Where did the LLINs go?

An analysis of data from 7 countries with the most recent surveys (2008-2009)

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with contribution of a host of others

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Background

- WMR 2010
  - "Access"
    - Africa, including Sudan: 765 m at risk
    - Need 385 m LLINs at 1 LLIN/2 persons
    - Manufacturer's data: 3-year running total
      - 192 m (50%) in 2007-2009
      - 290 m (76%) in 2008-2010

  - Percentage of households with at least one ITN--IHME/WHO model
    - 41% in 2009, 42% by mid-2010

Objective

- Examine the number of LLINs delivered by manufacturers and the number distributed by MOHs during the three years before the survey, to the number of LLINs found in households during the survey

- Choose only the most recent surveys (2008-9) in countries which have had distributed a reasonable amount of LLINs before the survey

Methods I

- Most recent DHS/MIS on DHS website
- Kenya, Liberia, Rwanda, Senegal, Sierra Leone, Sao Tome & Principe, Uganda
- Surveys 2008-2009
- Compared manufacturer's LLIN data—from JM
- MOH LLIN data--WHO
- Number of LLIN adjusted for survey design

Methods II

- Calculation of the household multiplier weight
  - UN population estimate
  - Number of households sampled
  - Number of persons sampled (standardized weight)
    - Survey estimate of persons per household
  - Estimate of total households in the country
  - Fraction of total households that were sampled = household multiplier (weight)

Methods III

- Definition of ITN
  - Brand = LLIN, lifetime of the LLIN
  - New within last 12 months & treated by manufacturer
  - Treated within the last 12 months

Percentage use of ITN, all ages, surveys

Kenya	38
Liberia	26
Rwanda	43
Senegal	25
Sierra Leone	19
STP	45
Uganda	26
MEDIAN	26

Dates of survey, number LLINs distributed

	Dates of survey	Data from Manuf/MOH	National Mass campaign	Months between campaign and survey
Kenya	2008 11 – 2009 02	2006-8	2006 7-8	~24
Liberia	2009 1-3	2006-8		
Rwanda	2008 1-4	2005-7	2006 9-10	~15-18
Senegal	2008 11 to 2009 1	2006-8		
Sierra Leone	2008 4-6	2005-7	2006 11	~15
STP	2008 09 – 2009 01	2006-8		
Uganda	2009 11-12	2007-9		

Average number of ITNs per household, survey report

Kenya	1.1
Liberia	0.7
Rwanda	0.9
Senegal	**1.7**
Sierra Leone	0.6
STP	1.1
Uganda	0.8

LLINs, manufacturers & MOH

	Dates of survey	Year 1	Year 2	Year 3
Kenya 　Manufacturers 　MOH	2008 11 – 2009 02	2006 8,700,429 6,378,465	2007 1,555,150 1,591,492	2008 3,235,173 2,437,621
Liberia	2009 1-3	2006 470,083 ND	2007 771,086 ND	2008 632,022 ND
Rwanda	2008 1-4	2005 460,000 185,000	2006 2,061,537 1,957,720	2007 748,116 998,894
Senegal	2008 11 to 2009 1	2006 462,000 400,000	2007 1,487,810 735,000	2008 1,103,037 1,572,261
Sierra Leone	2008 4-6	2005 95,480 100,000	2006 1,546,220 1,301,164	2007 193,230 316,199
STP	2008 09 – 2009 01	2006 84,548 ND	2007 28,114 ND	2008 24,000 ND
Uganda	2009 11-12	2007 1,603,181 1,622,001	2008 1,870,846 2,273,413	2009 1,633,302 876,054

Number LLIN delivered/distributed (in 3 years before survey) vs. found during surveys

	Manufac-turer data (3y), mil	MOH distribu-tion data (3y), mil	Survey data, mil	% Survey/ MOH	% Survey/ Manu/	% Expect-ed decay, MOH	% Expect-ed decay, Manuf.
Kenya	13.490	10.407	8.366	80	62	64	64
Liberia	1.873	No data	0.507	NA	27		77
Rwanda	3.269	3.142	1.968	60	63	79	82
Senegal	3.053	2.707	2.119	78	69	80	83
Sierra Leone	1.835	1.717	0.534	29	31	80	80
STP	0.136	No data	0.049	NA	36		64
Uganda	5.107	4.771	5.656	111	119	72	74
MEDIAN				69	63		

