

THE USE OF ITNs FOR THE CONTROL OF TBRF IN TANZANIA



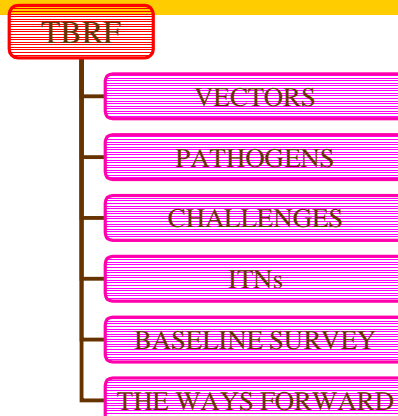
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Summary



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What is TBRF?

- ? An infectious human disease, tick-borne relapsing fever (TBRF)
- ? Caused by infection with the spirochaetes (bacterium *Borrelia sp*)
- ? Transmitted to man by *Ornithodoros* soft tick species
 1. Tick bites (saliva)
 2. Coxal fluid contamination while feeding
- ? Ticks become infected from feeding the blood of relapsing fever patient
 1. transovarially (from one generation to the next via the female ovaries)
 2. transstadially (larvae? nymphs? adults)
- ? *Ornithodoros* soft tick remains infective throughout its life (lifespan: 2 yrs)
It represents an important arthropod reservoir of the disease

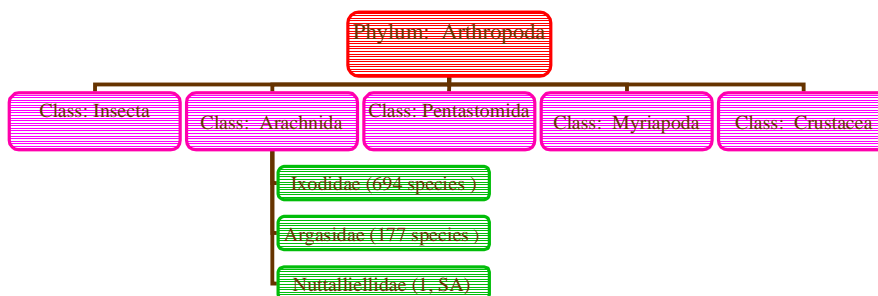


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The Place of Disease Vector in Animal Kingdom


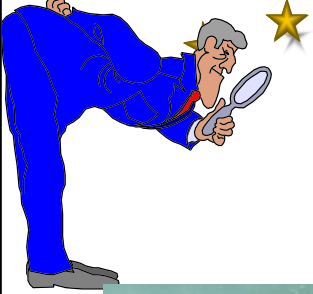


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Ornithodoros soft ticks.



Adult female



Larva

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Borrelia species in a smear



Giemsa stain



Acridine orange stain

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Biology of *Borrelia species*

- Spirochete, unevenly coiled
- $< 0.1\text{-}0.5\ \mu \times 3\text{-}25\ \mu$
- Variation in appearance and antigenicity with subsequent attacks
- Fibrillar structure and cell body rotate in opposite directions



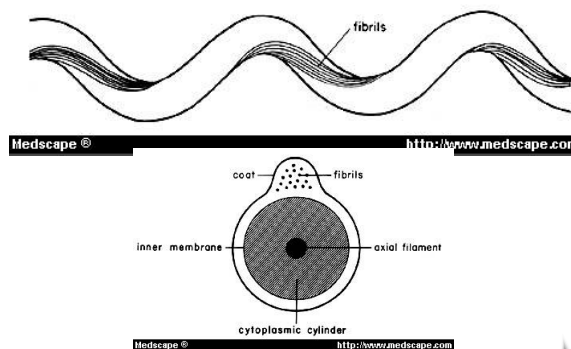
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Bacterial spirochaetes

- *Borrelia spp.* – fibrillar structure



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Importance of TBRF

- TBRF is a neglected vector-borne disease, despite high incidence and mortality in parts of Africa
- It is a significant cause of **infant and perinatal mortality in Sub-Saharan Africa**
- It is a serious cause of childhood illness and mortality in Tanzania
- During pregnancy the *Borrelial* infection is particularly intense and often provokes an **abortion or a premature birth**



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Challenges

- The extremely high perinatal mortality rate during an attack asks for **prevention and early effective management of TBRF.**
- This is a challenge where access to health services in rural areas of developing countries is hampered by many factors.
- **There is a great need of community based health care programmes in rural areas where the disease is endemic**



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Why ITNs?

