goes by. I am going to ask you about an imaginary person living in the same context like you, and I am going to describe him/her to you.

INTERVIEWER: Empty the 3rd cup infront of the respondent. For each of questions X8a to X8d start with an empty plate and 10 peanuts. Do not leave peanuts on plate. If the respondent used ½ peanut, replace it after asking the question with one whole peanut and make sure that the respondent starts with 10 whole peanuts.

Tengani mtedza umene uyimire mmene mukuganizira kuti nkotheka bwanji kuti mmodzi mwa anthu awa akhoza kumwalira mu zaka zisanu kuchokera lero: *Pick the number of peanuts that reflects how likely you think it is that one of the following persons will die within a five-year period beginning today:*	**# of peanuts in plate**
BK_X8a **For men:** **Mwamuna wa zaka ngati inu wa thanzi ndipo alibe kachilombo ka HIV?** *A man your age who is healthy and does not have HIV?* **For women:** **Mkazi wa zaka ngati inu wa thanzi ndipo alibe kachilombo ka HIV?** *A woman your age who is healthy and does not have HIV?*	[_____]
BK_X8b **For men:** **Mwamuna wa zaka ngati inu amene ali ndi kachilombo ka HIV koma sanayambe kudwala?** *A man your age who is infected with HIV?* **For women:** **Mkazi wa zaka ngati inu amene ali ndi kachilombo ka HIV koma sanayambe kudwala?** *A woman your age who is infected with HIV?*	[_____]
BK_X8c **For men:** **Mwamuna wa zaka ngati inu amene ali ndi kachilombo ka HIV ndipo akudwala Edzi?** *A man your age who sick with AIDS?* **For women:** **Mkazi wa zaka ngati inu amene ali ndi kachilombo ka HIV ndipo akudwala Edzi?** *A woman your age who sick with AIDS?*	[_____]

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BK_X8d **For men:** **Mwamuna wa zaka ngati inu amene akudwala Edzi ndipo akulandira mankhwala otalikitsa moyo a ARV?** *A man your age who sick with AIDS and who is treated with antiretroviral treatments (ART)?* **For women:** **Mkazi wa zaka ngati inu amene akudwala Edzi ndipo akulandira mankhwala otalikitsa moyo a ARV?** *A woman your age who sick with AIDS and who is treated with antiretroviral treatments (ART)?*	[_____]

B Online Appendix B: Information Intervention

B.1 Intervention video scripts

I would like to show you a video showing that people in Malawi are living longer nowadays than 5 or 10 years ago. These videos have been recorded by actors and the information in these videos is consistent with recent health and mortality trends in Malawi.

Video 1 (Story 1—Davie the carpenter): A middle-aged man, working it his carpenter's shop, talks: Hi, my name is Davie and I have a bit of land where I grow maize. I also know how to work with wood. I am lucky because both my parents are still alive. They are both in their 70ies and are doing well. They are taking care of themselves: they have enough food, they are in good health and they don't need to go often to the hospital and they actively participate in village activities. They also teach important things about life to me and my children. They knew that they could live longer than their parents and with the little they were earning they bought some livestock to support themselves in their old days. My brothers and I also help them sometimes. My aunties and uncle also died very old. They were more than 65. And I see a lot of other families in our village with old family members that are still alive. My grand-parents were not so lucky and they were dead when they were my age. Yes, I really notice that people are living longer nowadays. And it is a good thing for everyone.

Interviewer: continue with Video 2 –Rose Video 2 (Story 2 – Rose): A middle-aged woman, working in her tailoring shop , talks: Hi, my name is Rose. I work in the field to plant cassava. When I have time, I do a bit of tailoring. I am married and I have four children who also help me in the field. The younger two go to school if they do not help at home. Five years ago, my husband got tested for HIV and he found out that he was HIV-positive. This was really a shock, and I was worried about the future of the family. How could we manage if my husband died soon? However, we have been lucky because my husband has had access to antiretroviral treatment (ART) in the local clinic. He takes his medicine regularly as the doctor explained him and I make sure he does not forget. He also often goes to the clinic for refill and check-ups. He looks really healthy and fit and does not show any sign of the disease. We do not know what will happen but we are very grateful for the availability of treatment. Ten years ago, my brother had HIV and he became very sick very quickly and died rapidly. Nowadays, there is more hope for people with HIV thanks to the availability of treatment. They can expect a longer life.

Video 3 (Story 3 – old man): An old man seating at home: I am lucky because I am more than 60 years old and I am still alive and feel healthy. I am not the only luck one. My neighbor next door is more than 70. And think about the popular musician Giddes Chalamanda. He is over 85 years old, and is still performing for the people. Last year, he even made is long-held dream of going to America come true, giving several shows across the USA. My parents were not so lucky because they died when they were in their 40ies. I think things are better nowadays. The kids, they do not die so frequently anymore. They get their immunization and many sleep under bed nets. They do not get sick so often. The

adults, they do not die from HIV so rapidly anymore. The treatments, they really help. Also, people are not so hungry anymore and they eat more. When I was a kid, we were often hungry. My children and grand-children, they have almost always their meal on the table. It helps to build your health and keep you strong and prevent you from being unwell. Yes, things have changed quite a lot and people are less sick and live longer. END OF VIDEO

B.2 Statistical Information

Figure B.1: Benefits-of-Knowledge Health-information Intervention: Health information sheet providing life-table-based information about 5-year and 10-year mortality probabilities for a woman aged 60-64 years old.

