Toward Understanding On-Farm Demand for Antibiotics

ERS & Farm Foundation Workshop on Challenges to Changing Antibiotic Use in Food Animal Production

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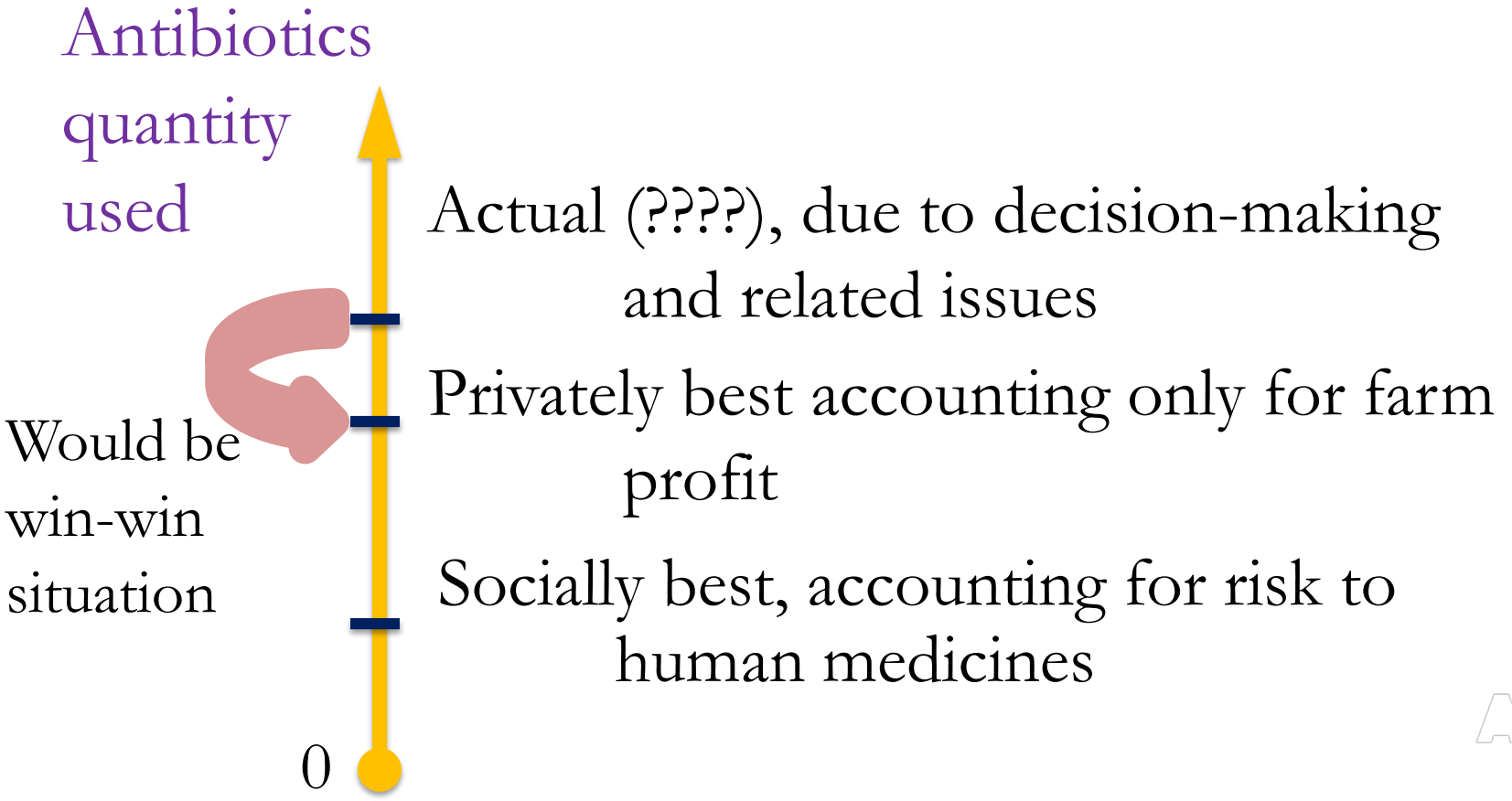
Purpose

