



The Blue, the Green, and the Toxic:

A field experience with the Kansas Department of Health and Environment (KDHE) focused on Harmful Algal Blooms

Karin Moser

Kansas State University
KDHE Bureau of Epidemiology and Public Health Informatics

Projects

Evaluate success of public health messaging campaign

- A Knowledge, Attitudes, and Practices Survey of Kansas Physicians and Veterinarians Regarding Harmful Algal Blooms

Increase enrollment in the Kansas Health Alert Network (KS-HAN)

- Promotional activities such as phone calls, conferences and inclusion of brochure with survey

Objectives

- Background on blue-green algae and Harmful Algal Blooms (HABs)
- HABs in Kansas during the summer of 2011
- KDHE's role in HABs
- Kansas Health Alert Network (KS-HAN)
- Knowledge, Attitudes, and Practices Surveys
- Promotional efforts for KS-HAN
- The Future of HABs in Kansas
- Lessons Learned through my experience at KDHE

BACKGROUND

Blue- Green Algae

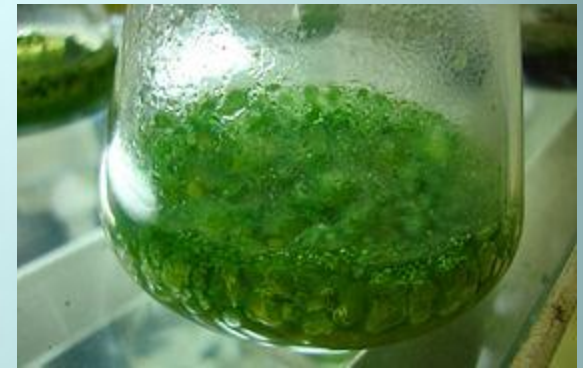


Image: <http://en.wikipedia.org/wiki/Cyanobacteria>

- Also known as cyanobacteria as the organism reflects some characteristics of bacteria as well as algae
- World Health Organization (WHO) has identified at least 46 species that have been known to show toxic effects in vertebrates¹
- 60% of cyanobacterial samples contain harmful toxins
- Proliferate to form Harmful Algal Blooms (HABs)

Harmful Algal Blooms (HABs)



Photo: Blue-green bloom and fishkill, BEFS
http://www.kdheks.gov/algae-illness/download/BG_Algae_Examples.pdf

HABs

- Associated with human and animal illness and animal deaths in at least 36 states in the United States (between 1995 and 2005)²
- Cause is uncertain (eutrophication)
- Cannot predict them so it is difficult to prevent them
- Likely to occur during hot, dry weather
- Produce a variety of toxins depending on species present

TABLE 8.1. CYANOBACTERIAL TOXINS AND THEIR ACUTE TOXICITY^a

Cyanotoxins	LD ₅₀ (i.p. mouse) ^b of pure toxin (µg/kg)	Taxa known to produce the toxin(s)	Mechanism of toxicity
Protein phosphatase blockers (cyclic peptides with the amino acid ADDA)			
Microcystins in general (~60 known congeners)	45–>1000	<i>Microcystis</i> , <i>Planktothrix</i> , <i>Oscillatoria</i> , <i>Nostoc</i>	all block protein phosphatases by covalent binding and cause haemorrhaging of the liver; cumulative damage may occur
Microcystin-LR	60 (25–125)	<i>Anabaena</i> , <i>Anabaenopsis</i>	
Microcystin-YR	70	<i>Hapalosiphon</i>	
Microcystin-RR	300–600		
Nodularin	30–50	<i>Nodularia spumigena</i>	
Neurotoxins			
Anatoxin-a (alkaloid)	250	<i>Anabaena</i> , <i>Oscillatoria</i> , <i>Aphanizomenon</i> , <i>Cylindrospermum</i>	blocks post-synaptic depolarization
Anatoxin-a(s) (unique organophosphate)	40	known only from two species of <i>Anabaena</i>	blocks acetylcholinesterase
Saxitoxins (carbamate alkaloids)	10–30	<i>Aphanizomenon</i> , <i>Anabaena</i> , <i>Lyngbya</i> , <i>Cylindrospermopsis raciborskii</i>	block sodium channels
Cytotoxin			
Cylindrospermopsin (alkaloid)	2100 in 1 day 200 in 5–6 days	<i>Cylindrospermopsis raciborskii</i>	blocks protein synthesis; substantial cumulative toxicity

^a derived from Turner et al., 1990; Kuiper-Goodman et al., 1999; Sivonen & Jones, 1999.

^b LD₅₀ = lethal dose₅₀ (the dose of a chemical that will, on average, kill 50% of a group of experimental animals); i.p. = intraperitoneal.

Health Effects

- Microcystin → Most common!
 - Hepatotoxic
- Anatoxin
 - Neurotoxic



Image: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0001-37141999000300016



Image: http://toxics.usgs.gov/highlights/algal_toxins/

Symptoms

Common human symptoms associated with blue-green algae exposure include:

Respiratory	Dermatologic	Other
Sore throat	Itchy skin	Earache
Congestion	Red skin	Agitation
Cough	Blistering	Headache
Wheezing	Hives	Abdominal pain
Difficulty breathing	Other rash	Diarrhea
		Vomiting
		Eye irritation

Animal Symptoms

Lethargy

Vomiting

Diarrhea

Convulsions

Difficulty breathing

General weakness

Tables: <http://www.kdheks.gov/algae-illness/index.htm>

2011 HABs in Kansas

Blue-Green algae is suspected in several dog deaths

1

OutdoorNews

MINNESOTA WISCONSIN MICHIGAN PENNSYLVANIA NEW YORK

OUTDOOR NEWS / OUTDOOR NEWS AUGUST 2011 / KANSAS: AUGUST BLUE-GREEN ALGAE ALERTS

EMAIL PRINT FEED

Kansas: August Blue-Green Algae Alerts

Posted on August 5, 2011

Blue-Green Algae Blamed For Pet's Death

There have been 17 reported cases of human illness after exposure to blue-green algae

Reporter: KAKE News
Email Address: news@kake.com

TOPEKA, Kansas -- The Kansas Department of Health and Environment, in conjunction with the Kansas State University Veterinary Diagnostic Laboratory, confirms that toxic blue-green algae is responsible for the death of one dog and suspected death of two others.

The two dogs suspected of blue-green algae poisoning are presently undergoing testing at the K-State Laboratory.

Print Story
Share
Tweet

Published: 8/19/2011 9:12 pm
Updated: 8/19/2011 10:22 pm

2

Blue-Green Algae Blamed For Pet's Death

There have been 17 reported cases of human illness after exposure to blue-green algae

Reporter: KAKE News
Email Address: news@kake.com

3



4

5 dogs suspected of dying from blue green algae at Milford Lake

August 19, 2011 | by Kim Hynes | KWCH 12 Eyewitness News

Images:

1. <http://www.ksn.com/news/local/story/Blue-Green-algae-is-suspected-in-several-dog/cRORdERZaEmmxZANQpRxsw.csp>
2. <http://www.outdoornews.com/August-2011/Kansas-August-Blue-Green-Algae-Alerts/>
3. <http://www.kake.com/home/headlines/128101338.html>
4. http://articles.kwch.com/2011-08-19/blue-green-algae_29907725

June 1 – Oct. 1, 2011

34 reports of human and animal HAB associated illness³

Human Illness

- 1 suspect
- 5 probable
- 7 confirmed

Animal Illness

- 1 suspect
- 1 confirmed
- 5 confirmed dog deaths.