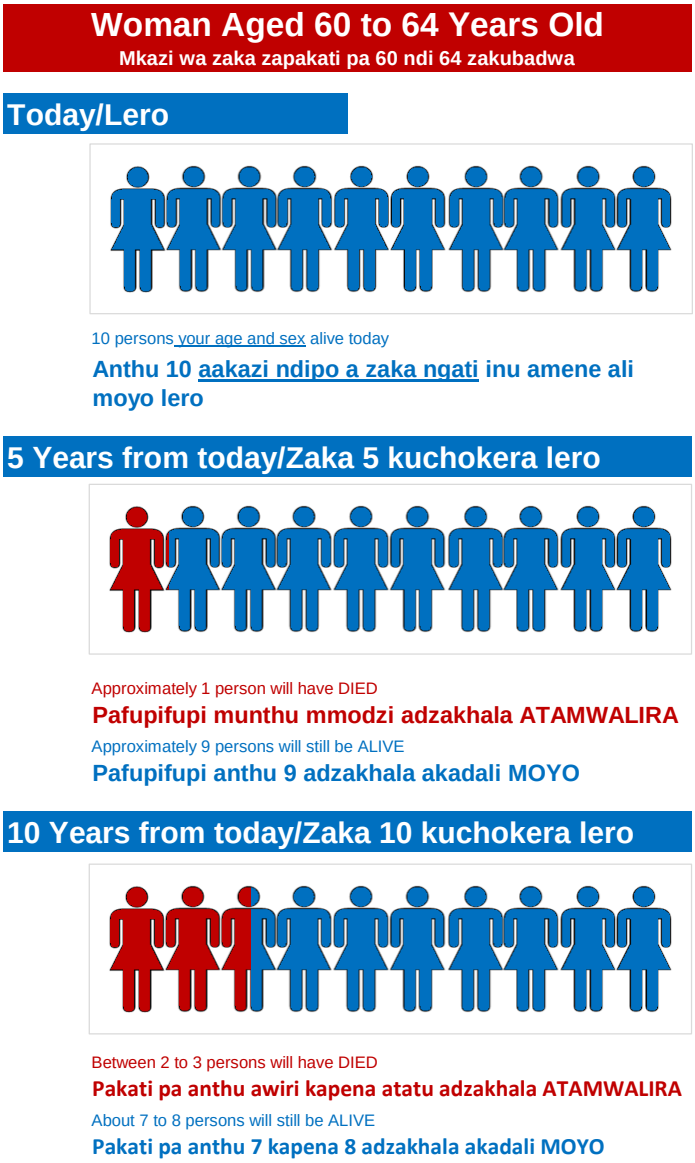
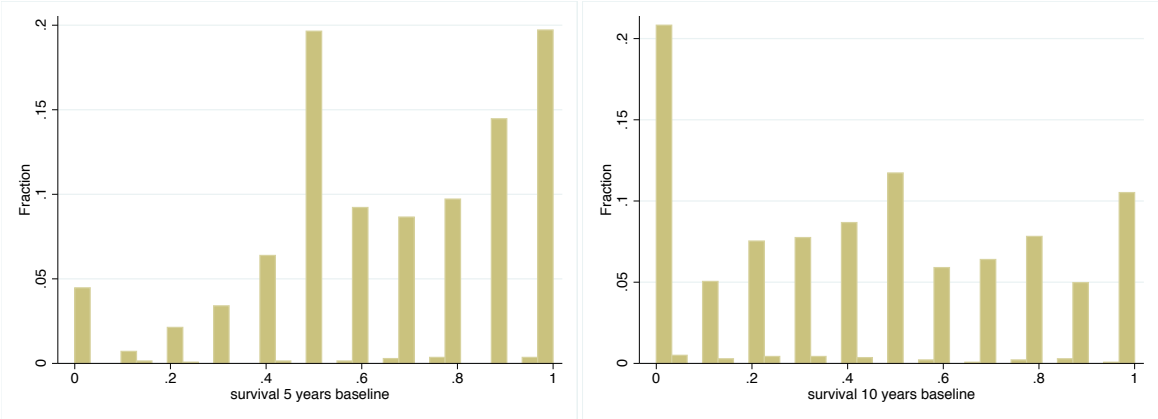


Table B.1: Life table probabilities of dying for BenKnow health-information intervention

	Probability of dying			
	Men		Women	
Age	within 5 years	within 10 years	within 5 years	within 10 years
< 45	0.06	0.13	0.04	0.08
45-49	0.07	0.15	0.05	0.1
50-54	0.08	0.18	0.06	0.13
55-59	0.1	0.23	0.07	0.17
60-64	0.14	0.31	0.11	0.25
65-69	0.2	0.43	0.16	0.37
70-74	0.28	0.58	0.24	0.53
75-79	0.41	0.71	0.38	0.68
80+	0.51	0.76	0.49	0.74

The table reports mortality probabilities for each demographic group that were conveyed during the Benefits-of-Knowledge Health-information Intervention using informations sheets like the one shown in Figure B.1. Lifetable survival probabilities were obtained Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2016 (GBD 2016) Results. Seattle, United States: Institute for Health Metrics and Evaluation (IHME), 2017. Available from http://ghdx.healthdata.org/gbd-results-tool

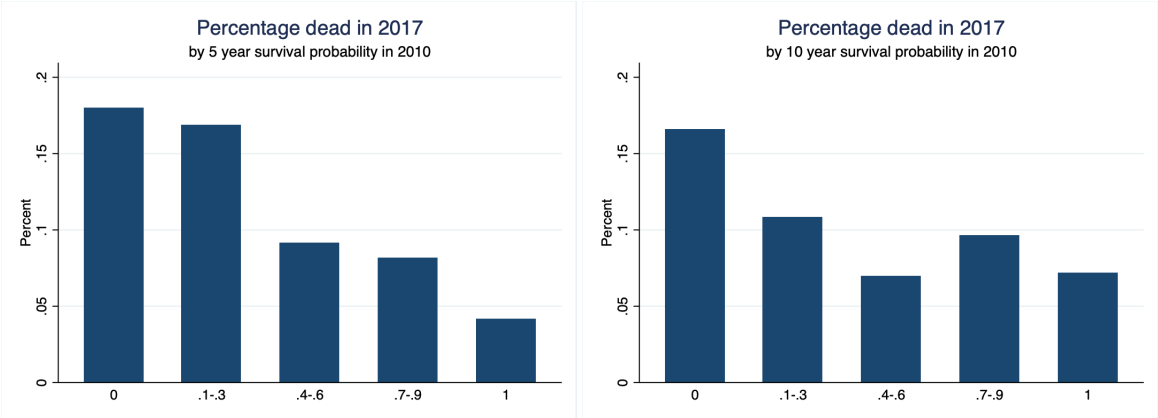
C Online Appendix C: Additional Tables and Figures



