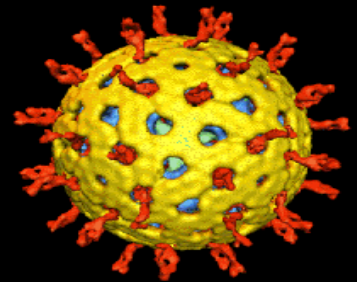


Overview of Microbial Food Safety Issues: Meat and Poultry Products



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- ❖ Indian Meat & Poultry Industry

- ❖ Important Foodborne Pathogens

- ❖ Bacterial, Viral, Parasitic

- ❖ Other Microbial Food Safety Issues

- ❖ Trans-boundary animal diseases

- ❖ Increasing antibiotic resistance

- ❖ Foodborne surveillance

- ❖ Risk assessment and standards

- ❖ Strengths/ Advantages

Indian Meat Industry

- ❖ Meat production : 6.4 Million Tonnes
- ❖ Value of meat produced : Rs.21, 900 crores
- ❖ Meat products : Rs.828 crores
- ❖ Registered slaughter houses: 3900
- ❖ Unregistered slaughter houses: 25750
- ❖ Modern Integrated meat plants: 15
- ❖ 15 more coming in near future

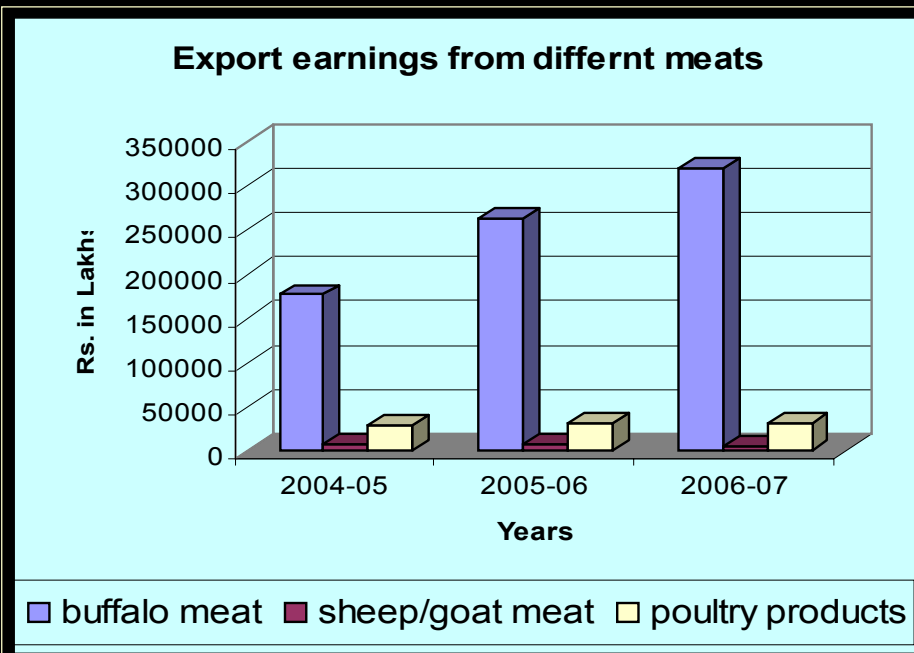


Source: Report of Working Group on
Animal Husbandry XI plan



Export

- Buffalo meat : 4,94,111.48 MT
 - Value of Rs. 3,211.70 Crores
 - Sheep/goat meat : 5,481.55 MT
 - Value of Rs. 63.05 Crores
- (2006-07)
- Bovine meat: 97% contribution



Source: APEDA web site



Indian Poultry Industry

- ❖ Transformed from backyard to a well-organized industry
- ❖ 70% : organized sector & 30% : unorganized sector
- ❖ Contribution: 11,000 crores to National GDP
- ❖ Egg production : 45.2 billion eggs (4th in world)
- ❖ Broiler production: 2.0 million tonnes (19th)
- ❖ Poultry products export: Rs. 315.90 Crores
(2006-07)



Food Safety



- Increased global trade
- Discerning and knowledgeable consumer



Important issue



- BSE & nv CJD: UK
- Melamine in milk/milk products: China
- Pesticide residues in cold-drinks: India
- Avian Influenza: India and Asian countries