14 - Did not meet the case definition

Public Health Impact

- 22 of 26 state parks in Kansas are adjacent to federal and state reservoirs
 - 6,100,000 visits to these state parks in 2011³
- HAB season (May – October) coincides with peak months of recreational water use and 3 holidays
 - Memorial Day
 - Independence Day
 - Labor Day

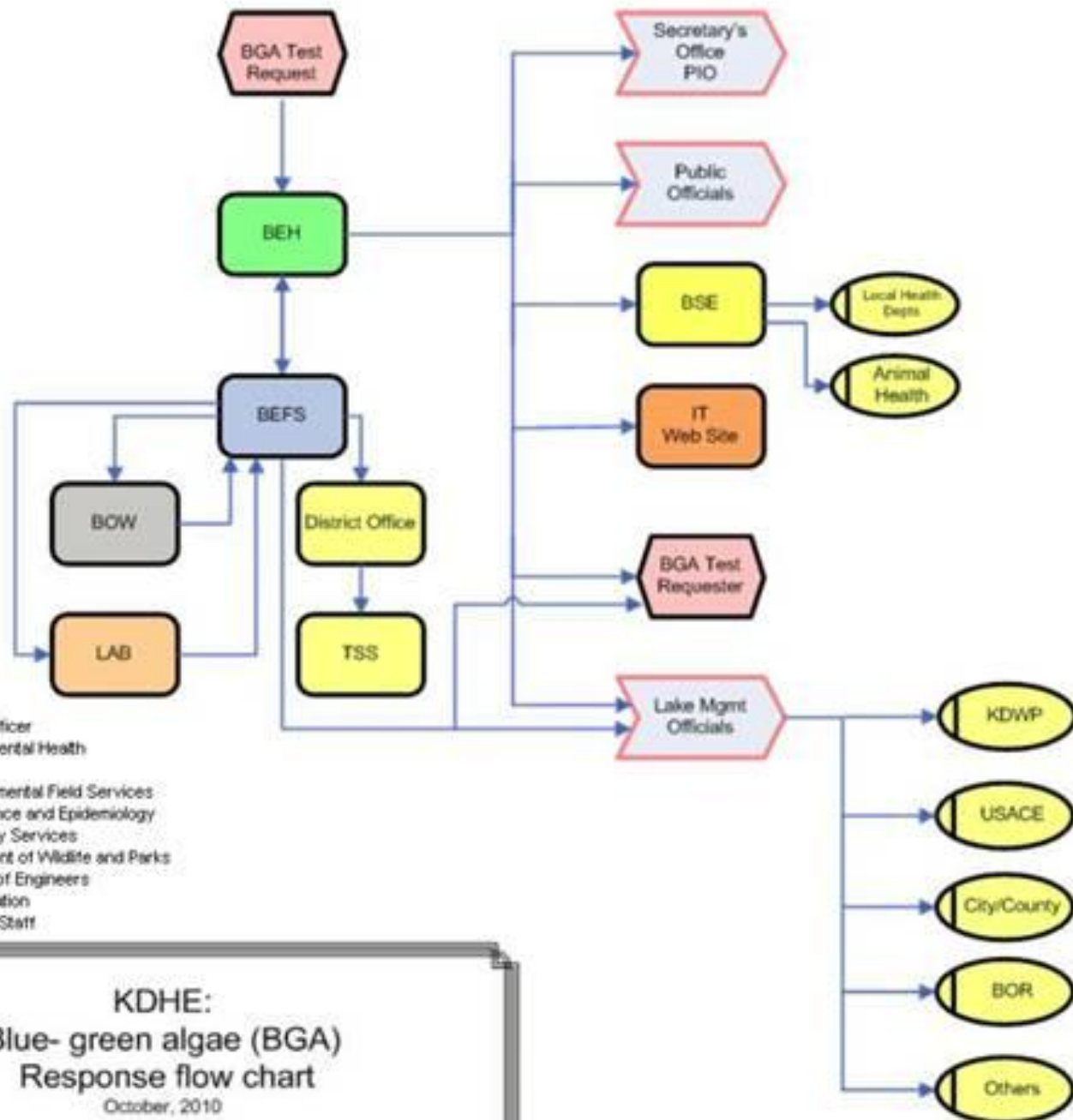
KDHE's Role in HABs

- Monitoring and disease surveillance
 - August 2010- 1st HAB Policy signed
- Public Health Messaging
 - Posting Advisories/Warnings at affected lakes
 - Healthcare provider notifications

Monitoring and Surveillance

- Monitoring- Sampling only occurs when a potential bloom has been **reported** to KDHE and been confirmed by BEH
 - Multi-agency effort
- Disease Investigation- HAB illnesses are only investigated and recorded if they have been **reported** to KDHE

Passive Surveillance!!!



KDHE:
Blue- green algae (BGA)
Response flow chart

October, 2010

HAB Response Plan

Condition	Alert Level	Recommended Actions
•Microcystin toxin detectable to <20 ug/L or •20,000 to 100,000 cells/mL	Public Health Advisory	•Post signage •Discourage direct contact •Notify LHDs, healthcare providers, veterinarians •Issue media release
•Microcystin toxin ≥ 20 ug/L or •$\geq 100,000$ cells/mL	Public Health Warning	•Post signage •Prevent direct contact •Notify LHDs, healthcare providers, veterinarians •Issue media release
Visible cyanobacterial surface accumulation	Public Health Warning	•Post signage •Prevent direct contact •Notify LHDs, healthcare providers, veterinarians •Issue media release

Public Health Messaging

- Increase knowledge of HABs and harmful health effects
- Increase awareness of how and when to report HAB affected lakes and HAB related illness to KDHE

Public Health Messaging (2)

- HAB webpage created
 - Links to HAB Illness Reporting Forms
 - Photographic examples of blue green and non-blue green algae
 - Current Public Health Advisories/Warnings map
- KS-HAN
 - HAN alert sent to registered physicians and veterinarians of current Advisories/Warnings

KS-HAN



- A network that enables local and state emergency health and safety entities to share important public health and general emergency preparedness information rapidly.
- Also allows for the rapid notification of any and all users in the event of an emergency.⁵

Public Health Messaging (3)

- Letter from Dr. Moser, Secretary of KDHE⁶
 - Sent to members of the Kansas Academy of Family Physicians
- Email sent from Drs. Garrison and Van der Merwe⁷
 - Sent to members of the Kansas Veterinary Medical Association and posted on their website.

WERE THE PUBLIC HEALTH MESSAGES SUCCESSFUL?

Knowledge, Attitudes, and Practices of Kansas
Physicians and Veterinarians Regarding
Harmful Algal Blooms

Specific Aims

- 1) HAB-related illnesses in the summer of 2010 and in the summer of 2011
- 2) Receipt of public health messaging
- 3) Influence of public health messaging
- 4) Awareness of HABs and Advisories/Warnings related to lake conditions in their area
- 5) Support monitoring and disease surveillance

METHODS

Study Design

- Achieved Institutional Review Board Approval from both KDHE and KSU
- Participants selected from licensure lists from the KBHA and KBVE (current to Jan 2012)
- A member list from the KVMA was used to update the KBVE list with email addresses
- Generated a random sample

Exclusion criteria

- KVMA members with membership status of “Associate”, “Cancelled”, “Graduate”, or “Inactive” were removed from KBVE list
- Individuals with an address outside the state of Kansas were removed

Survey Methodology

- Physician survey 29 multiple choice and free text questions
- Veterinary survey 31 multiple choice and free text questions
- Two rounds of distribution
 - Electronic questionnaire (Round 1)
 - 4/20/12-5/4/12; reminder 2 days prior to the deadline
 - Mail out and electronic (Round 2)
 - 6/22/12-7/6/12; accepted paper surveys until 7/13/12

Data Analysis

- Counts and frequencies generated for each question, taking into account skip patterns
- Post stratification weighting was not performed
- Hypothesis testing used to compare differences in proportions (p value < 0.05 considered significant)

RESULTS

Generating the Random Sample

- Total physicians- 841
- Total veterinarians- 1178
- 95%CI and 50% Response Rate
- Random Sample (700 physicians, 796 veterinarians)

Electronic distribution (Round 1)

	Physicians (n = 667)	Veterinarians (n= 443)	Combined (n = 1110)
Survey Monkey® RR	8.3%	15.7%	11.0%
Completed Survey	53	56	109
Invalid Addresses	28	87	115
Chose not to participate	2	0	2
Did not respond	584	300	884

Mail and Electronic (Round 2)

	Physicians (n = 695)	Veterinarians (n = 761)	Combined (n = 1456)
Mail and electronic RR	18.6%	32.2%	25.7%
Completed online	122	235	357
Previously completed online	5	7	12
Deceased	1	2	3
Moved out of State/Sold practice	1	1	2
Invalid Addresses	31	18	49
Chose not to participate	0	3	3
Did not respond	535	495	1030

Overall (Round 1 and 2)