(a) 5 years **(b) 10 years**

Figure C.1: Subjective survival probabilities at baseline.

Panel (a) shows a histogram of the 5-year own subjective survival probability at the 2017 Intervention baseline. Panel (b) shows a histogram of the 10-year own subjective survival probability at the 2017 Intervention baseline.



(a) 5 years **(b) 10 years**

Figure C.2: Predictive power of subjective survival probabilities.

The figures show the percentage of respondents who are dead in 2017 by different levels of subjective survival probabilities elicited in 2010. The left figure uses 5 year survival probabilities while the right figure uses 10 year survival probabilities.

Table C.1: Subjective survival expectations as predictors of expected age at death and expected remaining life years (2018)

	(2) Expected age at death	(3) Expected remaining life years
Predictor: 5-year survival expectations		
Subj. survival probability	5.94***	6.27***
(5 years)	(1.20)	(1.19)
Observations	1,580	1,580
Predictor: 10-year survival expectations		
Subj. survival probability	5.85***	6.04***
(5 years)	(0.99)	(0.99)
Observations	1,578	1,578

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: Based on 2018 MLSFH mature adults. Questions were phrased as: Expected age at death: "How long do you expect to live? That is, until what age?". Expected remaining life years is the difference between expected age at death minus the current age. Analyses additionally control for age group, gender and schooling. Standard errors are clustered at village level.

Table C.2: Predictors of 5-year subjective survival probabilities in 2017 among MLSFH mature adults

	Subj. 5-year survival probability			
	(1)	(2)	(3)	(4)
# of persons suspect have died from AIDS in past 12 months[a]	-0.0075***			
	(0.0025)			
# of funerals attended last month		0.0013		
		(0.0043)		
# of deaths among children, spouses and parents in last 5 years			-0.0062	
			(0.013)	
Household affected by death/illness of adult household member or someone providing support for family				-0.032**
				(0.013)
Observations	1,428	1,531	1,531	1,531

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: Analyses additionally control for age group, gender and years of schooling. Standard errors are clustered at village level. (*a*) Question is worded as: Overall, how many people known to you do you suspect have died from AIDS in the past 12 months?

Table C.3: Qualitative perceptions about changing mortality level (2017)

	Mean	# obs
Prior to BenKnow mortality/survival information		
Respondent noticed that people nowadays live longer	0.453	733
How noticed:		
Attends fewer funerals	0.157	287
Fewer friends/relatives are dying	0.106	303
People are dying at older ages	0.087	298
AIDS treatment has become available	0.443	393
Health services have improved, helping individuals	0.355	361
Other	0.028	290
Post BenKnow mortality/survival information		
Agrees that BenKnow information reflects what happens in the community	0.944	732

Notes: Top panel shows the proprtion of respondents in the treatment group who answer "yes" to the question "Have you noticed lately that people in Malawi living in villages like yours tend to live longer than they used to 5 or 10 years ago?" during the BenKnow intervention (prior to conveying the BenKnow mortality/survival information), and how they noticed that people live longer. Bottom panel shows the proportion of the respondent who agree, after the BenKnow mortality/survival information was presented, that the BenKnow information reflects mortality patterns in the community (i.e., proportion of respondents answering "reflects correctly" or "reflects somewhat" to the question "Do you think this information reflects correctly what happens to people of your age and sex dying in your community nowadays")

Table C.4: BenKnow treatment effects on sexual behaviors: excluding polygamous men

	Sexual Risk Index (SRI)		
	(1) **SRI1 Had sex**	(2) **SRI2 Number of partners (0,1,2+)**	(3) **SRI3 Sex and condom (no sex, 1 partner, 2+ w/ condom, 2+ w/o condom)**
BenKnow treatment effect	-0.140**	-0.133**	-0.135**
	(0.070)	(0.062)	(0.061)
Observations	1380	1380	1380

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the effect of treatment on risky sexual behavior using an ordered probit specification for individuals who are not polygamous. Estimates are based on (ordered) probit specification in Eq. (3). All analyses additionally control randomization strata (village pair) fixed effects, dummies for age groups, gender and years of schooling. Standard errors are clustered at village level. Sexual Risk Indices are defined as: Had Sex: 0 = not sexually active in the last 12 months, 1 = sexually active in the last 12 months; Number of Partners: 0 = not sexually active in the last 12 months, 1 = sex with spouse only, 2 = sex with multiple partners; Sex and Condom: 0 = not sexually active in the last 12 months, 1 = sex with spouse only, 2 = sex with multiple partners and condom at last intercourse, 3 = sex with multiple partners and no condom at last intercourse.

Table C.5: BenKnow treatment effects on subjective health and wellbeing

	(1) **Subjective Wellbeing**	(2) **SF12 Physical Score**	(3) **SF12 Mental Score**
BenKnow treatment effect	-0.032	-0.006	-0.005
	(0.055)	(0.031)	(0.049)
Observations	1,478	1,466	1,466

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: This table shows regression coefficients for the treatment effect on subjective health and wellbeing. SF12 physical and mental score are constructed using a 12 item questionnaire on general health, physical activity and includes emotional health. Subjective wellbeing is based on the question "How satisfied are you with your life, all things considered?," with responses ranging from 1 = very unsatisfied to 6 = very satisfied. All regressions include village pair fixed effects, dummies for age categories used in the intervention, gender and years of schooling. Standard errors are clustered at village level.

