

Introduction to foodborne disease surveillance in the United States: Improving the output of our national surveillance systems

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November 2, 2006
Atlanta, Georgia



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What is public health surveillance?

- “Ongoing systematic collection, analysis, and interpretation of outcome-specific data for use in planning, implementation and evaluation of public health practice, closely integrated with the timely dissemination of these data to those responsible for prevention and control ” NNDSS Website
- “Surveillance is monitoring linked to action”
Henrik Wegener
- Core public health function at all levels
 - - not research
 - - not an afterthought



National (foodborne) disease surveillance - a brief history

- 1901: First meeting of the Council of State and Territorial Epidemiologists (CSTE) defined national surveillance priorities
- 1912: National surveillance began (telegraph)
- 1925: Full national participation in national surveillance
- 1942: National surveillance for non-typhoid salmonellosis
- 1952: Weekly surveillance data publication
- 1961: CDC began publishing it in MMWR

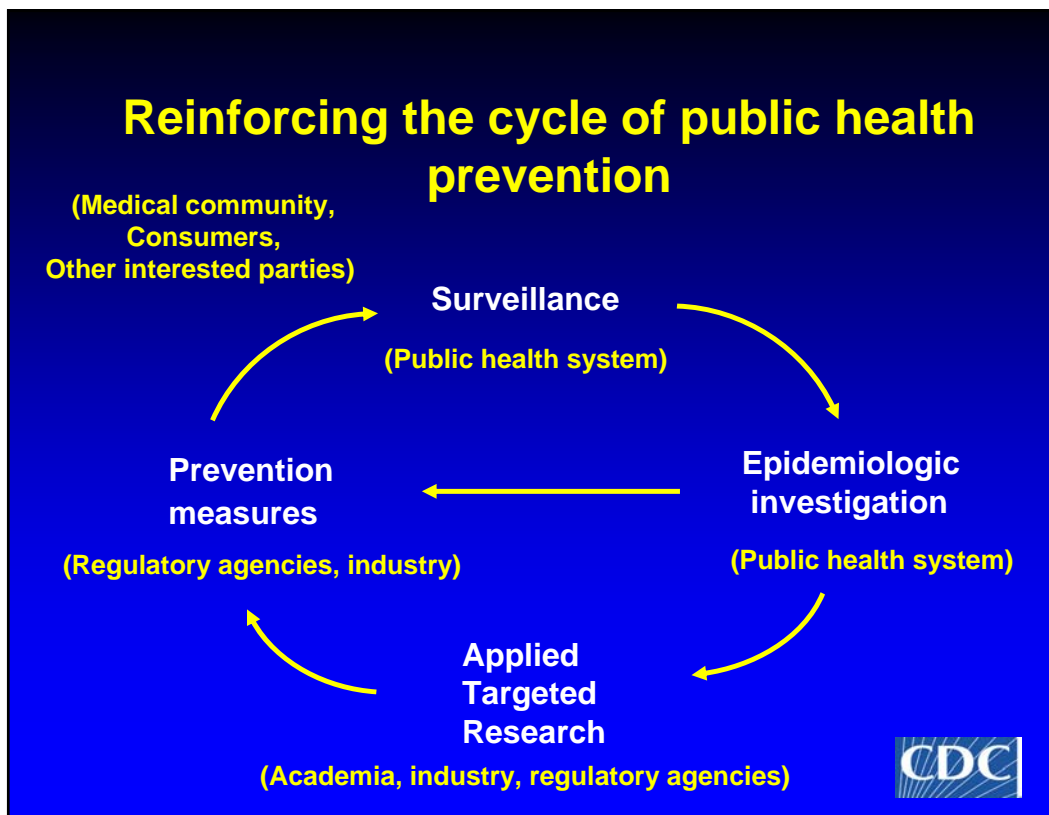
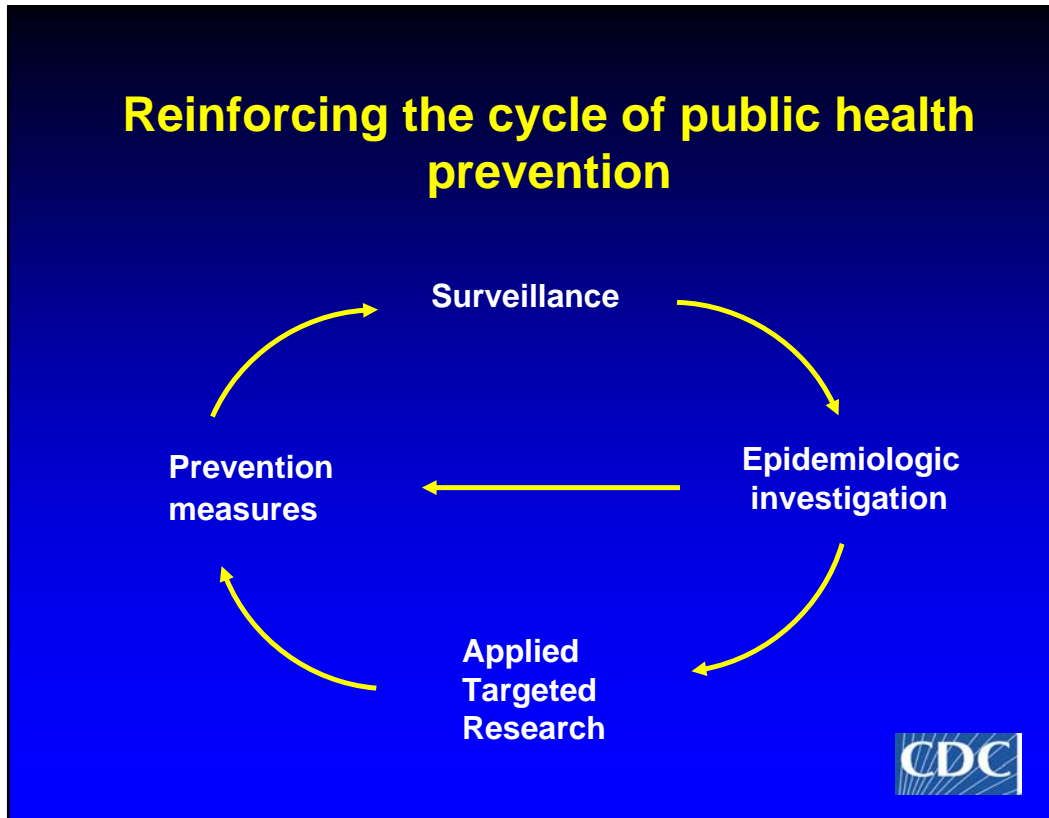
- 1962: Weekly reporting of Salmonella serotyping from State Public health labs (first public health lab based surveillance)
- 1967: Foodborne outbreak reporting
- 1995: *E. coli* O157 made nationally notifiable
- 1996: FoodNet and PulseNet launched