	Physicians (n = 700)	Veterinarians (n = 796)	Combined (n = 1496)
Overall	27.6%	42.9%	35.5%
Completed Survey	175	291	466
Did not participate	66	118	184
Did not respond	459	387	846

Physician Demographics

- Type of practice:
 - 27.4% family practice; 29.7% pediatric office
- Years in practice:
 - 48.6% 1 to 20 years; 22.9% for 21 to 30 years
- Sex:
 - 50.3% male; 40.6% female
- Age:
 - 25.1% 31 to 40 years; 26.3% 51 to 60 years

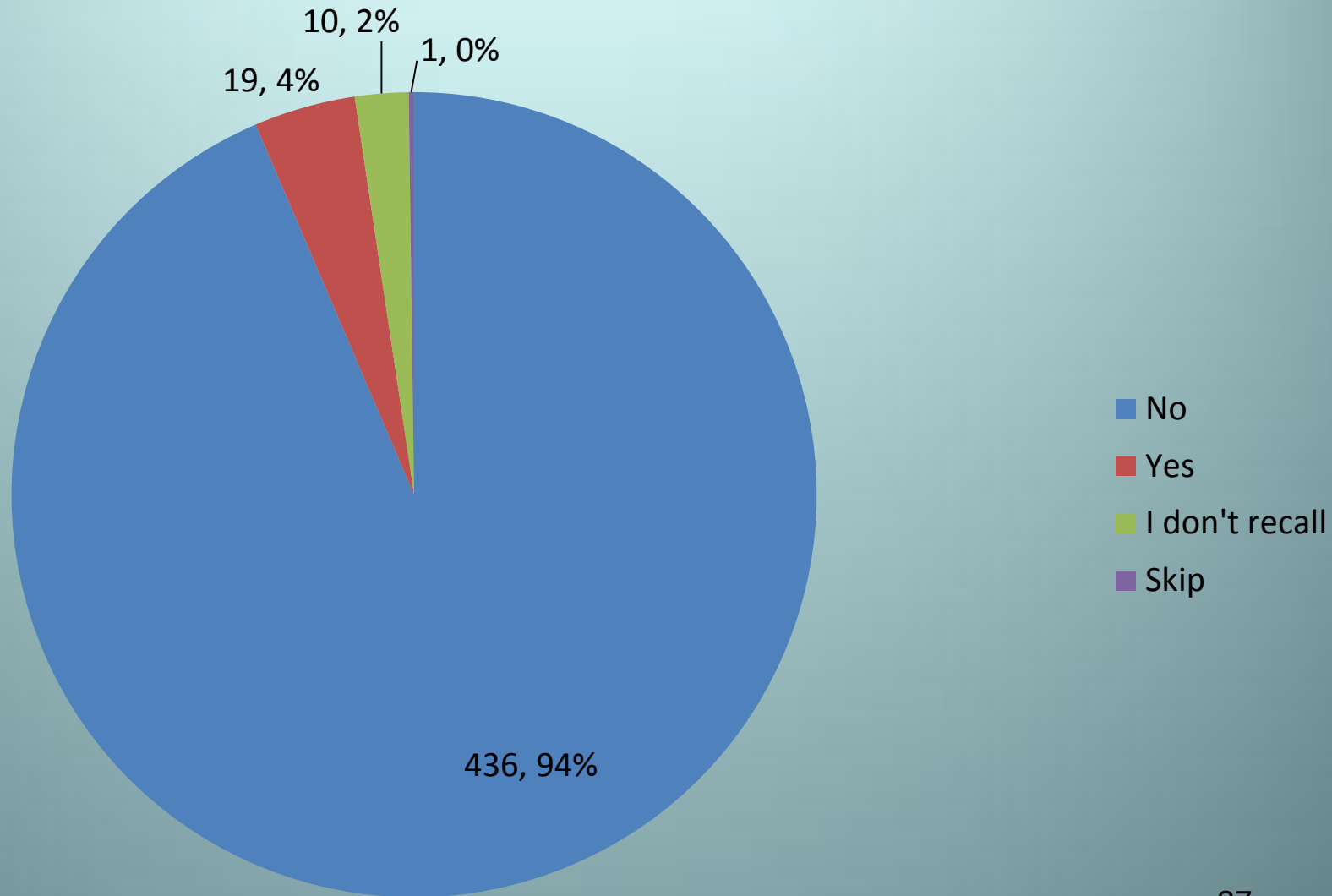
Veterinary Demographics

- Type of practice:
 - 49.8% companion animal exclusive; 21.0% mixed
- Years in practice:
 - 41.6% 1 to 20 years; 27.8% 21 to 30 years
- Sex:
 - 59.8% male; 36.8% female
- Age:
 - 19.6% 31 to 40 years; 19.9% 41 to 50 years; 28.2% 51 to 60 years

Specific Aim #1

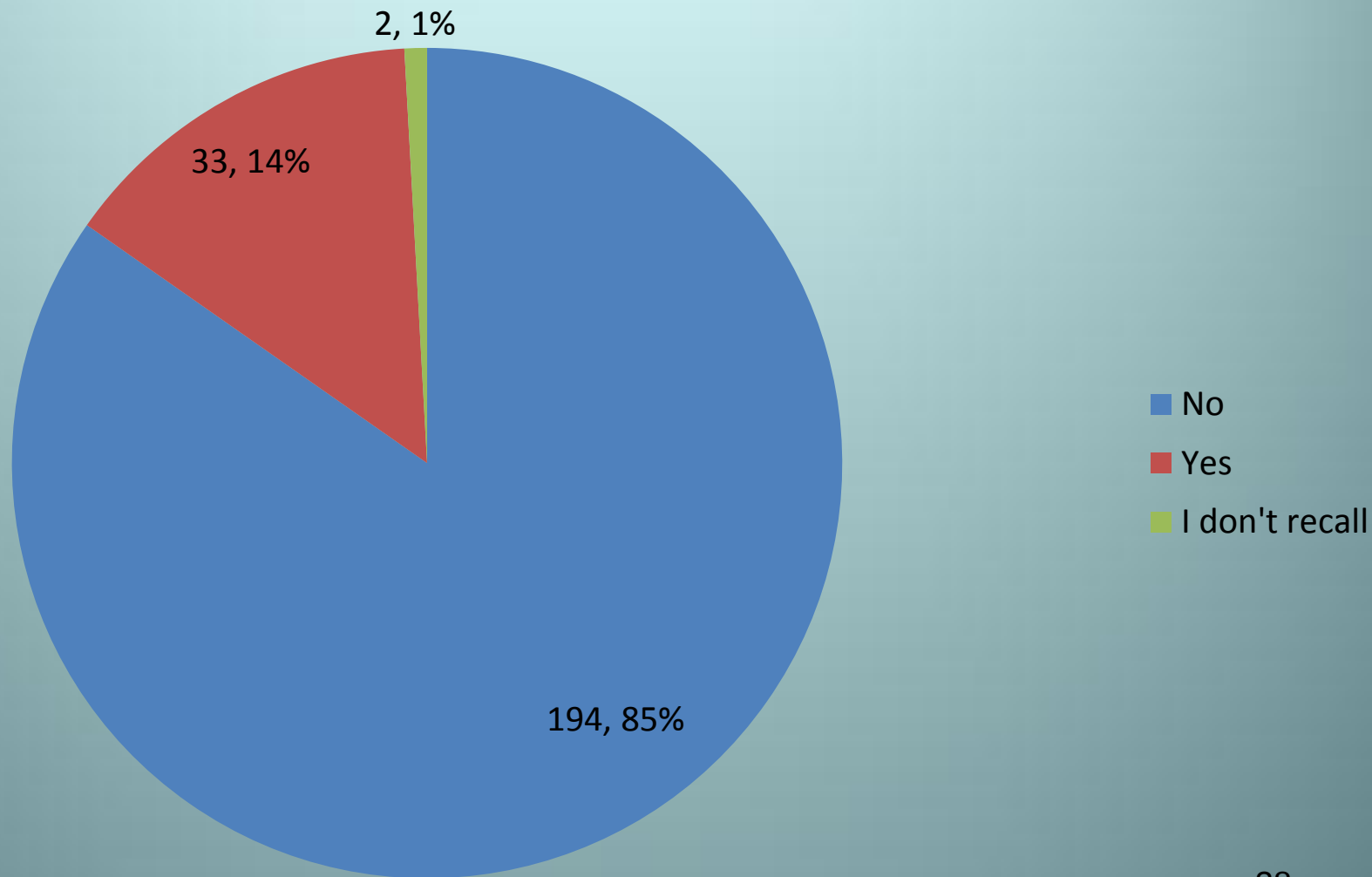
- Determine the number of physicians and veterinarians in Kansas making diagnoses of HAB-related illnesses in the summer of 2010 and in the summer of 2011