Table C.6: Predicted probabilities of sexual risk taking, by BenKnow assignment: HIV negative respondents only

	BenKnow Assignment		
	Control	Treatment	Difference
No sex (SRI3 = 0)	.334	.356	.022
Single partner (SRI3 = 1)	.581	.569	-.012
Multiple partners with condom (SRI3 = 2)	.01	.009	-.001
Multiple partners without condom (SRI3 = 3)	.075	.066	-.009

Notes: The table shows the predicted probabilities of being in each risky sex state calculated using the ordered probit model with four different states. The sample includes only respondents who were tested negative for HIV during the HTC.

Table C.7: Predicted probabilities of sexual risk taking, by BenKnow assignment: Men only

	BenKnow Assignment		
	Control	Treatment	Difference
No sex (SRI3 = 0)	.166	.206	.04
Single partner (SRI3 = 1)	.685	.679	-.006
Multiple partners with condom (SRI3 = 2)	.025	.021	-.004
Multiple partners without condom (SRI3 = 3)	.124	.095	-.029

Notes: The table shows the predicted probabilities of being in each risky sex state calculated using the ordered probit model with four different states. The sample includes only males.

Table C.8: Predicted probabilities of sexual risk taking, by BenKnow assignment: Women only

	BenKnow Assignment		
	Control	Treatment	Difference
No sex (SRI3 = 0)	.373	.409	.036
Single partner (SRI3 = 1)	.617	.584	-.033
Multiple partners with condom (SRI3 = 2)	.002	.001	-.001
Multiple partners without condom (SRI3 = 3)	.009	.006	-.003

Notes: The table shows the predicted probabilities of being in each risky sex state calculated using the ordered probit model with four different states. The sample includes only females.

Table C.9: BenKnow treatment effects Sexual Risk Index 3 (SRI 3): Heterogeneity by individual characteristics

	(1)	(2)	(3)	(4)
Sample	**Male**	**Age**	**Schooling**	**Cognitive ability**
BenKnow treatment effect	-0.127	-0.152	-0.067	-0.155***
	(0.086)	(0.112)	(0.126)	(0.058)
Treatment effect × characteristics	-0.072	-0.001	-0.124	-0.047
	(0.176)	(0.009)	(0.151)	(0.088)
Q-value	(1)	(1)	(1)	(1)
Observations	1,479	1,479	1,479	1,479

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for heterogenous treatment effects on risky sexual behavior using interactions with individual characteristics. The dependent variable is Sexual Risk Index 3 (SRI 3), that is, an index taking value 0 if sexually passive, 1 if having sex with the spouse only, 2 if having multiple sexual partners and using condom during the last intercourse, 3 if having multiple sexual partners and not using condom during the last intercourse. Male is a dummy for males, age is a dummy for being at least 60 years old, schooling is a dummy for whether individuals completed primary schooling and the cognitive ability is the z-score of the ICA cognitive score implemented in the MLSFH-MAC that measures multiple domains of cognitive ability (for details, see Kohler et al. 2020). Q-values are calculated using Benjamini, Yekutieli et al. (2001) to correct for multiple hypothesis testing.

Table C.10: BenKnow treatment effects on sexual behaviors: Heterogeneity by individual characteristics - Subsamples analysis

	(1)	(2)	(3)	(4)
Sample	**Female**	**Male**	$>= 60$	< 60
BenKnow	-0.201***	-0.246***	-0.196*	-0.111*
treatment	(0.074)	(0.091)	(0.104)	(0.064)
Q-value	(0.051)	(0.051)	(0.259)	(0.259)
Observations	889	590	632	847
	(5)	(6)	(7)	(8)
Sample	**No Schooling**	**Schooling**	**Low Cognitive**	**High Cognitive**
BenKnow	-0.039	-0.128*	-0.257**	-0.213***
treatment	(0.112)	(0.071)	(0.102)	(0.079)
Q-value	(1)	(0.259)	(0.066)	(0.051)
Observations	449	939	674	805

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the effect of treatment on risky sexual behavior using an ordered probit specification for different sub-samples. The dependent variable is a variable taking value 0 if sexually passive, 1 if having sex with the spouse only, 2 if having multiple sexual partners and using condom during the last intercourse, 3 if having multiple sexual partners and not using condom during the last intercourse. First 2 columns show results by gender. Columns 3 and 4 show results for younger (age less than 60) and older respondents. Columns 5 and 6 show results by whether individuals completed primary schooling. Columns 7 and 8 show results below and above the median in the cognitive score. Q-values are calculated using Benjamini, Yekutieli et al. (2001) to correct for multiple hypothesis testing.

Table C.11: BenKnow treatment effects on sexual behaviors: Misreporting of sexual behavior

	Sex active		**Multiple partners**	
	(1)	(2)	(3)	(4)
BenKnow treatment	-0.160**	-0.211*	-0.220*	-0.237*
	(0.066)	(0.113)	(0.125)	(0.135)
Misreporting		0.015		0.094
Observations	1479	1479	1479	1479

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the effect of treatment on risky sexual behavior using a probit specification. Columns 1 and 3 are probit models while columns 2 and 4 are probit models allowing for misreporting following Hausman, Abrevaya and Scott-Morton (1998). In particular, the model allows for the possibility of false negatives (report safe sex while having risky sex). The row Misreporting shows the estimated probability of misreporting. Sexual Risk Indices are defined as: Sex active: 0 = not sexually active in the last 12 months, 1 = sexually active in the last 12 months; Multiple partners: 0 = 0 or 1 sexual partner in the last 12 months, 1 = more than 1 sexual partner in the last 12 months. In the first two columns, the set of controls include gender, age, schooling and village pair fixed effects. In the last two columns, we substitute pair effects with region fixed effects. Standard errors are always clustered at the village level.