Duration of ownership of LLINs

	< 12 months	12-23 months	24-35 months	>=36 months	Missing/unk
Kenya	35	23	12	**22**	6
Liberia	70	9	13	**7**	9
Rwanda	30	37	15	**16**	1
Senegal	--	--	--	**--**	--
Sierra Leone	41	34	8	**16**	7
STP	26	12	5	**50**	8
Uganda	35	29	14	**14**	5

Comparison of survey data with the decay model

	< 12 months	12-23 months	24-35 months	>=36 months	Missing/unk
Kenya	35 **35**	23 **15**	12 **51**	22	6
Liberia	70 **41**	9 **43**	13 **16**	7	9
Rwanda	30 **27**	37 **64**	15 **4**	16	1
Senegal	--	--	--	--	--
Sierra Leone	41 **12**	34 **85**	8 **3**	16	7
STP	26 **25**	12 **26**	5 **49**	50	8
Uganda	35 **40**	29 **39**	14 **21**	14	5

Percentage of nets that are LLIN, surveys

Kenya	**76**
Liberia	95
Rwanda	92
Senegal	80
Sierra Leone	88
STP	99
Uganda	**75**
MEDIAN	88

Percentage of nets used
& no. of persons using last night

	used	1 person*	2 persons*	3+ persons*
Kenya	77	40	41	17
Liberia	73	19	37	44
Rwanda	83	20	37	34
Senegal	NA			
Sierra Leone	88	22	40	28
STP	79	32	42	22
Uganda	79	42	43	19
MEDIAN	**79**	27	41	**25**

* Denominator is one net

Mean number of persons sleeping under a net

Kenya	1.8
Liberia	2.2
Rwanda	2.3
Senegal	---
Sierra Leone	2.3
STP	2.0
Uganda	1.8
MEDIAN	2.1

* Rural Malindi district: 2.47

Limited, old data

- Limited: Only 7/35 countries in last three years
- Newest data is 2-3 years old
  - One within 13 months

Summary

- ~30% of distributed LLIN cannot be found in household surveys within 15-24 months
- In some countries, two-thirds of LLIN are "missing"
- Expected decay accounts for those with ~30%
- Quicker average decay than 8%-20%-50%?
- Need to "replace" approximately 1/3rd with continuous distribution during 36 months
- Need a longer lasting LLIN
- Most nets are LLIN – 88%
- Most nets are being used – 79%
- Few old nets (>36 months)

Implications

- One-time distribution of current LLINs at 1 LLIN per 2.0 persons is unlikely to yield universal coverage for 2-3 years
  - Appears that on-going distribution will be needed
  - Need to find out why the LLINs go missing

Move forward: how do MOHs investigate the "missing nets" issue

- Three inexpensive surveys to track number of LLIN still in households
  - 1) Within 30 days of mass distribution, 2) next malaria season, 3) following malaria season
  - Management survey concept: ~$30,000 per survey
  - Gap filling