PESTICIDES
IN COLD DRINKS

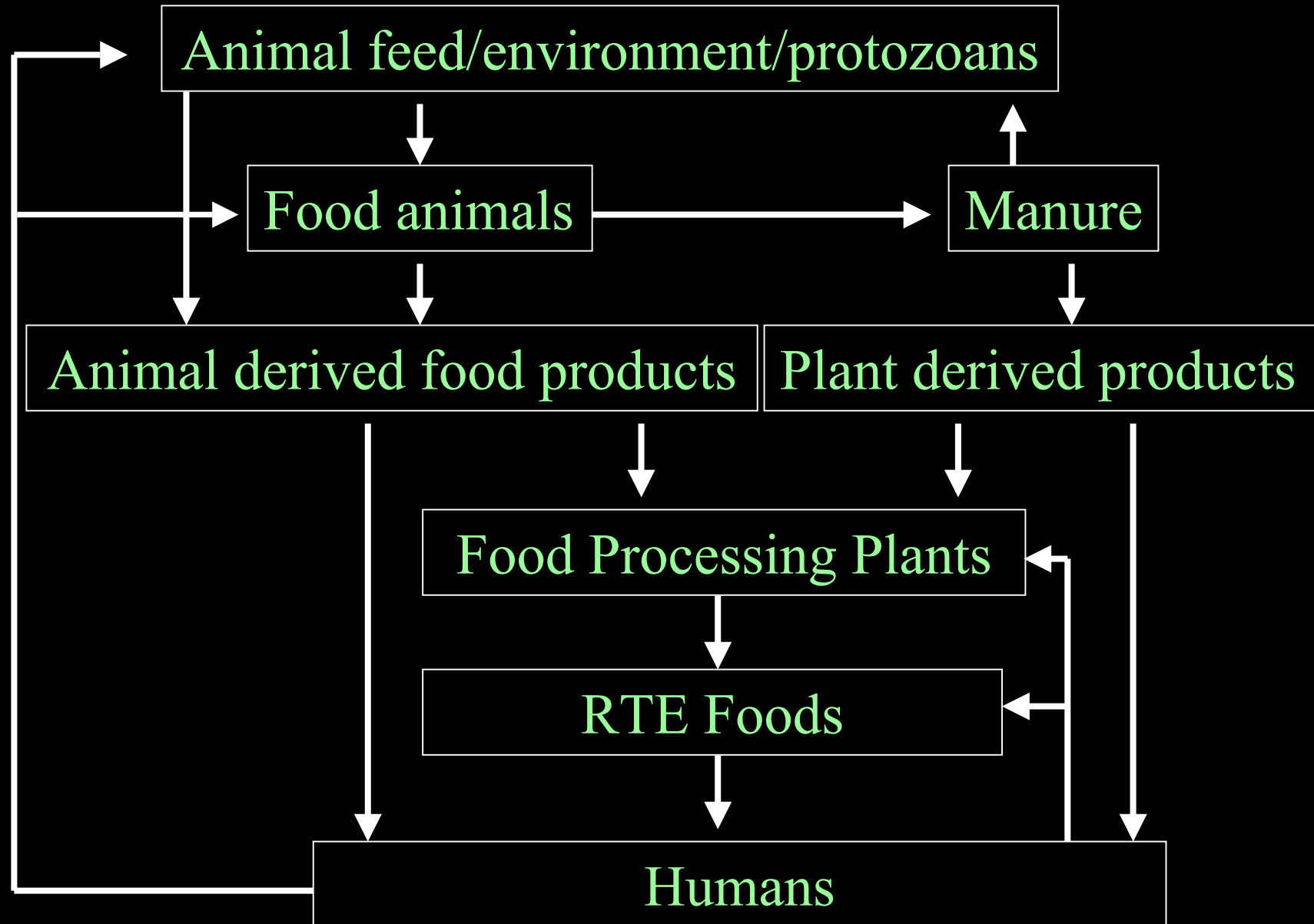




Microbial Food Safety

- ❖ Foodborne illness : Global magnitude difficult to assess
 - Deaths due to diarrhoeal diseases in 2005: 1.8 million
 - Developed countries: 30% population
(INFOSAN WHO 2008)
- USA: 76 million cases of foodborne diseases
 - 325,000 hospitalizations
 - 5,000 deaths
- India: Magnitude is unknown
 - Diarrhoeal diseases (Food and waterborne) :
18.6 million children under age of 5
 - 3,86,000 deaths in children (1 in every 5 global deaths in children)