Overall 2010 HAB Illness Suspected or Diagnosed



n= 466

Overall 2011 HAB Illness Suspected or Diagnosed



n= 229

Reporting to KDHE

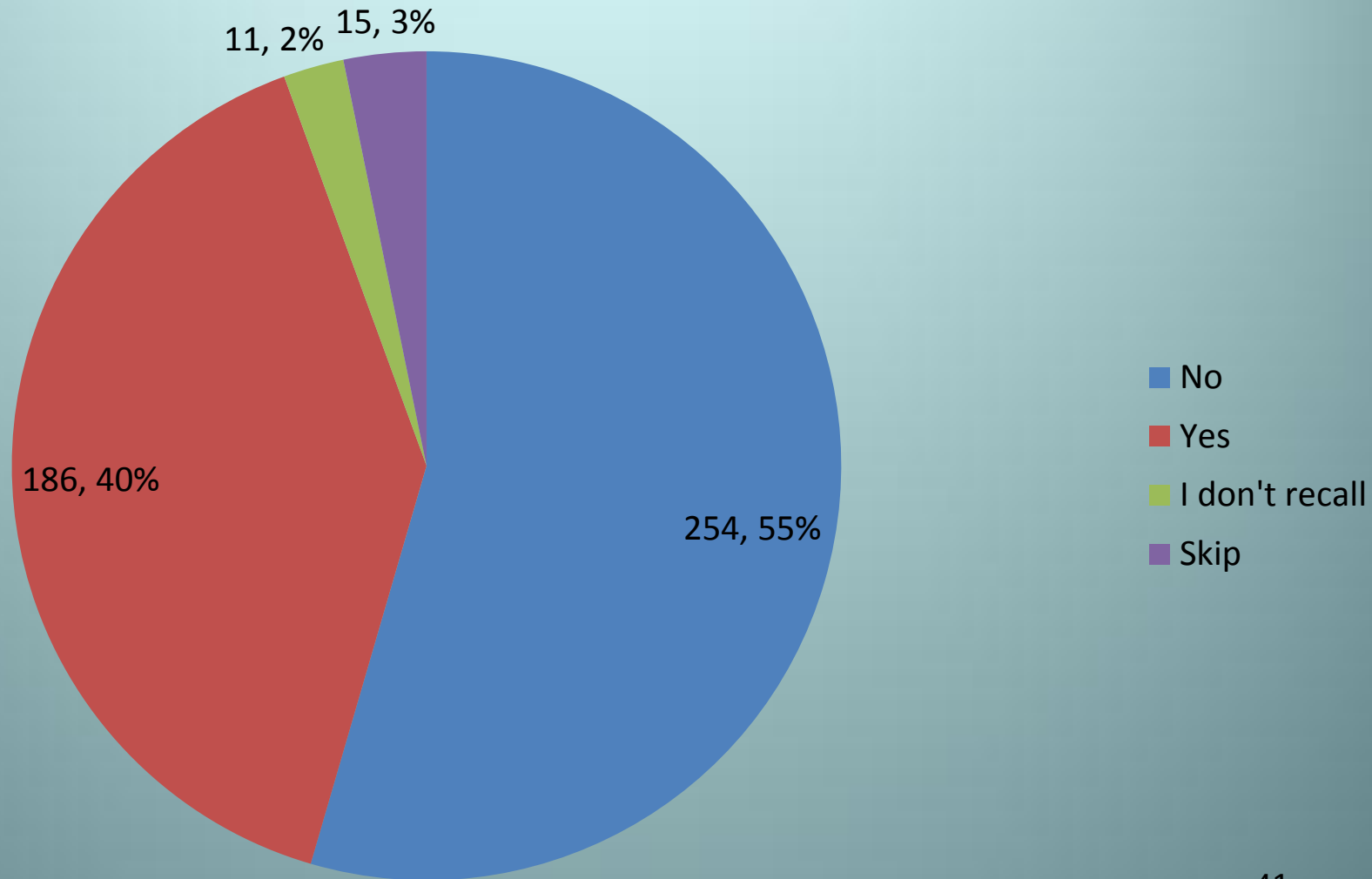
- Majority did not report to KDHE
- 2010:
 - 36.8% not aware; 73.7% did not report
- 2011:
 - 33.3% not aware; 42.4% did not report

Reporting to KDHE (2)

Physicians	HAB illness	Exposed in public water	Reported to KDHE	Method of Reporting
2010	4	2	1	EpiHotline
2011	11	9	0	

Veterinarians	HAB illness	Exposed in public water	Reported to KDHE	Method of Reporting
2010	15	4	0	
2011	22	13	5	EpiHotline

Overall Inquiry of Water Body History

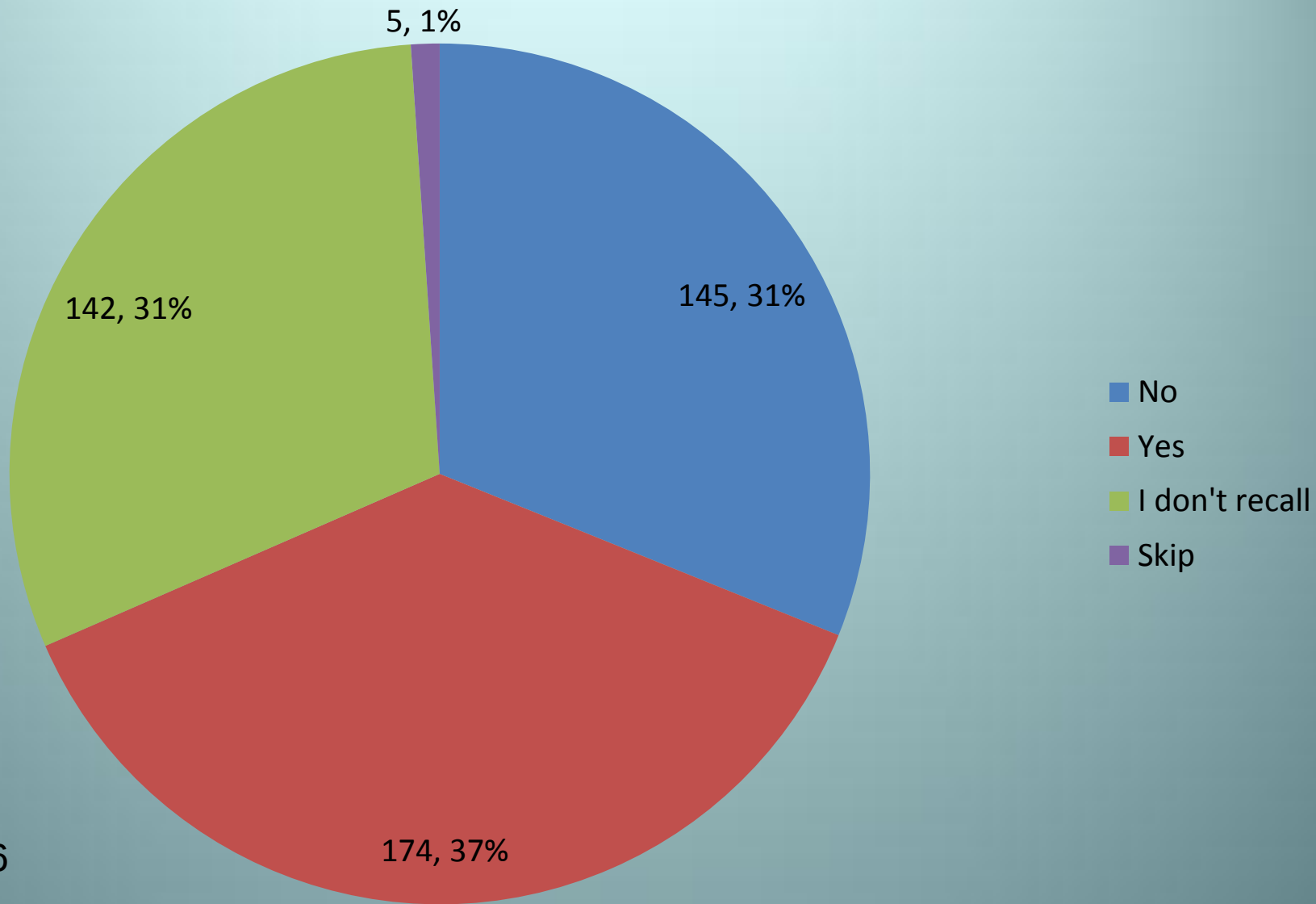


n= 466

Specific Aim #2

- Determine the number of physicians and veterinarians in Kansas who remembered receiving public health messaging about HABs from the KDHE prior to the summer of 2011

Overall Receipt of Email



n= 466

Specific Aim #3

- Determine whether the public health messaging about HABs from KDHE influenced diagnostic practices.