Why do we conduct surveillance? (Specific purpose varies by system)

- Define the magnitude, burden and trend of a disease we can do something about
- Identify outbreaks, so control actions can be taken and sources can be defined
- Provide a platform for research to improve prevention measures
- Measure impact of control and prevention efforts
- Identify new and emerging problems, (including intentional events)





Foodborne disease surveillance - our federalized system

- 50 states: Each has
 - Health Department
 - Epidemiology Office
 - Public Health Laboratory
 - Regulation of food safety (sometimes in Agriculture)
- 3600 counties, many cities. Each has a health department.
 - Where surveillance and response begins
 - Nurses, sanitarians, technicians
 - Case interview, restaurant inspections, respond to complaints
- Relatively few consistent federal regulations



Standard public health surveillance in the United States

- In each county or city:
 - Clinicians report notifiable diseases to county
 - Clinical laboratories report specific diagnosed infections
 - Public health nurses interview the cases
 - Citizen complaints are monitored
 - Local foodborne outbreaks are investigated by local public health and food safety authorities



Standard public health surveillance in the United States

➤ In each state:

- Counties/cities report notifiable diseases to states
- Counties may ask states for help in investigations
- Strains of *Salmonella*, *Shigella*, *E. coli* O157:H7 are referred to the State public health laboratory for serotyping confirmation, and for PulseNet
- More widespread foodborne outbreaks are investigated by state epidemiological and food safety authorities