Transmission of Foodborne Diseases



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Important Pathogens

IVRI



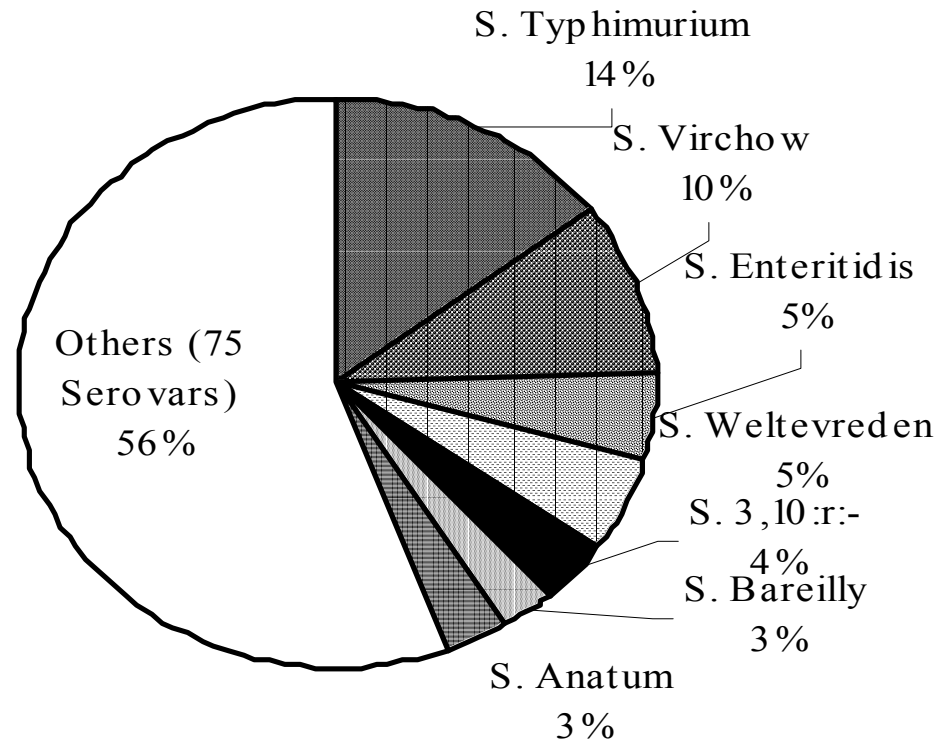


Salmonella

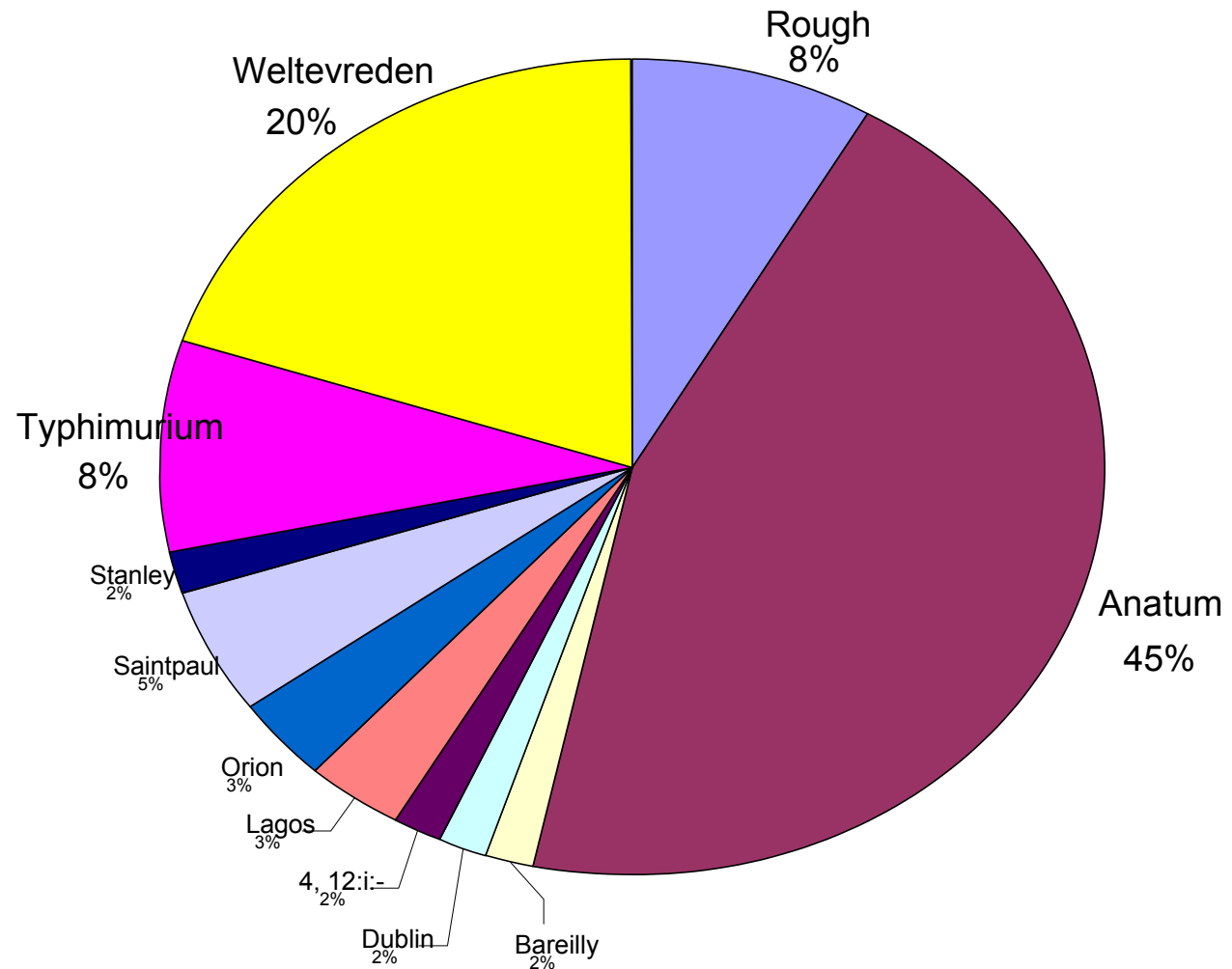
- ❖ 2541 serotypes
- ❖ > 128 serotypes present in India
 - ❖ New added every year
- ❖ Prevalence in human (non typhoid) : 1 - 5%
- ❖ Prevalence in healthy carriers: 1 - 2%
- ❖ Prevalence in meat and poultry: 5 - 7%
- ❖ RTE meats and poultry products: 0 - 3%