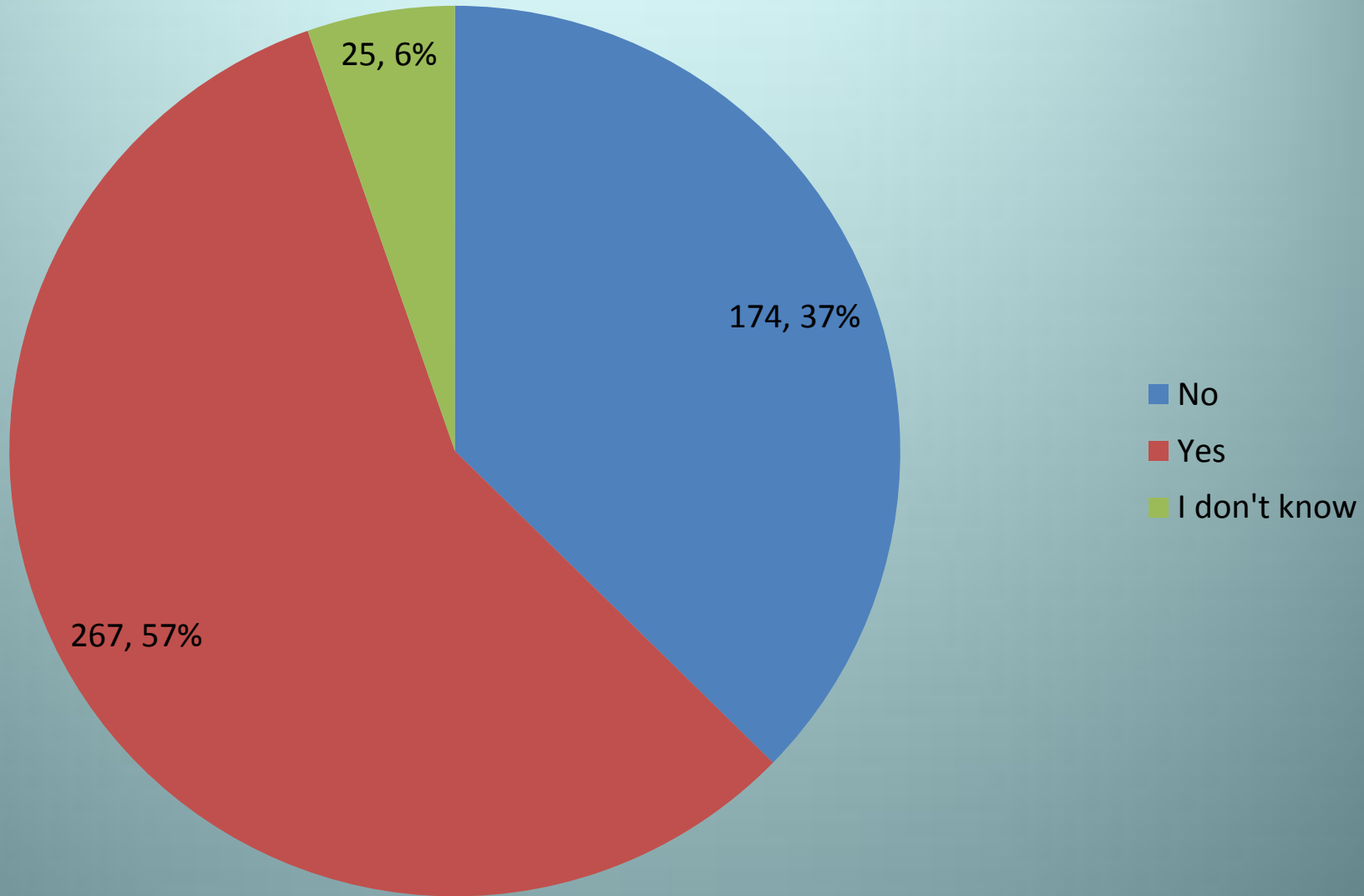
Influence of Email

- 60.9% - “Yes” the letter influenced diagnostic practices
 - Increased awareness (34.9%)
 - Was a good reminder of signs and symptoms (31.1%)
 - Increased knowledge regarding HABs (15.1%)

Specific Aim #4

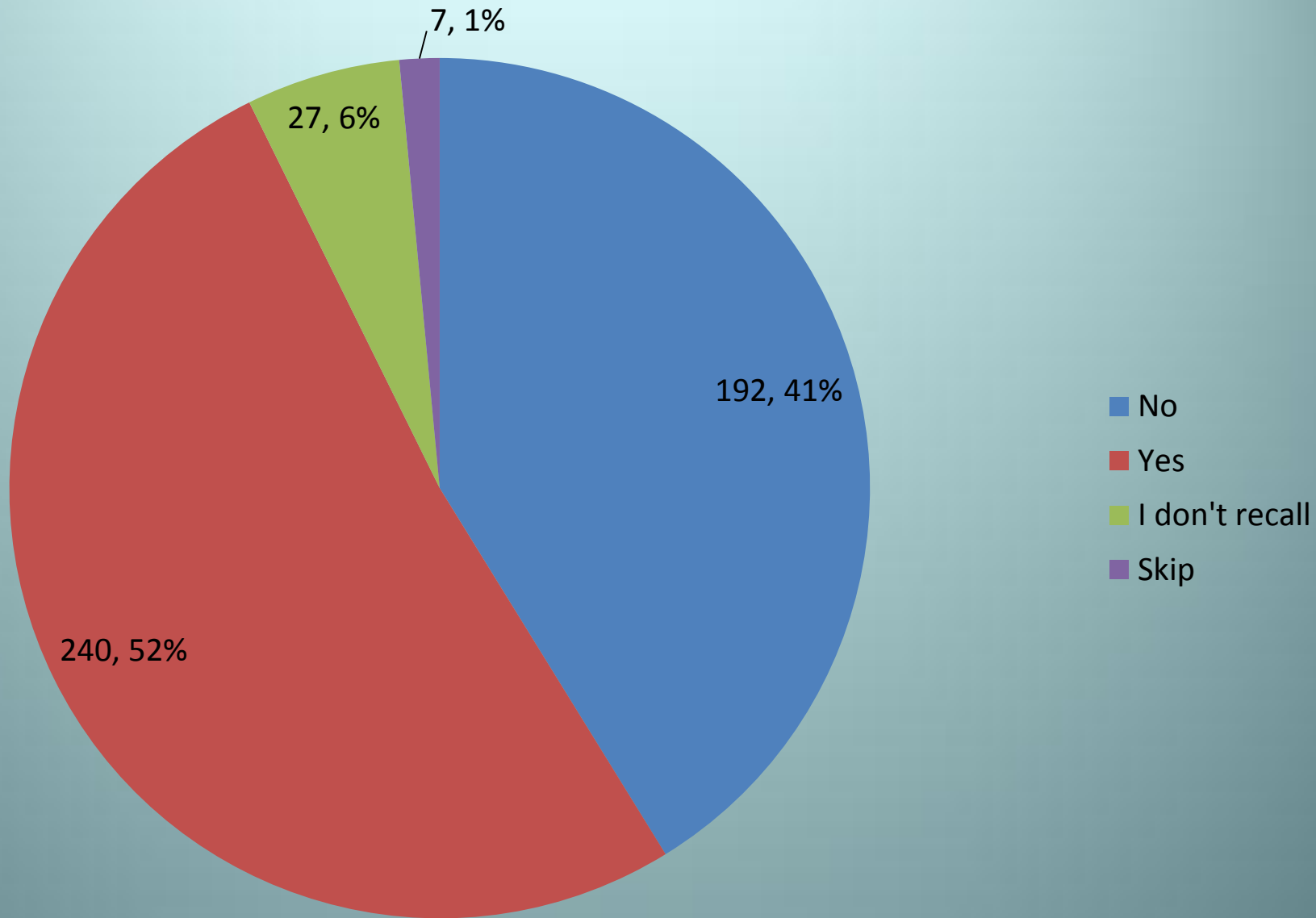
- Assess whether physicians and veterinarians in Kansas were aware of Advisories/Warnings related to lake conditions in their area.