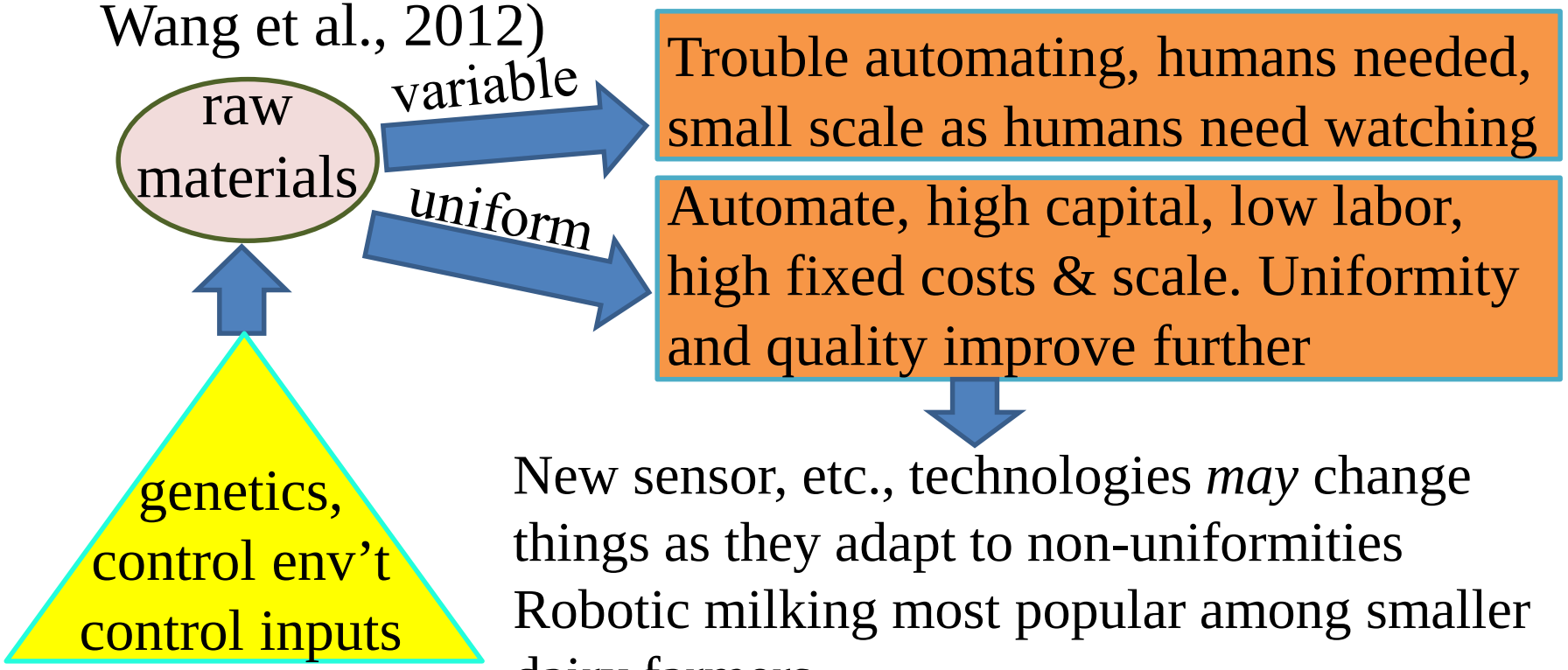
- Focus is managerial economics of farm-level antibiotics choices, with dairy emphasis. Research reveals
  - strong pressures on human medicine doctors to over-prescribe antibiotics (e.g., Linder et al. 2017)
  - As with others, evidence that farmers may, through rational inattention or irrationality, mismanage their inputs (e.g., Perry et al. 2017) and risk protection (Du et al. 2017)
- We seeks to understand why antibiotics are used and whether opportunities exist for behavioral (non-traditional) economics approaches to reduce demand

Graphical perspective



What have antibiotics & other control inputs done?

- Chandler emphasized the importance of throughput in justifying capital investments
- Non-uniformities impede throughput in agriculture (e.g, Wang et al., 2012)



New sensor, etc., technologies *may* change things as they adapt to non-uniformities
Robotic milking most popular among smaller dairy farmers

Specifics, dairying

Source://www.youtube.com/watch?v=1lZF8mSRq4Q

- Content here mainly about dairying
- Antibiotics have been widely applied in animal agriculture, for
  - A. Growth promotion
  - B. Disease prevention
  - C. Disease treatment
- In much of world, efforts to reduce applications. US FDA VFD has sought to eliminate Purpose A and reduce B-C
- In dairying, A not an issue. C is the major issue, mainly for udder inflamation (mastitis) but also for respiratory issues
  - Few other choices for infected animal
  - Animals are long-lived

What of organics?