Zoonotic *Salmonella* serovars in animals

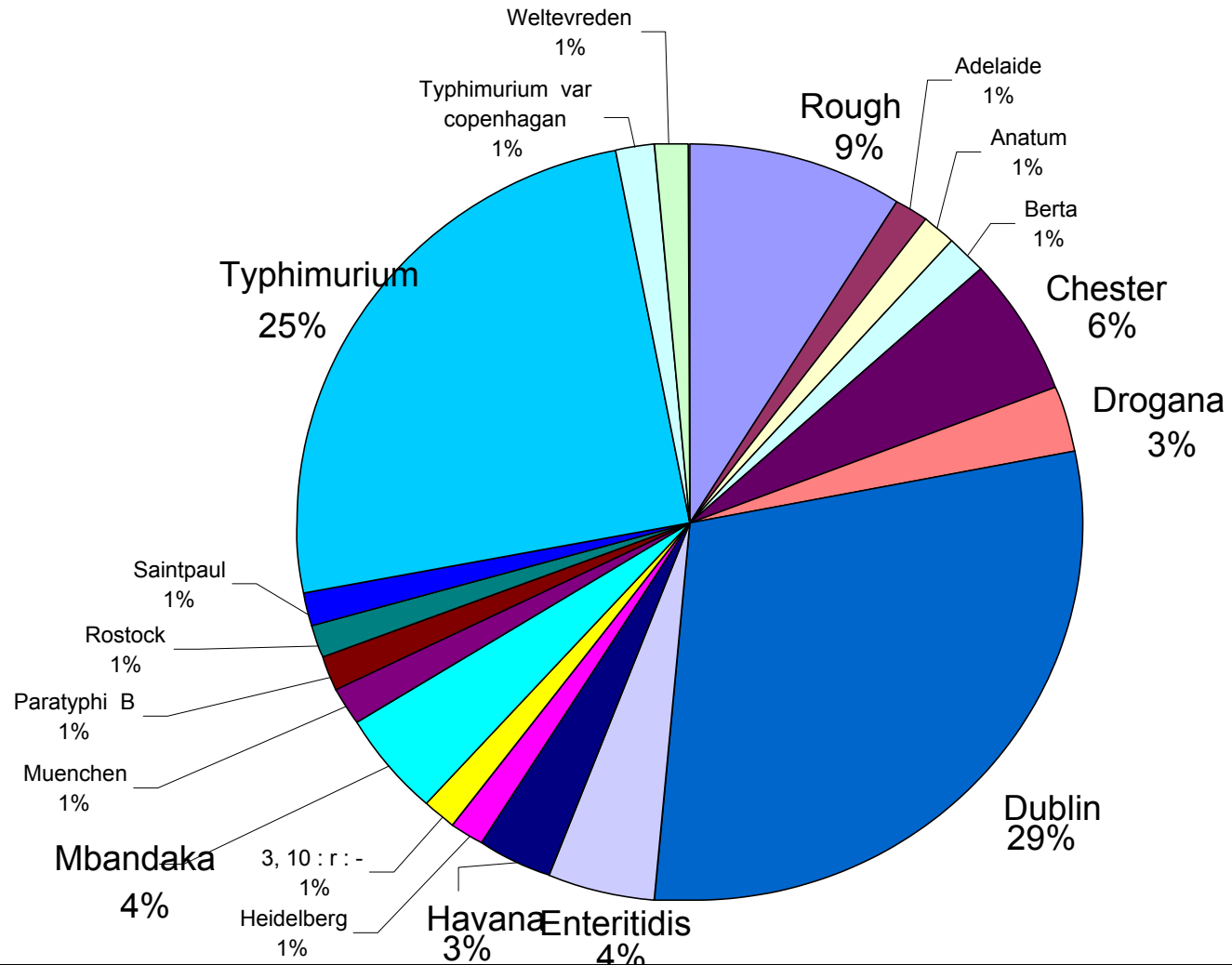
Singh, 2004



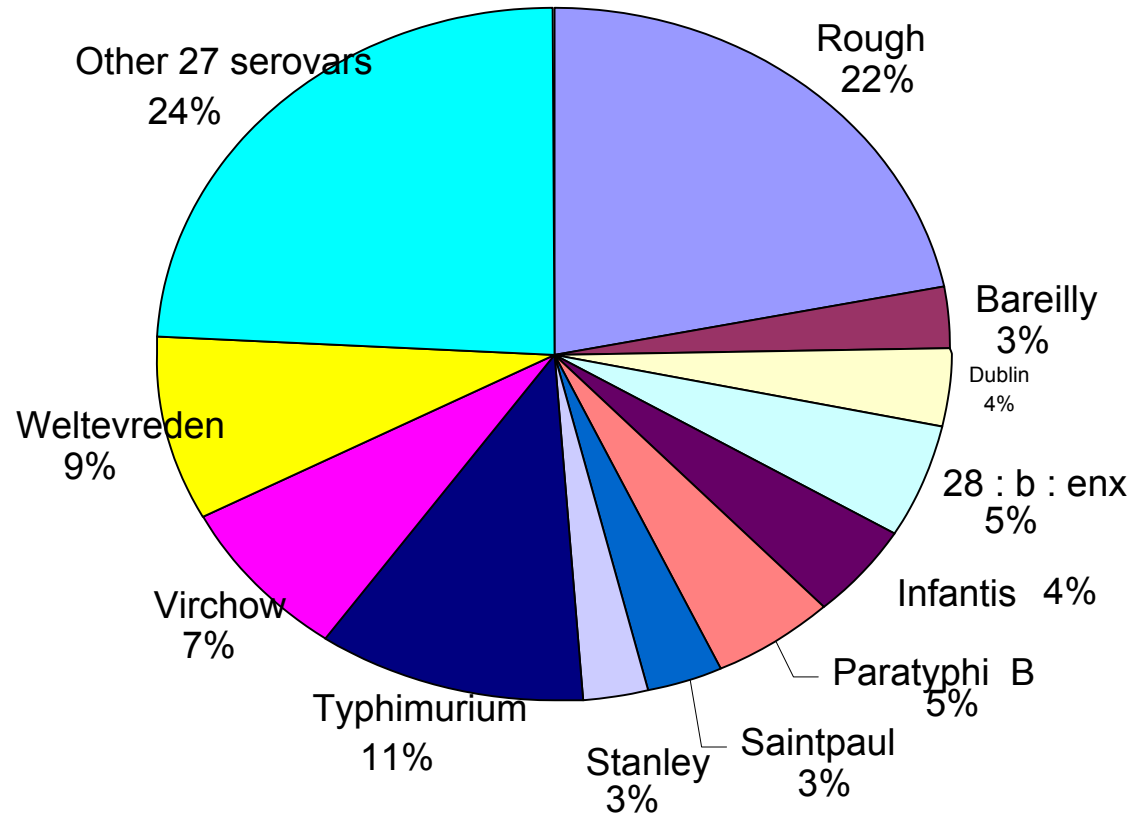