Overall Prior HAB Awareness



n= 466

Overall 2011 HAB Awareness

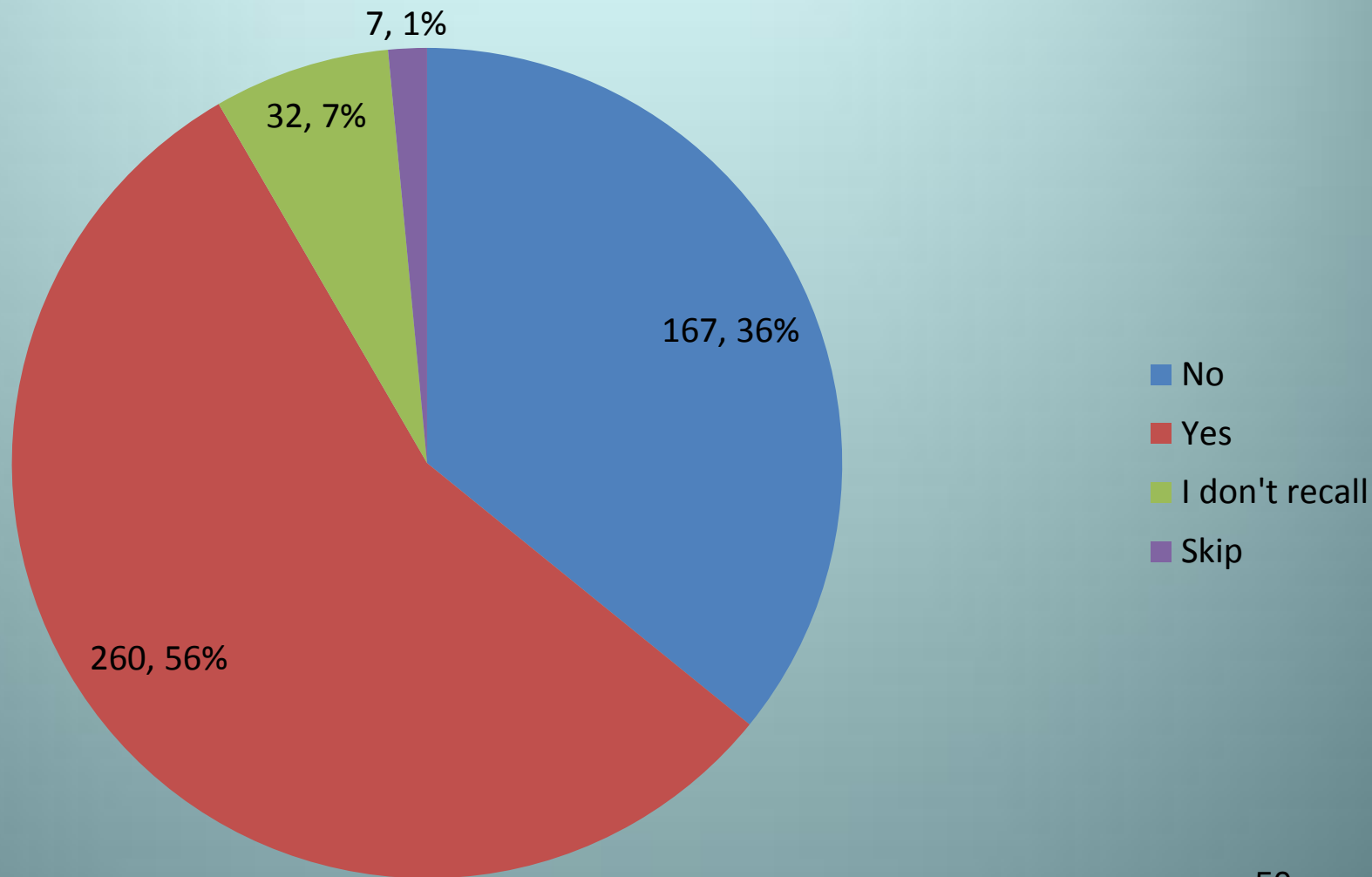


n= 466

HAB Awareness

	Prior HAB Awareness	2011 HAB Awareness	p - value
Physicians	33.1%	47.4%	< 0.0001
Veterinarians	71.8%	54.0%	< 0.0001