- Mastitis a contagious disease, being passed during milking and from environmental contamination
- Emphasis on prevention (biosecurity, caring labor, sanitary capital)
- Once animal has an issue, can try treat without antibiotics. But, as is often the case, if problem persists then the cow is either
  - i) culled directly for meat
  - ii) if young, mildly affected, and with health passport, may be sold to conventional herd
- Antibiotic treatments will persist in dairying

Survey

Source: https://hoards.com/article-20125-calf-feeding-changes-are-on-the-way.html2

- Lake State Dairy Farm Business Viability Survey sent to farmers in WI, MN + MI. Paper and web versions, March-September 2017, 21% response rate
- Purchased list + lists of state registered milking herds
- Section on antibiotics asks
  - how used,
  - what costs,
  - willingness to pay for treatment

MI	MN	WI	Total
118	171	392	688

How used, I

Written protocols to treat health veterinary conditions?					
Size	Cows			Organic	Total
	<100	100-499	500+		
Yes	50.4%	74.4%	88.2%	51.9%	60.9%
Total	355	153	76	52	636

Function of antibiotics		
Use	Treat current infection	Prevention
87.7%	70.3%	62.7%

How used, II

Treat a current infection?			
	<100 cows	100-499 cows	500+ cows
Yes	67.6%	73.9%	77.6%
Prevent infections (e.g., dry cow therapy)?			
Yes	60%	66%	76.3%
Keep cow's mastitis history records?			
Yes	60.5%	83.2%	93.2%
Separate mastitis-infected cows?			
Yes	27.1%	44.7%	75%
Total	330	153	76

Nature of losses

Mean loss per cow per year if can't use	
Small	$1,834
Medium	$462
Large	$454
Average	$1,252

Median cost per case	
Diagnosis	$5
Therapeutics	$30
Non-saleable milk	$80
Veterinary service	$15
Labor	$15
Death loss	$34
Lost future milk	$200
Premature culling	$200
Lost future reproduction	$100

Data comparable to Rollin et al.

Therapeutics as share <5%

Willingness to pay for antibiotics treatment

Cow not performing optimally. You isolate. There is a probability she can be cured by antibiotics, loss avoided if she is. What are you WTP?

Generally over-paying and so over-applying vs. profit impact

Loss avoid probability	Loss			
	$100	$150	$200	$250
0.40	$103	$127	$117	$102
0.55	$137	$131	$122	$138
0.70	$154	$153	$166	$196
0.85	$169	$172	$196	$198

Only WTP not significantly larger than expected loss avoided

Fitted model, what do farmers worry about?