Salmonella serovars in buffaloes



Salmonella serovars in Cattle

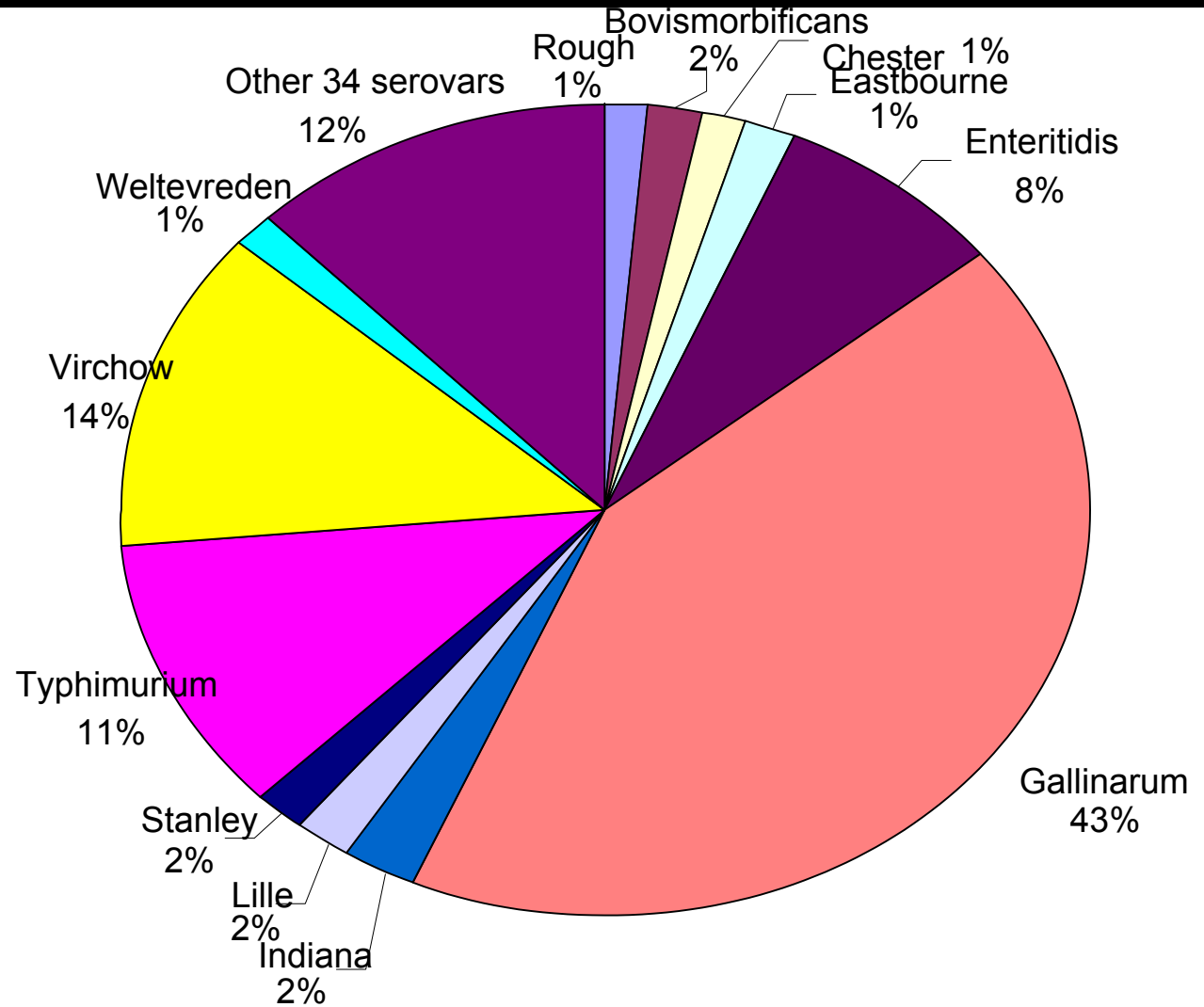


Salmonella serovars in Goats



Salmonella serovars in birds

Singh, 2004



•Virchow and Typhimurium are more common than Enteritidis.