- Small village cohort studies
  - Qualitative
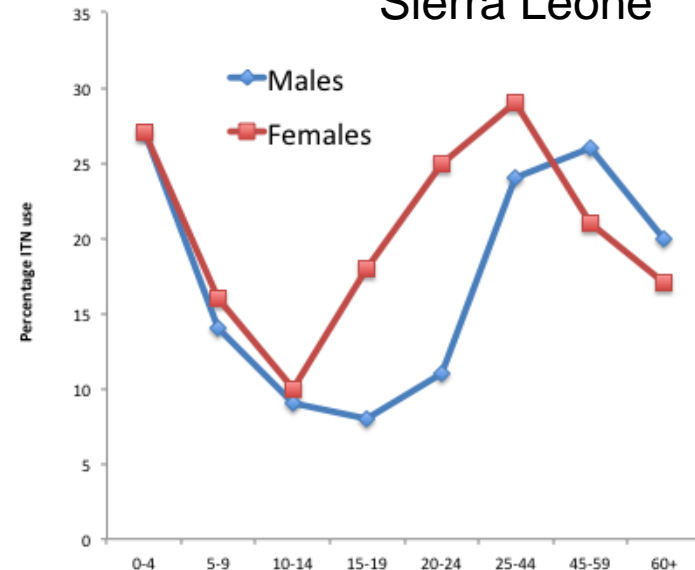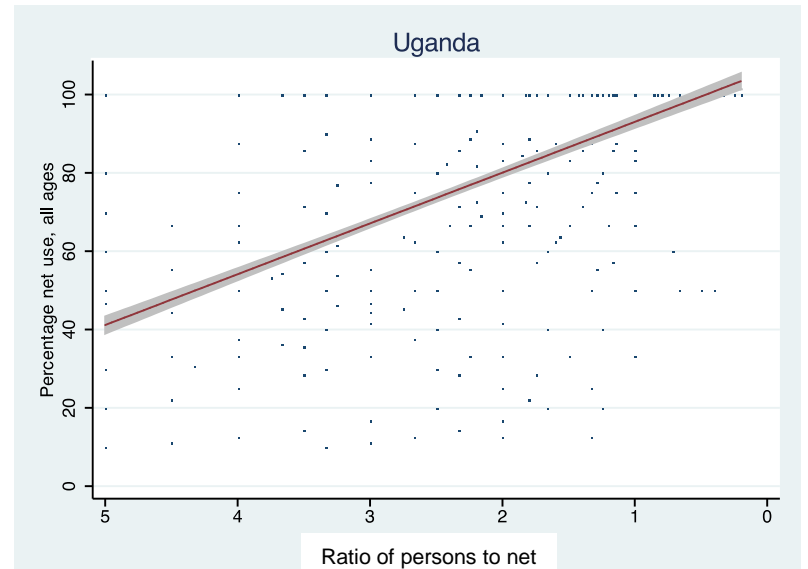 - Avoid Hawthorne effect