Table C.12: BenKnow treatment effects on population survival expectations: Heterogeneity by the accuracy of the prior

	Healthy		**HIV-**		**AIDS**	
	(1) good news	(2) gap	(3) good news	(4) gap	(5) good news	(6) gap
Treatment	0.056*	0.059**	0.071**	0.067***	0.038	0.026
	(0.033)	(0.023)	(0.035)	(0.025)	(0.039)	(0.039)
Treatment × characteristics	-0.021	-0.066	-0.047	-0.114	-0.043	-0.068
	(0.043)	(0.090)	(0.047)	(0.095)	(0.048)	(0.125)
Observations	1272	1272	1268	1268	1269	1269
	ART		**Unconditional**			
	(7) good news	(8) gap	(9) good news	(10) gap		
Treatment	0.039	0.033	-0.004	-0.020		
	(0.035)	(0.031)	(0.027)	(0.018)		
Treatment × characteristics	-0.010	0.001	-0.026	0.022		
	(0.046)	(0.104)	(0.036)	(0.062)		
Observations	1267	1267	1300	1300		

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the effect of treatment on population subjective survival probabilities and interactions of treatment with measures of accuracy of prior beliefs. Gap is the gap between the objective population survival probability presented in the statistical information and the baseline unconditional subjective population survival. Good news is a dummy equal to 1 if the gap is negative. Characteristic corresponds to good news in odd columns and to gap in even columns. Each regression includes also the characteristic not interacted with treatment. Analyses are based on relation (4). All subjective survival probabilities are based on questions about hypothetical individuals, of the same age and gender as the respondent, with the specified health status; see Section 4.3 for additional detail. All analyses additionally control for age group, gender, years of schooling and strata. Standard errors are clustered at the village level.

Table C.13: BenKnow treatment effects on population survival expectations: Interactions with HIV status

	(1) **Healthy**	(2) **HIV+**	(3) **AIDS**	(4) **ART**	(5) **Unconditional**
Treatment	0.041***	0.042***	0.010	0.032**	-0.020
	(0.013)	(0.015)	(0.017)	(0.015)	(0.012)
HIV+	0.056	0.033	0.054	0.016	-0.033
	(0.048)	(0.051)	(0.074)	(0.073)	(0.047)
Treatment × HIV+	-0.030	0.010	0.010	-0.004	0.051
	(0.060)	(0.067)	(0.091)	(0.084)	(0.057)
Observations	1387	1384	1384	1380	1409

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the effect of treatment on population subjective survival probabilities and interactions of treatment with HIV status. HIV+ is a dummy equal to 1 if the respondent was tested positive for HIV during the HTC. Analyses are based on relation (4). All subjective survival probabilities are based on questions about hypothetical individuals, of the same age and gender as the respondent, with the specified health status; see Section 4.3 for additional detail. All analyses additionally control for age group, gender, years of schooling and strata. Standard errors are clustered at the village level.

Table C.14: BenKnow treatment effects on population survival expectations: Heterogeneity by individual characteristics

	(1) **Male**	(2) **Age**	(3) **Schooling**	(4) **Cognitive**
Healthy				
Treatment	0.012	0.030	0.099***	0.043***
	(0.019)	(0.023)	(0.022)	(0.010)
Treatment × characteristics	0.075*	0.001	-0.080**	-0.003
	(0.039)	(0.001)	(0.031)	(0.018)
Q-value	(.232)	(1)	(.098)	(1)
Observations	1421	1421	1421	1421
HIV+				
Treatment	0.047**	0.044*	0.082***	0.042***
	(0.020)	(0.023)	(0.028)	(0.013)
Treatment × characteristics	-0.012	-0.000	-0.056	-0.012
	(0.038)	(0.001)	(0.038)	(0.017)
Q-value	(1)	(1)	(1)	(1)
Observations	1418	1418	1418	1418
AIDS				
Treatment	0.019	0.009	0.054	0.016
	(0.024)	(0.026)	(0.035)	(0.016)
Treatment × characteristics	-0.008	0.000	-0.053	-0.040**
	(0.044)	(0.002)	(0.046)	(0.020)
Q-value	(1)	(1)	(1)	(.387)
Observations	1419	1419	1419	1419
ART				
Treatment	0.027	0.068***	0.096***	0.038***
	(0.023)	(0.024)	(0.028)	(0.013)
Treatment × characteristics	0.023	-0.002	-0.083**	-0.034
	(0.045)	(0.002)	(0.040)	(0.020)
Q-value	(1)	(.393)	(.334)	(.393)
Observations	1415	1415	1415	1415
Unconditional				
Treatment	-0.010	-0.014	0.001	-0.014
	(0.016)	(0.020)	(0.031)	(0.012)
Treatment × characteristics	-0.011	-0.000	-0.021	-0.008
	(0.030)	(0.001)	(0.041)	(0.020)
Q-value	(1)	(1)	(1)	(1)
Observations	1446	1446	1446	1446

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the effect of treatment on population subjective survival probabilities for different sub-samples. Male is a dummy for males, age is a dummy for being at least 60 years old, schooling is a dummy for whether individuals completed primary schooling and cognitive is the z-score for the cognitive score. Analyses are based on relation (4). All subjective survival probabilities are based on questions about hypothetical individuals, of the same age and gender as the respondent, with the specified health status; see Section 4.3 for additional detail. All analyses additionally control for age group, gender, years of schooling and strata. Standard errors are clustered at the village level. Q-values are calculated using Benjamini, Yekutieli et al. (2001) to correct for multiple hypothesis testing.