Standard public health surveillance and response in the United States

➤ At federal level: Human health

- Each state voluntarily reports notifiable diseases to CDC
- CDC publishes these each week in the Morbidity and Mortality Weekly Report
- CDC also collects reports of outbreak investigations
- States may ask CDC for help in investigations
- Public health laboratories submit results of serotyping of *Salmonella*, *Shigella*, to CDC; PulseNet databases
- CDC laboratories assist in identifying the unusual strains, in outbreaks of unknown etiology
- More widespread foodborne outbreaks are investigated by CDC at invitation of state authorities



Standard veterinary and food monitoring in the United States

➤ At federal level:

- FSIS/USDA is the key agency for slaughter/meat and poultry
 - Regular monitoring of Salmonella in slaughtered animal carcasses - thresholds for regulatory action
- FDA is the key agency for regulating safety of other foods, and for approval of animal drugs.
 - Retail food sampling for foodborne pathogens in NARMS
- APHIS/USDA is the key agency for on-farm animal health
 - Surveys of farms (Center for Epidemiology and Animal Health)
 - Response to outbreaks of animal disease (avian flu, Newcastle disease etc)

➤ At CDC, in our Food Safety Office, we have a representative from each agency stationed with us



Foodborne disease – late 20th Century Long standing surveillance systems

➤ Consumer complaints: local

➤ Notifiable disease reporting: local → state → national

- Specific diseases information
- Best information comes from clinical laboratories
- Supplemental forms for some diseases (e.g. Vibrio, Listeria, Typhoid)

➤ Laboratory subtype based surveillance

- Referral of isolates from clinical laboratories to public health laboratories
- Salmonella and Shigella serotyping

➤ 24 hour “hotline” surveillance for botulism

- We provide the therapeutic antitoxin for suspect cases
- We provide emergency clinical, laboratory and epidemiological consultation
- About 25 foodborne and 50 wound cases occur each year.