Overall 2011 Advisory/Warning Awareness

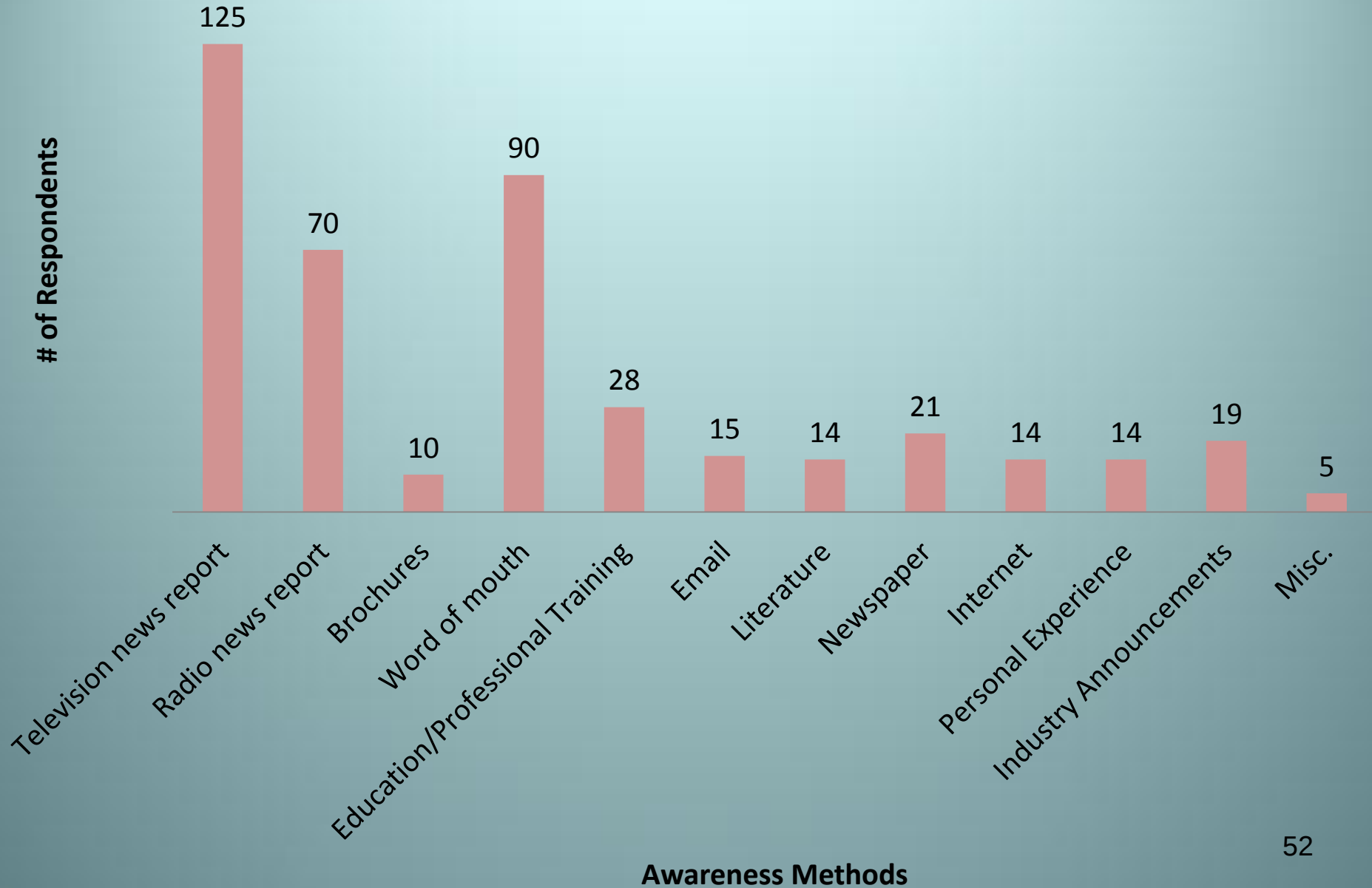


n= 466

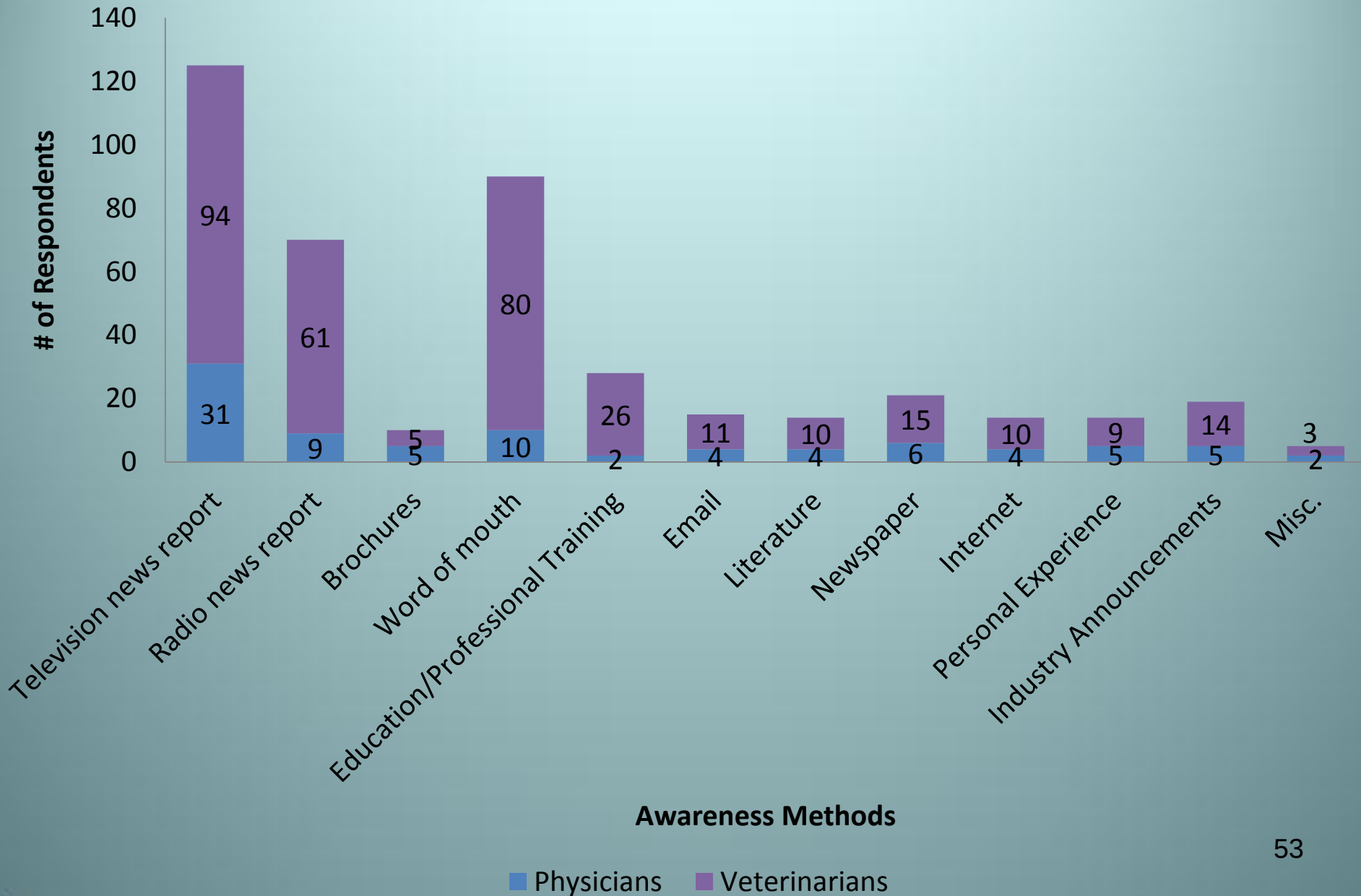
2011 Messaging Awareness

	2011 Messaging awareness
Physicians	46.3%
Veterinarians	61.5%
p – value	0.0014

Awareness Methods



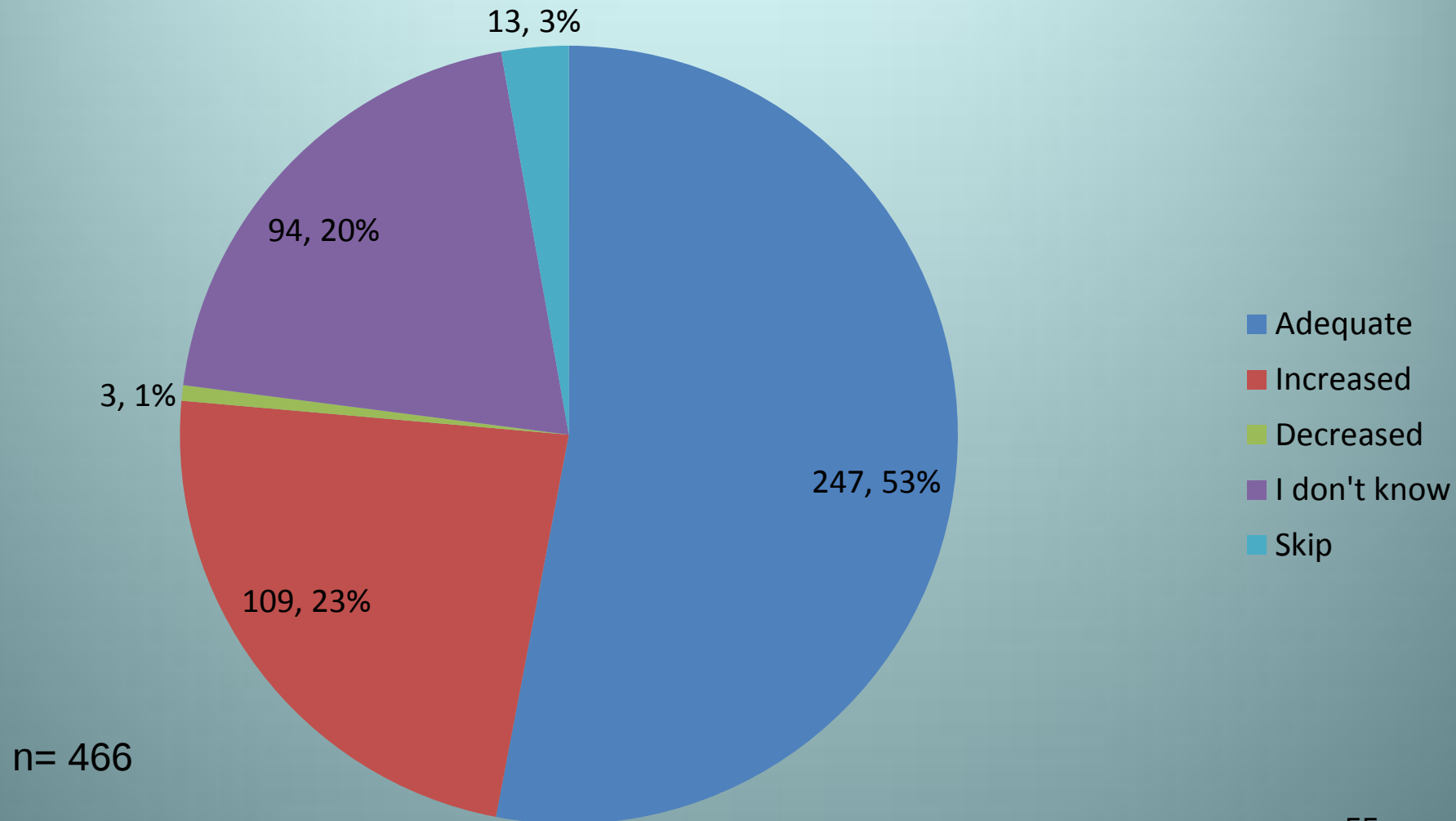
Awareness Methods



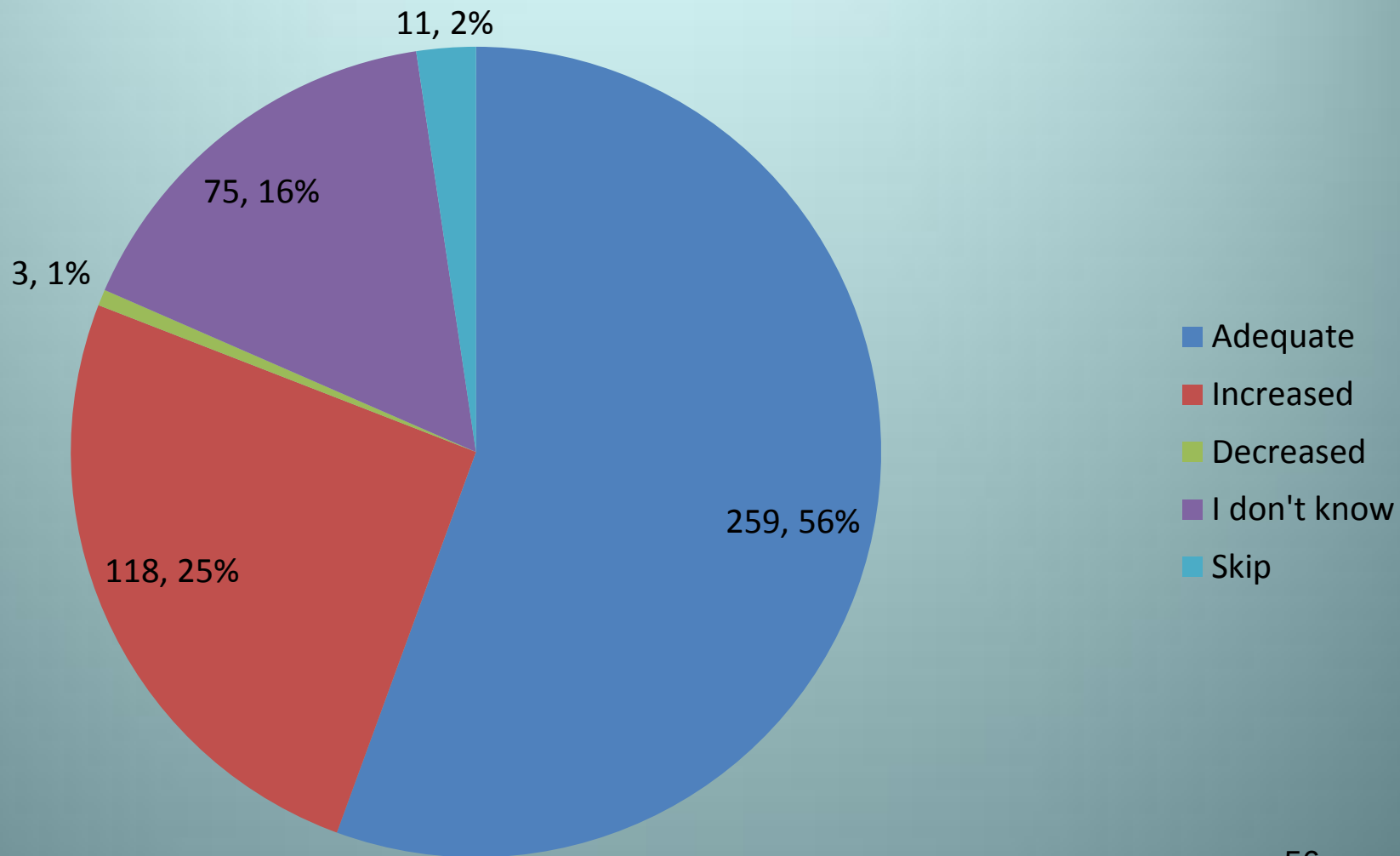
Specific Aim #5

- Assess attitudes among Kansas physicians and veterinarians regarding recreational water monitoring by state public health and environment agencies.

Overall Support of KDHE HAB Monitoring



Overall Support of KDHE HAB Disease Surveillance



n= 466

DISCUSSION

Discussion

- HAB illness-
 - Confounding factors-
 - More HAB affected lakes in 2011?
 - Ascertainment bias
 - Summer 2011 was first year that a HAB policy was in place

Recommendations

- Lack of reporting
 - Need to increase knowledge regarding the need for reporting to assess incidence
- Reporting Method
 - Increase knowledge regarding different avenues of reporting
- Medical History
 - Education- Keep HABs in mind during warm summer months
- Receipt of Letter/Email (public health messaging)
 - Broaden the scope of recipients
 - Include nurses, registered veterinary technicians
 - Enroll more members in the KS-HAN
- HAB Awareness and Advisory/Warning Awareness
 - Educational efforts that target physicians

Education

- Educate through the use of:
 - Television News Reports (Local Weather)
 - Word of Mouth (Social Networking)
 - Radio Station Broadcasts
- Increase focus toward physicians
 - Utilize other sources
- KS-HAN

Conclusions

- Influence of Messaging
 - Increasing awareness was a success among those who received the messaging
- KDHE efforts in monitoring and disease surveillance
 - Can focus on educational efforts

Further Study

- Collect more data such as sex and age regarding the non-responders
- Determine why there was a significant decrease in veterinary awareness prior to summer 2011 and during summer 2011
- Investigate how many lakes were HAB affected during 2010