Table C.15: BenKnow treatment effects on population survival expectations: Heterogeneity by individual characteristics - Subsamples analysis

	(1) **Women**	(2) **Men**	(3) $>= 60$	(4) < 60	(5) **No Schooling**	(6) **Schooling**	(7) **Low Cognitive**	(8) **High Cognitive**
Healthy								
BenKnow	0.011	0.077	0.084	0.014	0.090	0.023	0.045	0.047
treatment	(0.016)	(0.017)	(0.017)	(0.017)	(0.017)	(0.015)	(0.015)	(0.018)
Q-value	(1)	(0.0001)	(0.0001)	(1)	(0.0001)	(0.49)	(0.023)	(0.042)
Observations	851	567	590	826	427	894	627	789
HIV+								
BenKnow	0.046	0.029	0.041	0.047	0.082	0.029	0.052	0.040
treatment	(0.019)	(0.022)	(0.021)	(0.015)	(0.030)	(0.018)	(0.021)	(0.021)
Q-value	(0.079)	(0.507)	(0.204)	(0.039)	(0.079)	(0.355)	(0.079)	(0.204)
Observations	849	566	588	824	425	893	626	787
AIDS								
BenKnow	0.012	0.008	-0.005	0.036	0.046	0.005	0.058	-0.014
treatment	(0.022)	(0.025)	(0.028)	(0.016)	(0.029)	(0.024)	(0.025)	(0.021)
Q-value	(1)	(1)	(1)	(0.332)	(0.871)	(1)	(0.332)	(1)
Observations	852	564	594	820	427	893	628	786
ART								
BenKnow	0.028	0.041	0.008	0.068	0.080	-0.000	0.076	0.016
treatment	(0.021)	(0.025)	(0.023)	(0.018)	(0.025)	(0.019)	(0.021)	(0.021)
Q-value	(0.752)	(.551)	(1)	(.005)	(.014)	(1)	(.007)	(1)
Observations	846	566	589	821	425	891	622	788
Unconditonal								
BenKnow	-0.005	-0.025	-0.026	-0.002	-0.002	-0.014	-0.022	-0.007
treatment	(0.014)	(0.019)	(0.021)	(0.014)	(0.027)	(0.017)	(0.021)	(0.016)
Q-value	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Observations	865	578	602	839	429	917	646	796

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the effect of treatment on population subjective survival probabilities for different sub-samples. First 2 columns show results by gender. Columns 3 and 4 show results for younger (age less than 60) and older respondents. Columns 5 and 6 show results by whether individuals completed primary schooling. Columns 7 and 8 show results below and above the median in the cognitive score. Q-values are calculated using Benjamini, Yekutieli et al. (2001) to correct for multiple hypothesis testing.

Table C.16: BenKnow treatment effects on own survival expectations: Heterogeneity by accuracy of the prior

	Short run				Long run			
	5 years		10 years		5 years		10 years	
	(1) good news	(2) gap	(3) good news	(4) gap	(5) good news	(6) gap	(7) good news	(8) gap
Treatment	0.014	0.007	-0.008	0.016	-0.010	0.010	-0.010	0.023
	(0.037)	(0.030)	(0.047)	(0.035)	(0.038)	(0.027)	(0.049)	(0.034)
Treatment × characteristics	0.001	0.036	0.047	0.044	-0.002	-0.081	0.017	-0.070
	(0.047)	(0.109)	(0.057)	(0.119)	(0.047)	(0.094)	(0.059)	(0.116)
Observations	1256	1256	1254	1254	1234	1234	1231	1231

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the effect of treatment on own subjective survival probabilities and interactions of treatment with measures of accuracy of prior beliefs. Short run refers to the update from balesine to the HTC stage while long run to the 2018 follow-up. Gap is the gap between the objective population survival probability presented in the statistical information and the baseline unconditional subjective population survival. Good news is a dummy equal to 1 if the gap is negative. Characteristic corresponds to good news in odd columns and to gap in even columns. Each regression includes also the characteristic not interacted with treatment as well as pair fixed effects, gender and years of schooling.

Table C.17: BenKnow treatment effects on own survival expectations: Heterogeneity by relevance and tightness of the prior

	Relevance				Extreme prior			
	Short run		Long run		Short run		Long run	
	(1) 5 years	(2) 10 years	(3) 5 years	(4) 10 years	(5) 5 years	(6) 10 years	(7) 5 years	(8) 10 years
treatment	0.007	0.015	0.014	0.027	0.020	0.040**	0.007	0.036**
	(0.015)	(0.018)	(0.013)	(0.017)	(0.016)	(0.019)	(0.014)	(0.018)
Observations	921	919	911	907	982	981	976	973

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the effect of treatment on the update in own subjective survival probabilities for individuals more likely to consider the information provided relevant for their own survival. The first four columns only include individuals for whom the difference between baseline 5-year own survival and the baseline population survival is less than 20ppt. Baseline population survival is constructed as: healthy survival * HIV probability + HIV survival * (1-HIV probability). The second four columns exclude individuals who expressed extreme beliefs (0 or 1) at least half of the time in the past waves of the MLSFH either for 5-year or 10-year survival or they have less than 3 past observations. Short run refers to the update from baseline to the HTC while long run refers to the update from baseline to the 2018 MLSFH round. Standard errors clustered at village level in parentheses.