End
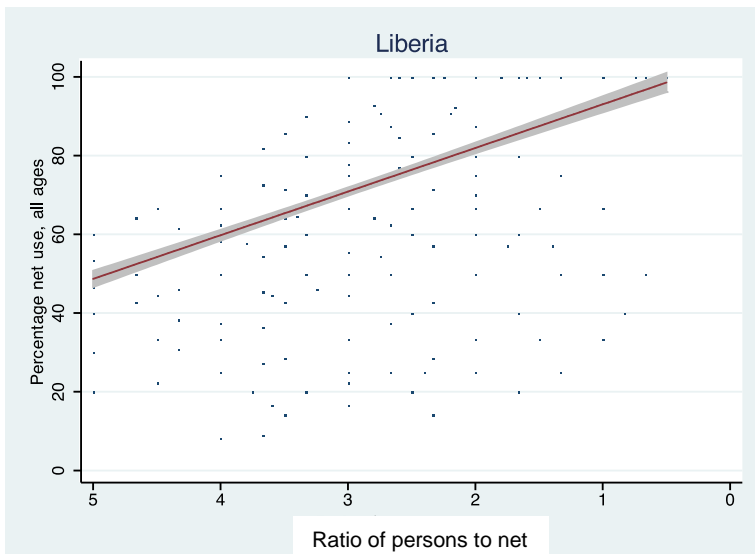
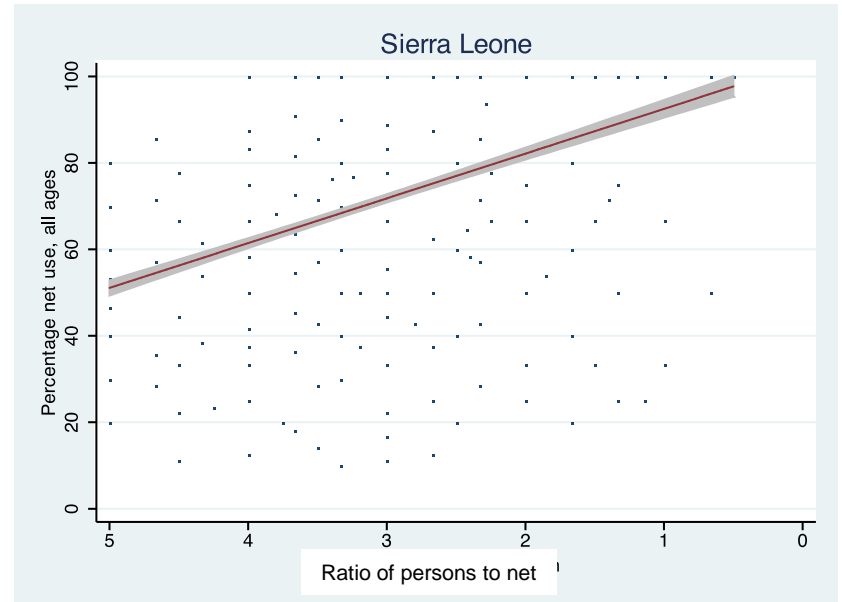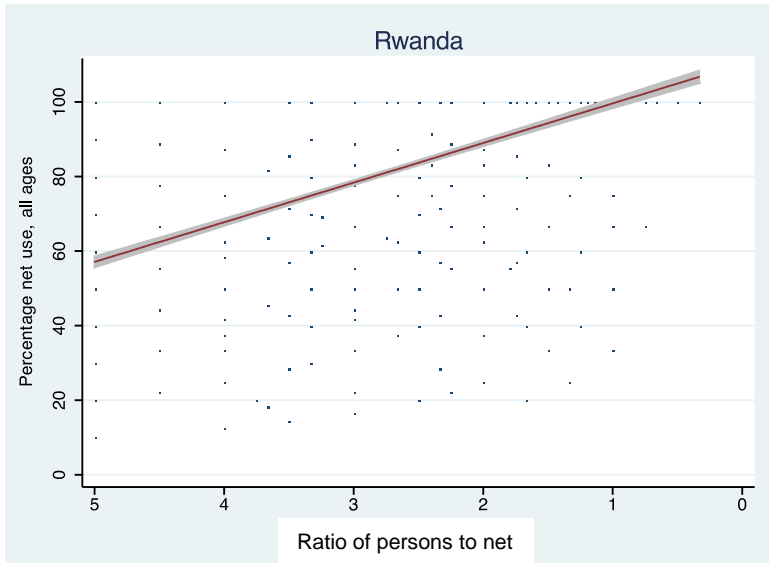# ITN use by age group