➤ Informal communication networks with all states



Since 1996, public health surveillance strengthened with new networks

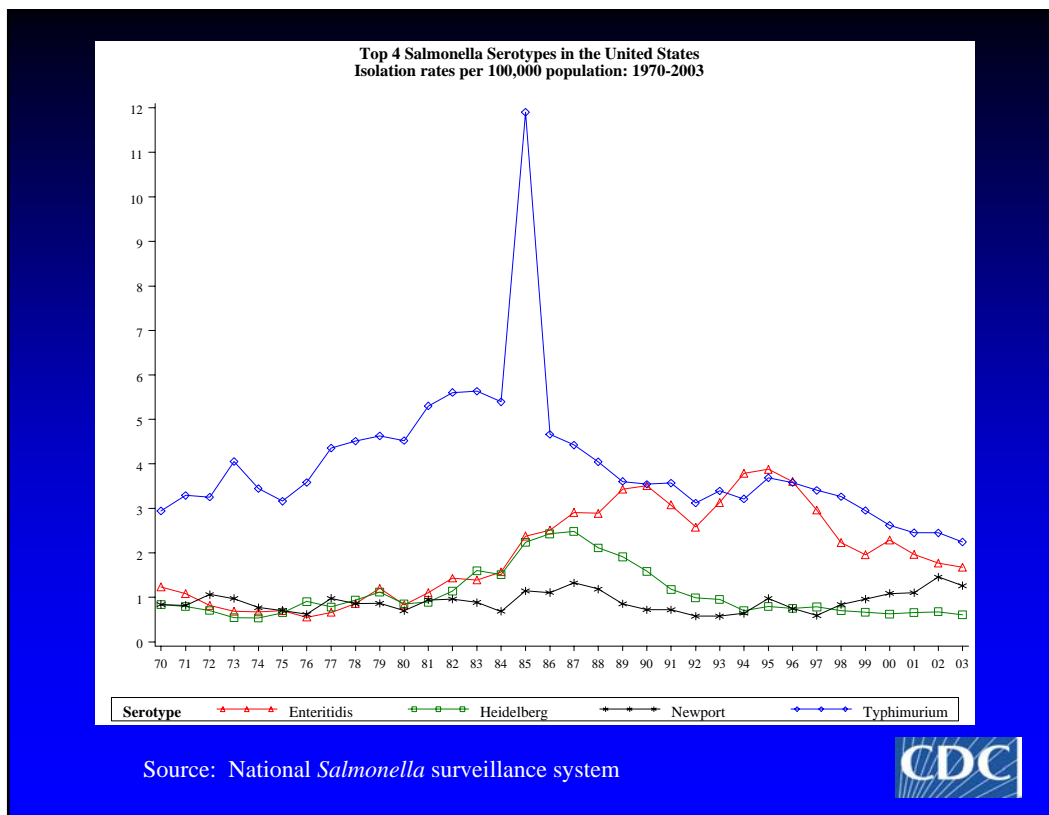
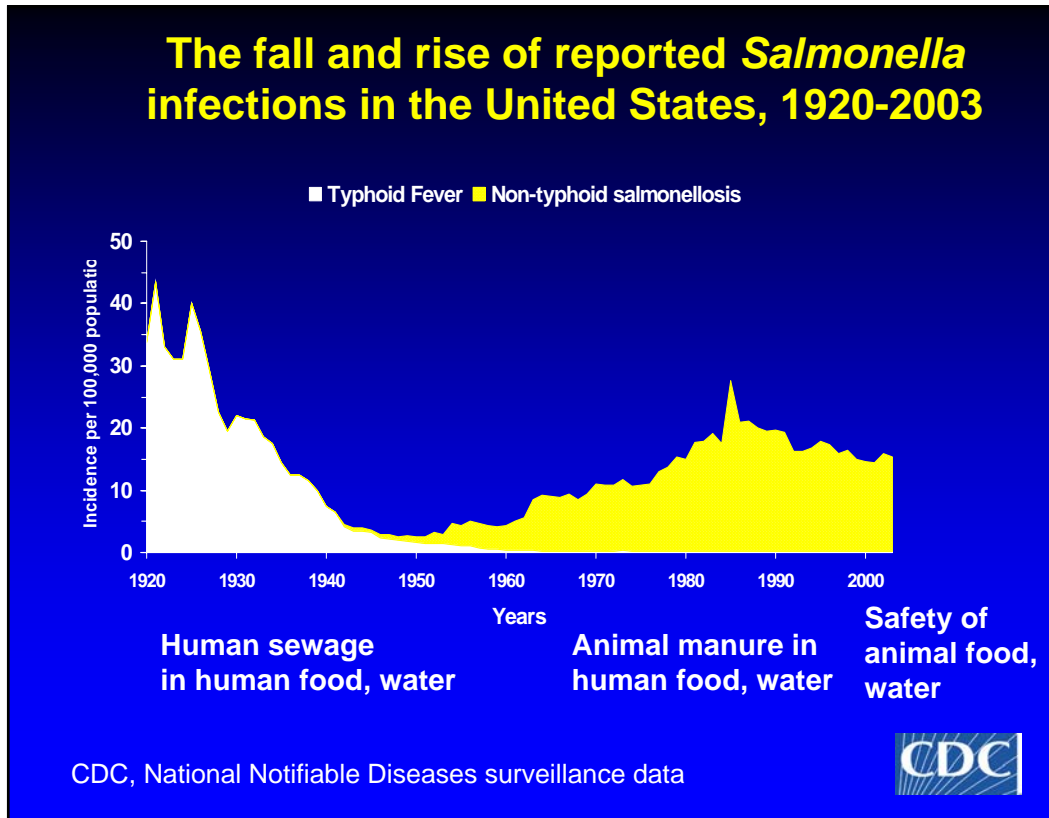
- **FoodNet:** Active sentinel 10-site surveillance collects data about sporadic cases. Burden and trend monitoring.
- **PulseNet:** The national subtyping network for bacterial foodborne pathogens: All 50 states. Improved outbreak detection and investigation.
- **Electronic Foodborne Outbreak Reporting (eFORS):** All 50 states. Reporting foodborne outbreaks to CDC via the Internet. Tracking trends by commodity, location, pathogen.
- **National Antimicrobial Resistance Monitoring System for Enteric Bacteria (NARMS):** All 50 states. Tracking trends in resistance, identifying emerging problems.