- Compare responses by rural and urban areas



Image: <https://kshealth.kdhe.state.ks.us/HealthAlertNetwork/>

KDHE

Bureau of Community Health Systems

Promotional Efforts

- Phone calls to physicians and veterinarians
- Attended Conferences
 - Kansas Veterinary Medical Association (KVMA)
 - Kansas Academy of Family Physicians (KAFP)
 - Kansas School Nurses
- Inclusion of KS-HAN brochure with mail out of survey

Increased Enrollment

- Phone calls
 - ~100 calls 15 signed up- 0 registered
- Veterinary conference
 - 16 signed up- 7 registered
- Physicians conference
 - 20 signed up- 7 registered
- School Nurses conference
 - 40 signed up- 3 registered

Success of Promotional Efforts

- January 2012
 - 13 physicians
 - 0 veterinarians
- August 1, 2012
 - 34 physicians
 - 12 veterinarians

The Future of HABs in KS

- New HAB Policy and Response plan as of April 2012
- HAB Informational Video
- Facebook, Twitter, Flickr and YouTube
- Physician and Veterinary Brochures
- Education efforts made at the KVMA and KAFP Conferences
- Efforts made to increase enrollment in KS-HAN



Images provided by Janet Neff, KDHE



Lessons Learned from Survey

- Institutional Review Board (IRB) process
- Distributing a survey with a lack of funding- effect on response rate
- Survey writing, analysis, reporting methods
- Intricacies of a multi-agency response

Lessons Learned from HAN

- Phone calls
 - Getting past the “Gate Keepers”
 - Too many steps decreases compliance
- Public health education at local professional conferences
- Complexity of an online health network

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- At KDHE
 - Dr. Farah Ahmed, Dr. Ingrid Trevino-Garrison, Gilbert Tabares, Tom Langer, Henri Menager, Janet Neff and Shelley Bearman
- At KSU
 - Dr. Robert Larson, Dr. Deon Van der Merwe, Dr. Michael Cates, and Barta Stevenson
- And of course my family and friends for all of their moral support as I have ventured through this learning experience.

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Questions?

Karin Moser

kmoser@vet.k-state.edu