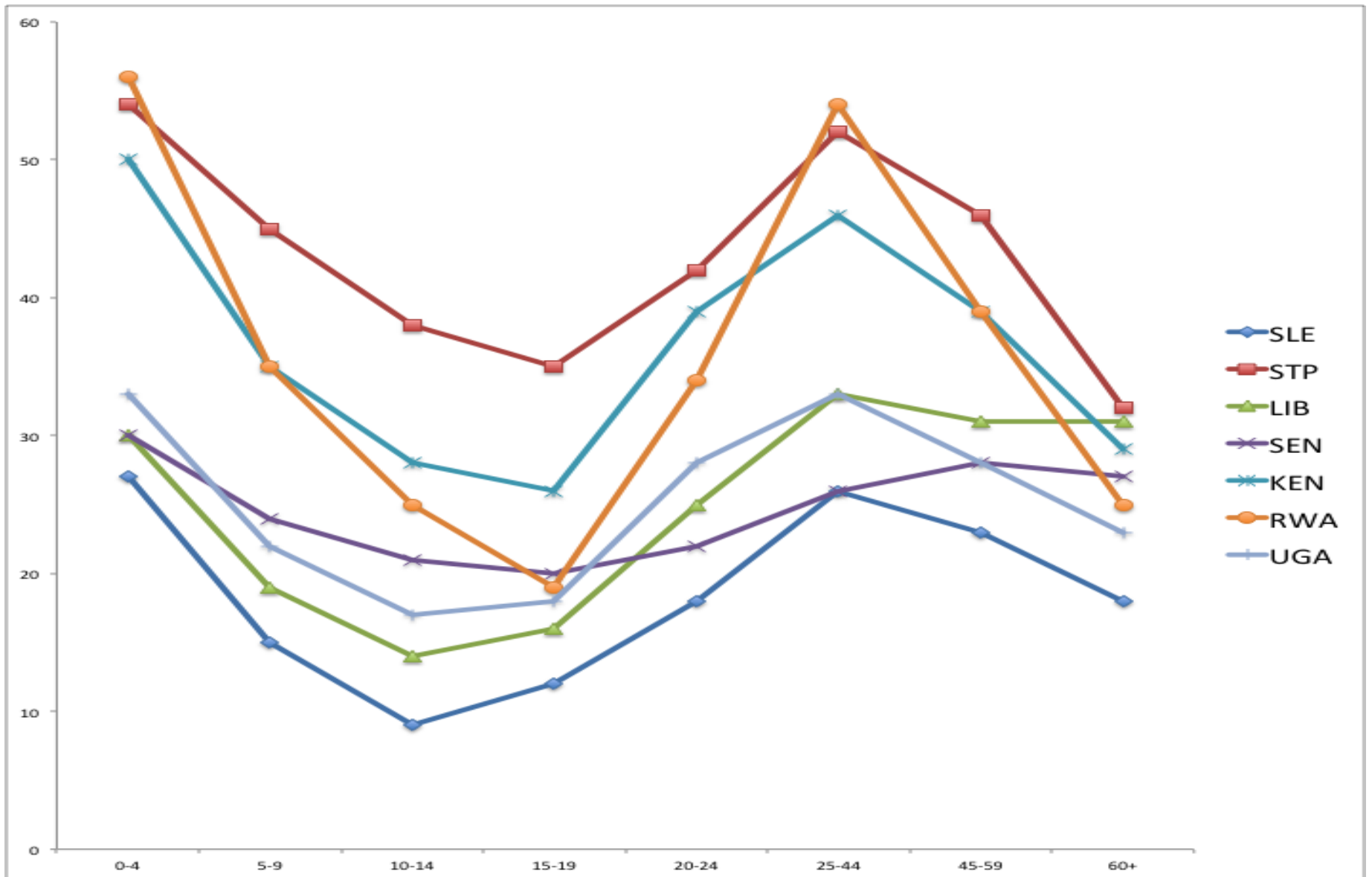
ITN use by age, gender
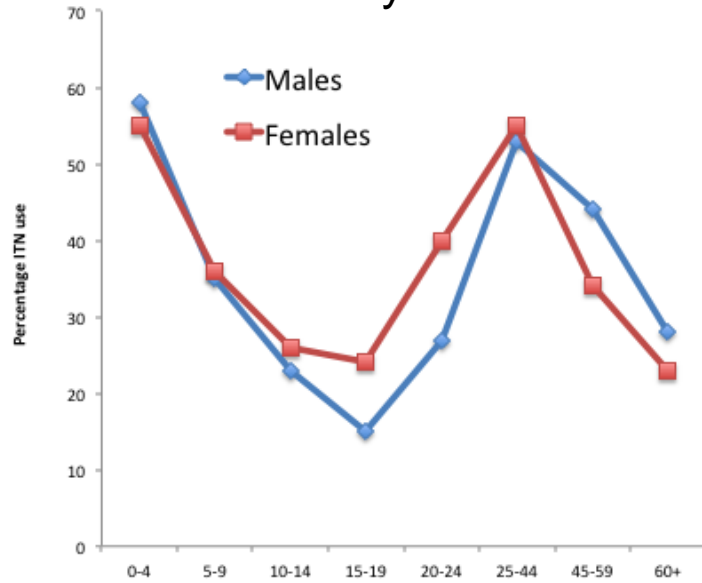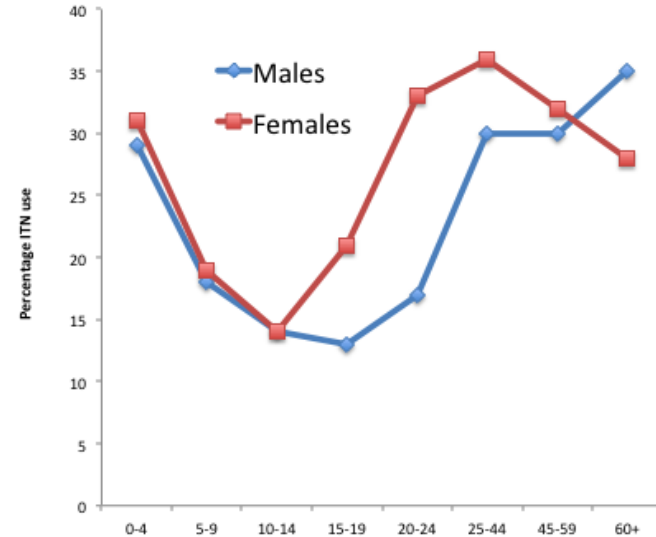