- ITNs protect against malaria transmission, and the promotion of their usage forms the basis of malaria control in the majority of endemic regions worldwide
- Tanzania is a good example of a country where many different partners are contributing to the common goal of promoting ITN usage
- Many innovative projects have introduced nets into households with high reduction of malaria transmission
- Tanzania is also one of the few African countries to have adopted a favourable taxation policy to promote mosquito net availability and affordability
- To prevent TBRF, ITNs would be the most cost efficient method to break the transmission cycle between human and ticks



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Baseline TBRF Surveys

- **Study site**
 - Muungano village (1,500 households: 7,500 population)
 - No ITNs intervention
 - No indoor residual sprays
 - Traditional houses (“TEMBE”)
- **Parasitological study (<5 yrs children & Pregnant women)**
 - Blood films (B/S)
 - Blood spots (PCR analysis)
- **Entomological study (200 households)**
 - 4 sites (bed room, sitting room, kitchen & Poultry area)
 - House infestation rates
 - Population structures
- **KAP Survey (200 heads of households interviewed)**
 - Tick bites
 - TBRF transmission
 - Sleeping behaviour/arrangement
 - Traditional Control Methods (TCM)



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Results: B/S Vs PCR

Total no.		Malaria	TBRF	
		Blood slide	Blood slide	PCR
Children with fever	54	15 (27.8%)	3 (5.6%)	6 (11.1%)
Healthy children	307	6 (2%)	7 (2.3%)	13 (4.2%)
Total	361	21 (5.8%)	10 (2.8%)	19 (5.3%)



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Discussion (B/S Vs PCR)

- It is the first study to use PCR to screen humans for *Borrelia sp.* infections in Africa
- PCR is twice as sensitive in detection of *Borrelia parasites*
- Sensitivity of screening of TBRF can be increased by PCR
- Microscopy is unreliable and misdiagnosis is likely to be very high
- The rate of TBRF infections is even higher than that reported in the health facilities



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A newly identified *Borrelia* sp

- Blood samples were spotted and dried onto Whatman filter paper (5mm diameter)
- Nested PCR based on a flagellin gene used for detection of *Borrelia* parasites in blood samples
- Positive samples (17/19) were directly sequenced in both directions using AB13100 sequencer (Fukunanga *et al.*, 2001).



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Nested PCR Results

Total no.		<i>Borrelia</i> sp.				
		PCR	<i>B. duttonii</i> type Ly	<i>B. duttonii</i> type 2(B)	Unknown type 3	Unknown type 5
Children with fever	54	6 (11.1%)	4	1	1	0
Healthy children	307	13 (4.2%)	6	0	4	1
Total	361	19 (5.3%)	10	1	5	1



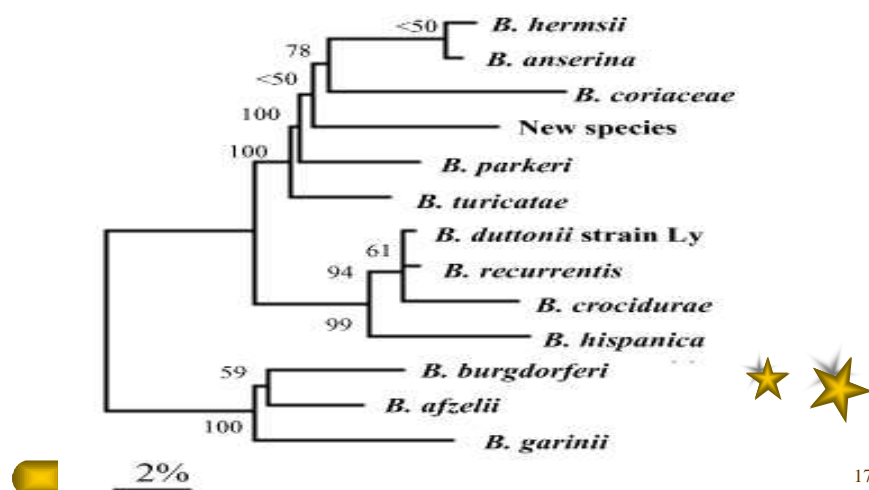
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Phylogenetic tree of *Borrelia* species