Table C.18: BenKnow treatment effects on own survival expectations: Heterogeneity by individual characteristics

	(1) **Male**	(2) **Age**	(3) **Schooling**	(4) **Cognitive**
5 year long run				
Treatment	-0.010	0.013	0.071**	0.003
	(0.023)	(0.025)	(0.027)	(0.014)
Treatment × characteristics	0.034	-0.001	-0.096***	0.002
	(0.041)	(0.002)	(0.033)	(0.018)
Q-value	(1)	(1)	(.033)	(1)
Observations	1380	1380	1380	1380
10 year long run				
Treatment	0.007	0.038	0.114***	0.019
	(0.021)	(0.028)	(0.030)	(0.015)
Treatment × characteristics	0.026	-0.002	-0.136***	-0.018
	(0.044)	(0.002)	(0.037)	(0.021)
Q-value	(1)	(1)	(.003)	(1)
Observations	1375	1375	1375	1375
5 year short run				
Treatment	-0.018	0.032	0.047	0.016
	(0.020)	(0.024)	(0.029)	(0.013)
Treatment × characteristics	0.084**	-0.001	-0.042	0.009
	(0.039)	(0.002)	(0.038)	(0.019)
Q-value	(.302)	(1)	(1)	(1)
Observations	1391	1391	1391	1391
10 year short run				
Treatment	-0.008	0.028	0.066*	0.015
	(0.022)	(0.027)	(0.034)	(0.016)
Treatment × characteristics	0.053	-0.001	-0.073	-0.004
	(0.041)	(0.002)	(0.044)	(0.021)
Q-value	(.804)	(1)	(.804)	(1)
Observations	1388	1388	1388	1388

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the effect of treatment on population subjective survival probabilities for different sub-samples. Male is a dummy for males, age is a dummy for being at least 60 years old, schooling is a dummy for whether individuals completed primary schooling and cognitive is the z-score for the cognitive score. Q-values are calculated using Benjamini, Yekutieli et al. (2001) to correct for multiple hypothesis testing. Short run refers to the update from balesine to the HTC stage while long run to the 2018 follow-up.

Table C.19: BenKnow treatment effects on own survival expectations: Heterogeneity by individual characteristics - Subsamples analysis

	(1) **Women**	(2) **Men**	(3) $>= 60$	(4) < 60	(5) **No Schooling**	(6) **Schooling**	(7) **Low Cognitive**	(8) **High Cognitive**
Short Run 5 years								
BenKnow treatment	-0.020	0.068	-0.005	0.028	0.044	0.002	0.008	0.019
	(0.015)	(0.022)	(0.020)	(0.017)	(0.028)	(0.018)	(0.018)	(0.017)
Q-value	(.964)	(.051)	(1)	(.904)	(.904)	(1)	(1)	(1)
Observations	833	555	582	804	398	981	611	776
Short Run 10 years								
BenKnow treatment	-0.005	0.041	-0.013	0.034	0.064	-0.015	0.028	-0.002
	(0.019)	(0.024)	(0.024)	(0.020)	(0.033)	(0.021)	(0.022)	(0.022)
Q-value	(1)	(0.676)	(1)	(0.676)	(0.676)	(1)	(1)	(1)
Observations	830	555	579	803	398	978	610	774
Long Run 5 years								
BenKnow treatment	-0.010	0.020	0.000	0.008	0.059	-0.026	-0.005	0.010
	(0.020)	(0.023)	(0.020)	(0.018)	(0.028)	(0.016)	(0.026)	(0.020)
Q-value	(1)	(1)	(1)	(1)	(0.578)	(1)	(1)	(1)
Observations	829	548	571	804	400	880	601	775
Long Run 10 years								
BenKnow treatment	0.011	0.030	0.006	0.032	0.086	-0.024	0.049	-0.010
	(0.017)	(0.030)	(0.023)	(0.019)	(0.027)	(0.020)	(0.028)	(0.025)
Q-value	(1)	(1)	(1)	(0.701)	(.046)	(1)	(0.701)	(1)
Observations	825	547	567	802	400	875	600	771

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the effect of treatment on population subjective survival probabilities for different sub-samples. First 2 columns show results by gender. Columns 3 and 4 show results for younger (age less than 60) and older respondents. Columns 5 and 6 show results by whether individuals completed primary schooling. Columns 7 and 8 show results below and above the median in the cognitive score. Q-values are calculated using Benjamini, Yekutieli et al. (2001) to correct for multiple hypothesis testing.

Table C.20: BenKnow treatment effect on expectations about HIV transmission conditional on sexual behaviors: differential risk of multiple partners

	Subj. prob. of contracting HIV in the next 12 months if sex with			
	(1) HIV+ partner	(2) spouse only $\pi(0) = \Pi f^s$	(3) multiple partners $\pi(1)$	(4) $\pi(1) - \pi(0)$
Treatment	0.017	-0.002	0.048***	0.053***
	(0.020)	(0.005)	(0.016)	(0.016)
Observations	1417	1299	1418	1298

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the treatment effect on beliefs over HIV transmission risk. HIV+ partner is the update from baseline MLSFH survey in 2010 to the follow-up survey in 2018 in the probability of becoming infected with HIV having sex with an HIV+ spouse over a year. $\pi(0)$ is the product of HIV+ partner and the subjective probability of the spouse being HIV+ at baseline. $\pi(1)$ is the update from baseline MLSFH survey in 2010 to the follow-up survey in 2018 in the probability of becoming infected with HIV having sex with multiple partners over a year. $\pi(1) - \pi(0)$ is the difference in transmission risk betweeen having sex with multiple partners and having sex with the spouse only. All regressions include village pair fixed effects, dummies for age categories used in the intervention, gender and years of schooling. Standard errors are clustered at village level. Standard errors clustered at village level in parentheses.