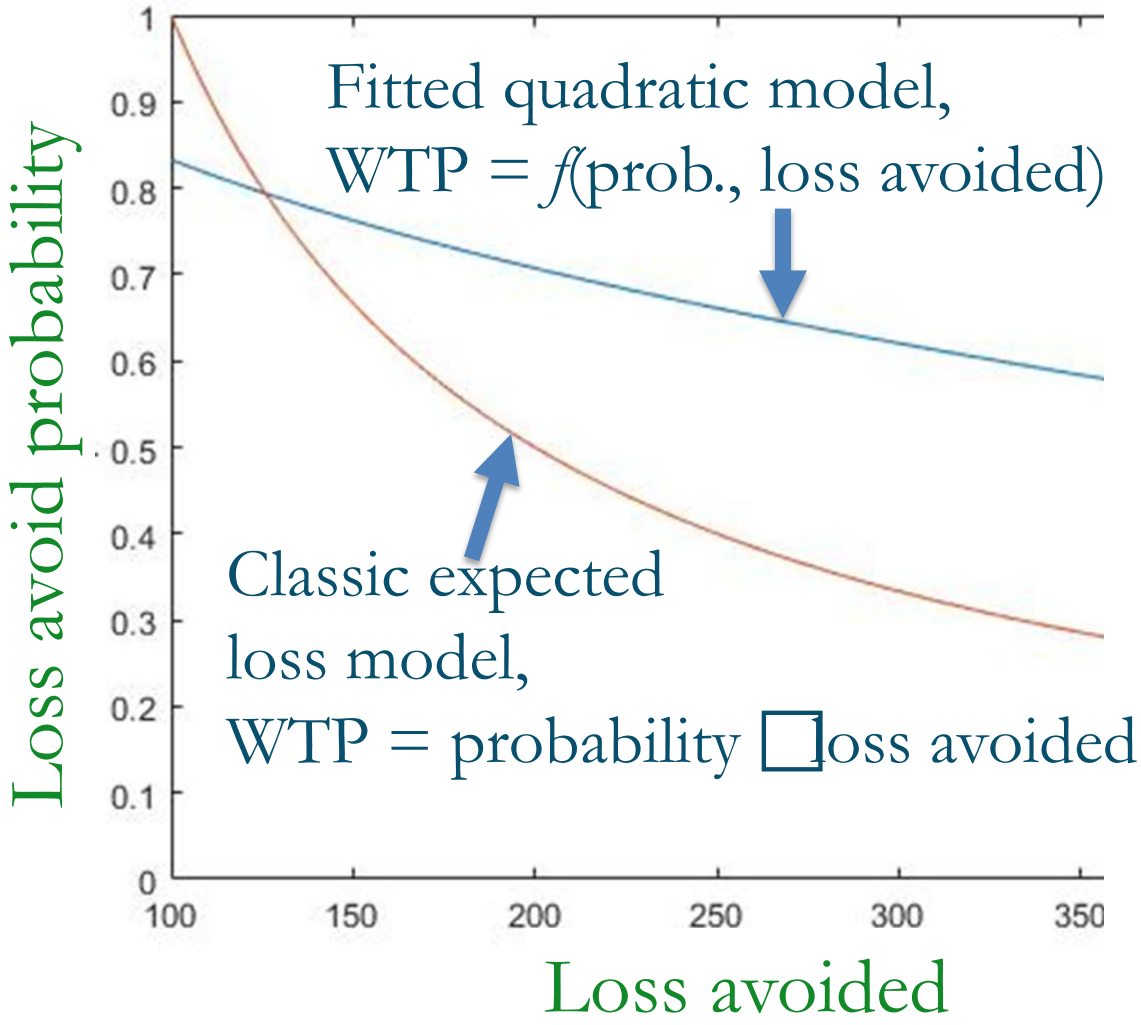


*Figure shows how probability and loss avoided trade off to keep WTP at $100

*Fitted curve shallower than expected loss curve

*Farmers are more keen to increase probability of loss avoided than to increase magnitude of loss avoided

Further evidence

Identify most & least IMPORTANT factors for your operation for managing mastitis	% most	% least
Increasing prob. treatment successful	59.8	12.8
Managing treatment cost	7.0	64.3
Reducing loss if cow infected & treatment effective	33.1	22.9
Total	513	507

Why emphasis on probability?

- Tempting to think that this is example of K&T loss aversion in prospect theory. We don't think it really fits
- There is psychology literature that finds subjects focus on probability management over loss management
- That would suggest case for more precise diagnostics to show when antibiotics not needed might be more effective than efforts to reduce loss avoided
- Alternatively, farmer may emphasize probability as indicator of contagion

Antibiotics & contagion

- Farmers treat a particular cow in part because contagion is a concern
- Contagion occurs through common implements + handling, + bacteria shed into environment
- Trade-off is i) cost now to stamp out an infection, vs. ii) potential uncertain continued cost in the future through early replacement, milk penalties, lower yields and further treatment costs
- We know little about how regulations to reduce treatment now will affect decision process and incentives to treat. But biosecurity to break transmission may lead growers to not over-apply

Four policy points

- Tax on antibiotics use would be ineffective. Cost very small compared with other costs. Bureaucracy + linking with vet time likely more effective
- Farmers keen to reduce loss risk but not so cost focused may over-apply vs. profit maximizing choice (diagram)
- WTP model suggests increasing loss avoided (e.g., with premium for better milk) won't affect antibiotics demand much. But farmers may be WTP for better diagnostics to increase probability of success and this should reduce demand for antibiotics
- Need to understand grower contagion concerns

Final comments

*Resistance issues aren't going away in agriculture

Drugs and antibiotics

Weed and insecticide resistance

Food safety

*Managing the public commons for disease and resistance susceptibility (with dynamics, externalities, etc.) is important, but so also is understanding input demand

THANK YOU

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