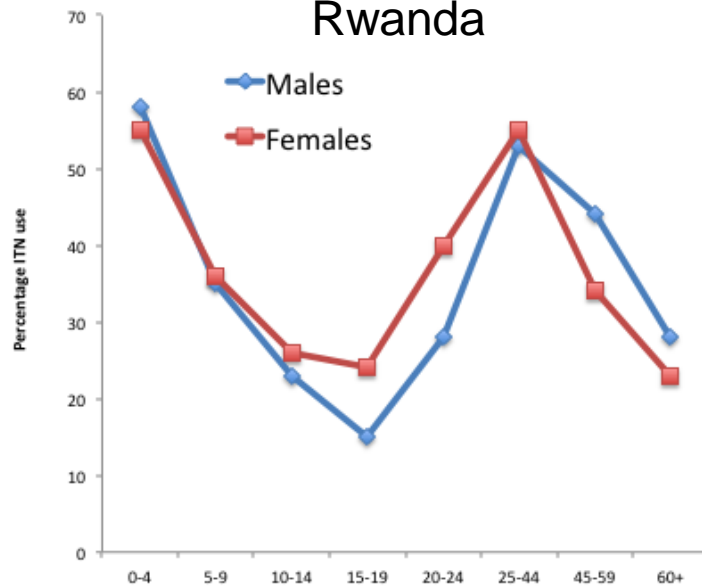
What does it take to get near 100% use
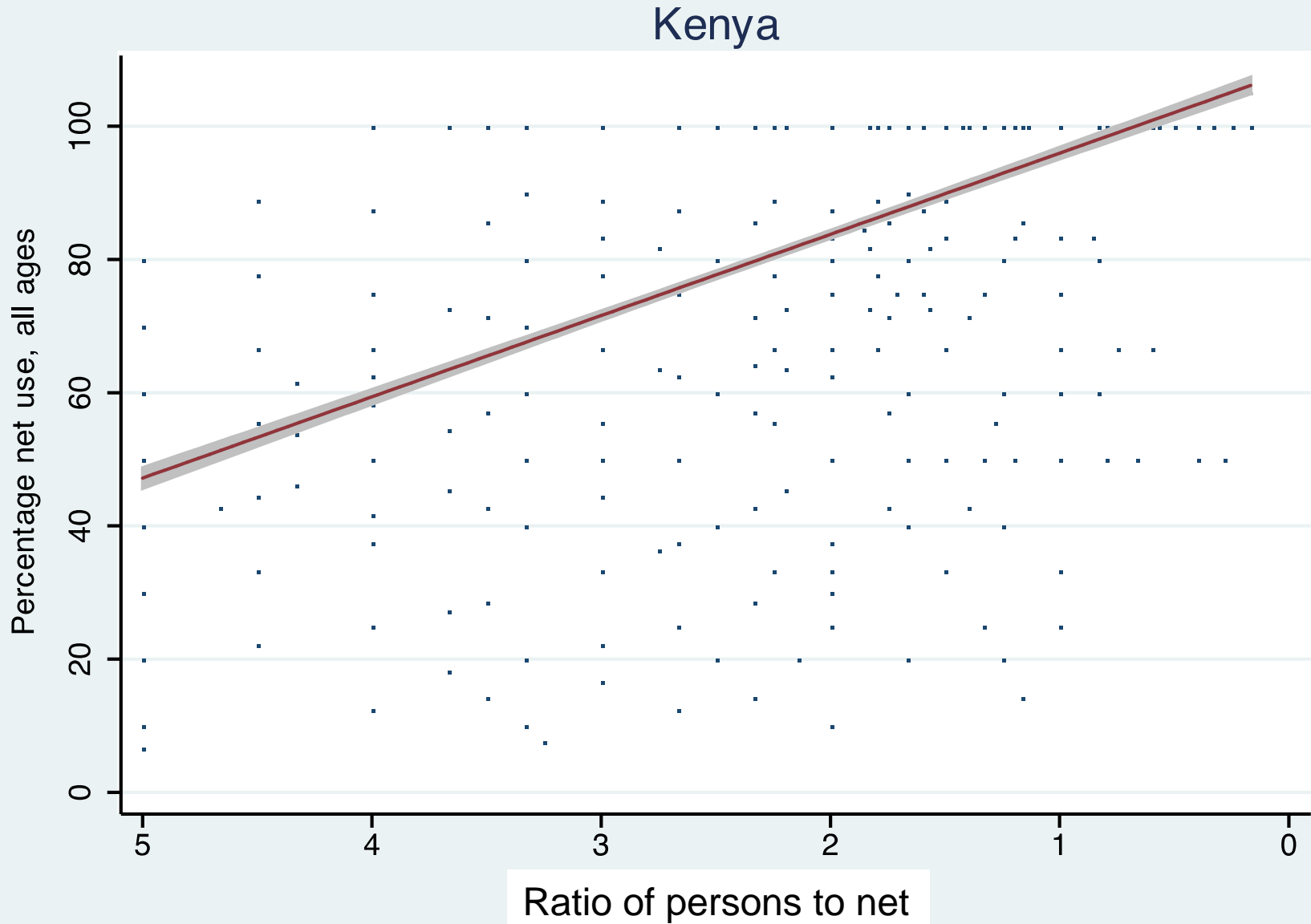
What does it take to get near 100% use