Table C.21: Balance transmission risk in 2010

	Control	Obs	Treatment	Obs	P-value
Panel A: all respondents					
Spouse	0.787	731	0.762	705	0.033
Multiple partners	0.760	731	0.731	704	0.007
Panel B: drop a pair					
Spouse	0.787	679	0.772	655	0.208
Multiple partners	0.757	679	0.737	654	0.070

Notes: The table shows the balance between treatment and control group for the transmission risks variables measured in 2010. p-value shows the p-value of a t-test where the null hypothesis is that the difference in means between treatment and control group is zero. Panel A shows results for all respondents while panel B shows results excluding individuals living in the second biggest village pair which causes most of the imbalance.

Table C.22: Main results: drop village pair that causes imbalance in transmission risk

	Risky sex	Population expectations		Own expectations		HIV expectations	
		healthy	hiv	5 years	10 years	$\pi_1 - \pi_0$	HIV prob
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment	-0.164***	0.037***	0.047***	-0.001	0.019	0.030**	-0.038***
	(0.011)	(0.046)	(0.014)	(0.015)	(0.017)	(0.013)	(0.014)
Observations	1377	1320	1318	1283	1278	1316	1354

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the effect of treatment on selected outcomes excluding individuals living in the second biggest village pair which causes most of the imbalance. Healthy and hiv refer to the update in population survival probabilities. 5 years and 10 years refer to the update in own survival probabilities. Risky sex is a dummy variable taking value 0 if sexually passive, 1 if having sex with the spouse only, 2 if having multiple sexual partners and using condom during the last intercourse, 3 if having multiple sexual partners and not using condom during the last intercourse. $\pi_2(1) - \pi_2(0)$ is the difference in transmission risk betweeen having sex with multiple partners and having sex with the spouse only. HIV prob is the update in the subjective probability of being HIV+ from baseline to the 2018 followup. All regressions include village pair fixed effects, dummies for age categories used in the intervention, gender and years of schooling. Standard errors are clustered at village level. Standard errors clustered at village level in parentheses.

Table C.23: Main results with entropy weights to balance transmission risk

	Risky sex	Population expectations		Own expectations		HIV expectations	
		healthy	hiv	5 years	10 years	$\pi_1 - \pi_0$	HIV prob
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment	0.039***	0.042***	0.015	0.010	-0.151***	0.032*	-0.044***
	(0.011)	(0.014)	(0.012)	(0.016)	(0.046)	(0.017)	(0.014)
Observations	1379	1377	1349	1346	1429	1298	1409

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the effect of treatment on selected outcomes reweighting the sample using entropy weights to balance treatment and control group on transmission risk having sex with multiple partners. Healthy and hiv refer to the update in population survival probabilities. 5 years and 10 years refer to the update in own survival probabilities. Risky sex is a dummy variable taking value 0 if sexually passive, 1 if having sex with the spouse only, 2 if having multiple sexual partners and using condom during the last intercourse, 3 if having multiple sexual partners and not using condom during the last intercourse. $\pi_2(1) - \pi_2(0)$ is the difference in transmission risk betweeen having sex with multiple partners and having sex with the spouse only. HIV prob is the update in the subjective probability of being HIV+ from baseline to the 2018 followup. All regressions include village pair fixed effects, dummies for age categories used in the intervention, gender and years of schooling. Standard errors are clustered at village level. Standard errors clustered at village level in parentheses.

Table C.24: Balance of other outcomes

	All	Obs	Control	Treatment	P-value
Saving and investments	0.007	1464	0.028	-0.014	0.162
Labor supply	19.651	1481	19.014	20.301	0.247
Income	8.958	1481	8.935	8.982	0.854
Children expenditure	7.187	1480	7.362	7.008	0.110
Mental health	0.011	1476	0.012	0.011	0.990
Alcohol and tobacco	0.187	1481	0.197	0.177	0.345
Own expenditure	6.471	1481	6.437	6.506	0.745
Savings	3.239	1481	3.230	3.248	0.946
Tools	1.047	1480	1.199	0.892	0.038
Seeds and fertilizers	1.332	1478	1.478	1.182	0.083
Cattle	0.636	1481	0.761	0.509	0.087
Goats	1.639	1480	1.680	1.597	0.558
Pigs	0.494	1480	0.581	0.405	0.055
Chicken	6.524	1470	6.681	6.365	0.484
Animals	9.257	1468	9.629	8.879	0.205

Notes: This table shows the mean and balance of the outcomes reported in Section 6.3.

Table C.25: BenKnow treatment effect on marital status: Women

	Outcome: being married in 2018			Divorced in 2018
	(1)	(2)	(3)	(4)
BenKnow treatment	0.018*	0.065***	0.001	0.002
	(0.010)	(0.018)	(0.012)	(0.011)
Sample	All	Married in 2017	Not married in 2017	Not married in 2017
Observations	886	353	525	525

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the treatment effect of the intervention on the likelihood of being married for women. Estimates are based on a linear probability model. Outcome variable $y_{ij(2018)}$ is being married (yes/no) in 2018, controlling for marital status (married yes/now) $y_{ij(2017)}$ in 2017. All analyses additionally control randomization strata (village pair) fixed effects, dummies for age groups, gender and years of schooling. Divorced includes divorced and separations.

Table C.26: BenKnow treatment effect on marital status: Men

	Outcome: being married in 2018			Divorced in 2018
	(1)	(2)	(3)	(4)
BenKnow treatment	0.010	0.278	-0.007	0.005
	(0.008)	(0.322)	(0.007)	(0.005)
Sample	All	Married in 2017	Not married in 2017	Not married in 2017
Observations	590	16	554	554

p-values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Notes: The table shows regression coefficients for the treatment effect of the intervention on the likelihood of being married for men. Estimates are based on a linear probability model. Outcome variable $y_{ij(2018)}$ is being married (yes/no) in 2018, controlling for marital status (married yes/now) $y_{ij(2017)}$ in 2017. All analyses additionally control randomization strata (village pair) fixed effects, dummies for age groups, gender and years of schooling. Divorced includes divorced and separations.