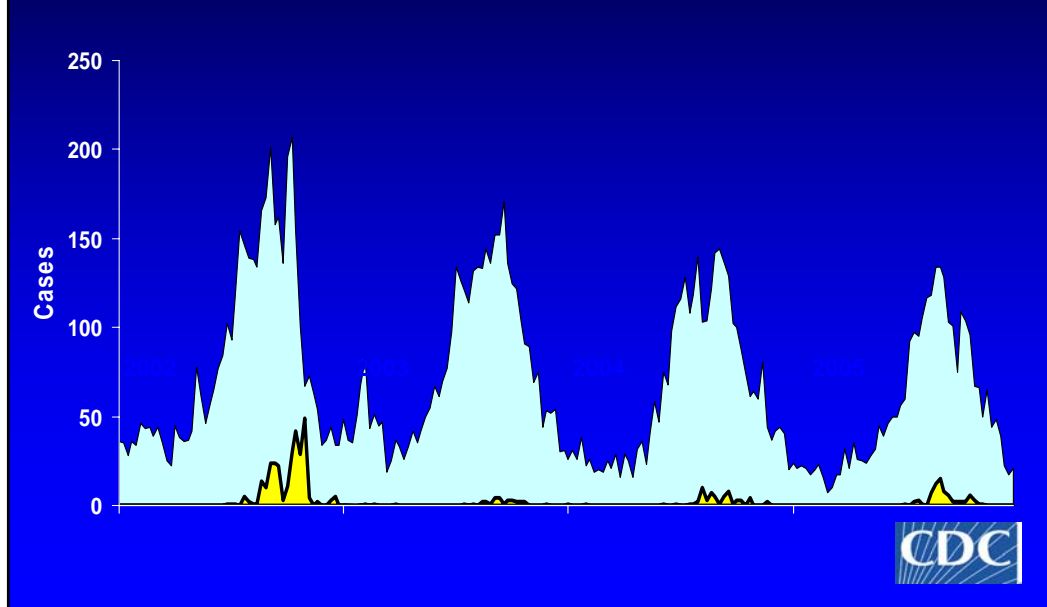
Critical elements of new surveillance networks

- **Reliable surveillance data for many users:**
 - Public health at state and national level
 - Risk assessment
 - Regulatory agencies
 - Industry itself
- **Consistent, standardized, and flexible**
- **Can propel action, measure progress**
- **Multi-agency collaboration and funding**
- **Public and industry appreciation of utility**





Salmonella Newport, Pattern A in PulseNet, by week of isolation, 2002-2005



Other parts of CDC also do surveillance for diseases that are sometimes foodborne

- **Hepatitis:** Hepatitis A surveillance and sentinel counties
- **Viral Diseases:** CaliciNet (Norovirus)
- **Parasitic Diseases:** Trichinosis, Cyclospora, Cryptosporidia
- **Viral Diseases:** Creutzfeld Jacob disease/prions

- **Environmental health:** Network of sanitarians to improve methods for inspection and investigation (EHS-Net)



Key features of any surveillance system

➤ Reporting network:

- Value to gathering data at state
- Participatory process

➤ Process:

- Data gathering and entry
- Assimilation of data at CDC
- Quality check or signoff
- Analysis and interpretation
- Summary and sharing

There is a cycle time
for the process,
that can be years, weeks,
or even days

➤ Data structure:

- Clear case definitions (agreed upon by CSTE)
- Consistency of supplemental information (and keep forms short)
- Database structured to assist analysis

➤ Outputs:

- Geared to specific purposes and audiences



Typical forms of outputs

➤ Within reporting networks:

- Listserv postings
- Webboard notifications
- Annual meetings

➤ Other decision makers, partners and general public:

- Weekly reports of case tallies in the MMWR
- Annual surveillance reports
- Scientific publications
- Periodic reviews
- Line lists of outbreaks



Natural history of surveillance systems

- Start small as pilots in a few places
- Add participants – the numbers go up
- Initially a simple paper form for data, some go electronic
- Maturity = stable reporting base
- Stable base permits trend evaluation
- Simple summaries grow into large reports
- If disease goes away, system may continue low level to detect resurgence

- May be adopted internationally

- Result: a variety of systems developed by different programs at different times for different purposes.