Percentage "access" to LLIN from MOH distribution data

	Pop (mil)	Year 1	Year 2	Year 3	3-year total	% pop. with "access" assuming 2.0 persons/ LLIN	Ratio pop/net from survey	% pop. with "access" using pop/net from survey
Kenya	30.25	2006 6.4	2007 1.6	2008 2.4	10.4	**69**	1.8	**62**
Liberia*	3.95	2006 0.5	2007 0.8	2008 0.6	1.9	**95**	2.2	**106**
Rwanda	10.00	2005 0.2	2006 2.0	2007 1.6	3.8	**75**	2.3	**87**
Senegal	12.53	2006 0.4	2007 0.7	2008 1.6	2.7	**43**	---	**---**
Sierra Leone	5.70	2005 0.1	2006 1.3	2007 0.3	1.7	**60**	2.3	**69**
STP*	0.16	2006 0.08	2007 0.03	2008 0.02	0.13	**171**	2.0	**163**
Uganda	32.71	2007 1.6	2008 2.3	2009 0.9	4.7	**29**	1.8	**26**

* Manufacturer's data. MOH data was not available.

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Equity ratio of % households with no nets

	Poorest/Richest
Kenya	41.0/31.6 = 1.2
Liberia	46.7/54.7 = **0.8**
Rwanda	58.6/27.0 = 2.2
Senegal	21.5/50.2 = **0.4**
Sierra Leone	66.9/57.7 = 1.2
STP	48.3/15.3 = **3.2**
Uganda	43.6/26.6 = 1.6
MEDIAN	1.3