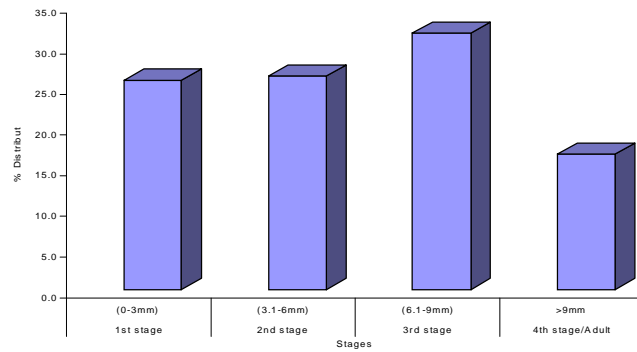


Discussion

(A newly discovered *Borrelia* sp)

- A new unnamed *Borrelia* species, differs from *B. duttonii* and the other Afrotropical species (*B. recurrentis* & *B. crocidurae*)
- It is phylogenetically closer to the Nearctic *Borrelia* species (*B. anserina* - 94.4% in a 344 nucleotide sequence; *B. parkeri* (93), *B. turicatae* (93%), & *B. hermsii* (91.5%))
- Detection of a new pathogenic *Borrelia* sp in Africa makes the development of vaccines a difficult prospect
- Further investigations are still needed

Ornithodoros soft ticks population structure

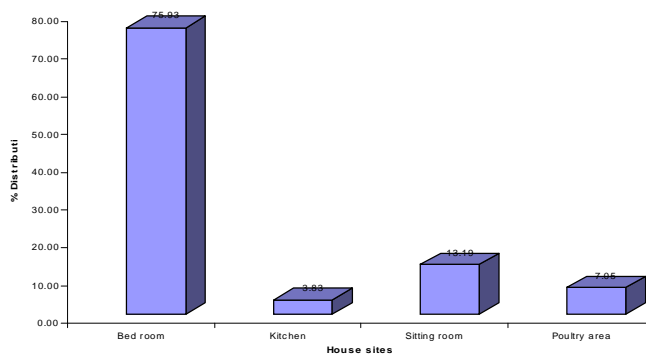


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Distribution of soft ticks in the households

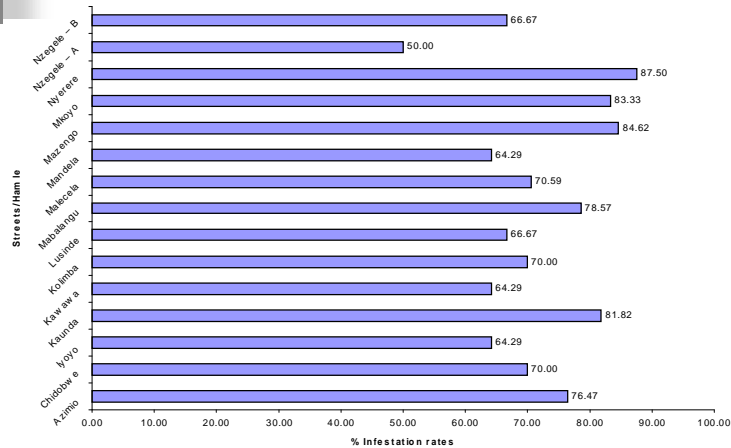


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House-ticks' infestation rates (%)

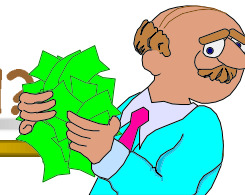


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Which Ways Forward?



- **TBRF vaccine?!**
- **Residual sprays?!**
- **Treated Bed Nets? (In Progress)**
- ? **The project seeks to investigate this thoroughly and in a rigorous scientific manner**



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Parasitological study

- **TBRF Prevalence (PCR) = 4.24%**
- **Risk Ratio (RR) = 33% (0.33)**

Sample size: 1,562 + 10% Drop-out (= 1,720 under five years children)

Conf. level	Power	Unexpo. : Exposed Ratio	Disease in Expo.	Risk Ratio	Odd Ratios	Sample sizes		
						Unexpo	Exposed	Total
95%	90%	1 : 1	1.40%	0.33	0.32	781	781	1,562



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Entomological survey

- **Population dynamics (Density)**
- **Population structure (age distribution)**
- **Vector competence/tick-bite rates**



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Acknowledgments

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Thanks!



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