Constraints on surveillance

- Under-reporting is a given
 - All systems have underreporting
 - Active outreach greatly increases costs
 - Not necessarily bad, as long as what is reported is consistently representative

- Dependent on state of medical system
 - Collect diagnoses, isolates that already exist
 - Depends on what is already being diagnosed, isolated
 - Changes in diagnostic methods – change in surveillance

- Dependent on local and state efforts
 - Resources, regulations, and zeal all vary
 - Comparison can be difficult
 - Critically impacts cycle time

- Confidentiality and ownership
 - Do not identify individual patients at national level
 - Data belong to States - sensitivities regarding release
 - Must share back with participants before can share with others



Challenges for surveillance

➤ Diversity of systems

- Variety of IT solutions, disparate methods
- Systems do not communicate well with each other
- Often States have their own systems
- Attempts to develop the one mega-system are to date unsuccessful

➤ Vocabularies vary

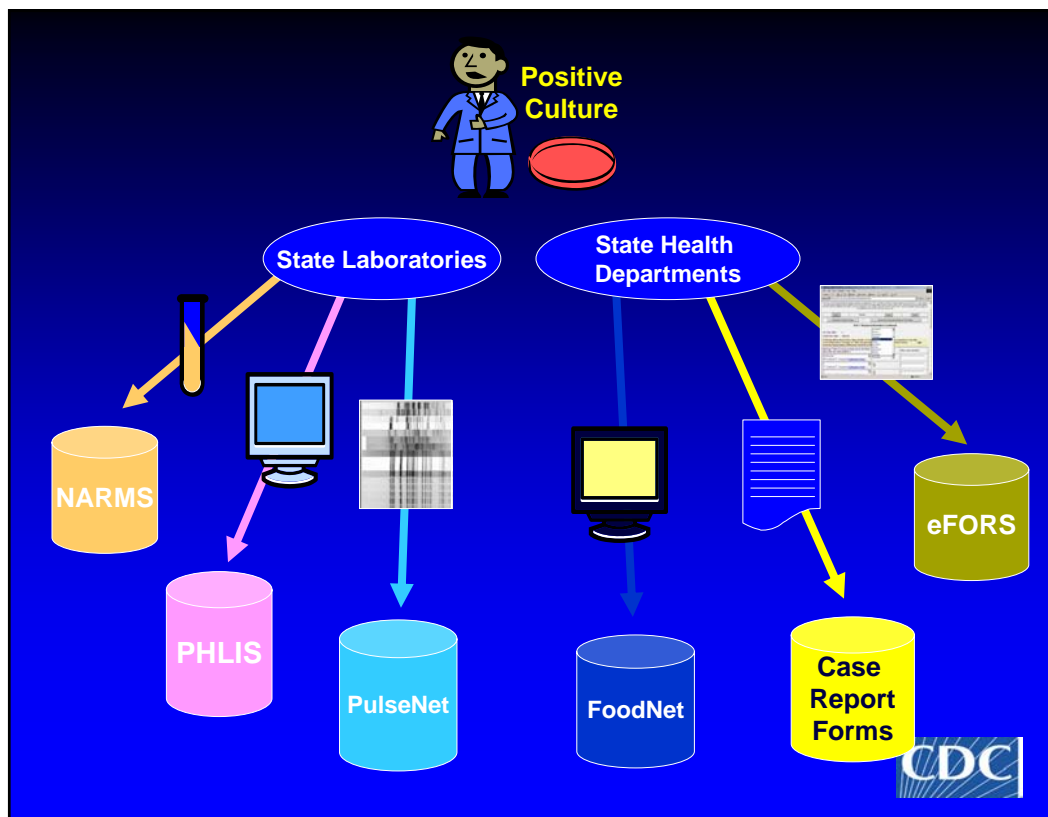
- Individual system variants
- Some large standard vocabularies are very out of date
- E.g., Sno-Med does not reflect standard serotyping for Salmonella

➤ No standard nomenclature for food, even in English

- What is a Rock Melon? Chicken Oscar?
- Problem of defining ingredients

➤ Growing dependence on information technology

- Systems often designed for ease of input, few for ease of output
- Easy to underestimate time it takes to summarize and interpret
- Internet should make distribution easier



Surveillance Systems Evolve

- Purposes may evolve over time
- Systems may mature - with more data available
- Sustained systems may be interesting to a broader audience
- Over the last 10 years, much effort has been put into improving processes in our systems
 - Strengthening existing systems
 - Building new networks
 - Higher quality information
 - Faster cycle time
- Now can make more information more available via publication, Internet, listserv groups, etc.
- Making output as useful as possible
 - Which data to summarize?
 - For which audiences?
 - Which formats to explore?



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Thank you

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