E. coli

❖ One of the most common pathogen

❖ Different types

➤ EPEC

➤ ETEC

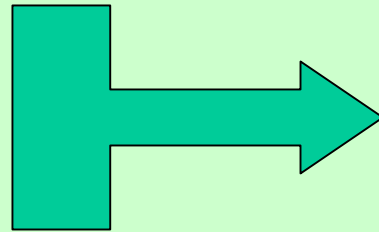
➤ EIEC

➤ EAaggEC

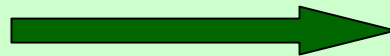
➤ EHEC

➤ DAEC

➤ CDTEC



Frequently reported



**Several isolations
in recent times**

Prevalence in Meats



- ❖ Numerous reports
 - ❖ Meat and poultry products : 20-50%; up to 100%
 - ❖ Human diarrhoea
 - ❖ Animal diarrhoea
- ❖ STEC (EHEC): ↑ Isolations in recent years
 - ❖ Animals : Important reservoirs
 - ❖ Isolations from meats : Buffalo, sheep, goat, kebabs, sausages
 - ❖ Majority STEC are non O 157: H 7
 - ❖ O 157: H 7 : Rare



Prevalence of STEC in Human

Source	No. of <i>E. coli</i>	STEC	Place	Reference
Diarrhoeal patients	1338	9	New Delhi	Pamchandran and Verghese (1987)
HUS patients	25	19	New Delhi	Kishore <i>et al.</i> , (1992)
Haemorrhagic enteritis	240	18	Bareilly	Kapoor <i>et al.</i> , (1995)
Diarrhoea and UTI infection	67	15	Bareilly	Banerjee <i>et al.</i> , (2001) & Ratore (2000)



L. monocytogenes

- ❖ Meningo-encephalitis & abortion
- ❖ Grows well : Refrigeration temperature
- ❖ Grows : Moderately low pH
High salt concentration
- ❖ Survives and can multiply under diverse environmental conditions
 - Various stages of production, processing and storage
 - Biofilm production

Prevalence in Meats



Source	Prevalence	Place	Reference
Buffalo meat	< 10%	Gujarat	Brahmbhatt and Anjaria (1993)
Goat meat	< 10%	Bareilly	Banurekha <i>et al.</i> , (1998)
Goat meat	6.66%	Bareilly	Barbuddhe <i>et al.</i> , (2000)
Sheep meat	7.4%	Bareilly	Barbuddhe <i>et al.</i> , (2000)
Various meats products	3 - 8%	Bombay	Waskar (2005)
Poultry meat	8.5%	Nagpur	Kalorey <i>et al.</i> , (2005)



Prevalence in Human

Source	Prevalence	Place	Reference
Abortion (150 patients)	14%	Mumbai	Krishna <i>et al.</i> , (1966)
Abortion still births	3%	-	Bhujwala <i>et al.</i> , (1973)
Abortion	3.3%	Northern India	Kaur <i>et al.</i> , (2007)
Abortion	10%	Nagpur	Kalorey (2008)
Abortion	6%	Goa	Barbuddhe (2008)



Campylobacter

- ❖ Important diarrhoeal pathogen
 - ❖ Guillain-Barré Syndrome
- ❖ Human diarrhoea: 10 - 15%
- ❖ Many asymptomatic carriers
- ❖ Poultry : Most important transmitters
- ❖ Isolations from poultry meat: 20 - 50% up to 100%
- ❖ Other meats: 3 - 5%
- ❖ Industrialized countries: Manifestations are severe
- ❖ In Asian countries: Symptoms are milder.



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Aeromonas

- Emerging pathogen of importance : Dairrhoea
- Implicated in extra intestinal infections
- **Pathogen found in aquatic environment**
 - Saline & brackish water
 - Drinking water
 - Treated & un-treated sewage
 - Abattoir waste water
 - Colonize slow sand filters
- **Fish – Major source**
- **Poultry, Mutton, beef, milk, etc. are also found to be contaminated**

Prevalence in meats



Source	Prevalence	Place	Reference
Mutton	24-37%	Hisar	Khurana and Kumar (1997)
Poultry	32-38%	Hisar	Khurana and Kumar (1997)
Poultry meat	16%	Bareilly	Kumar (1998)
Poultry meat	16%	Bareilly	Ghatak (2005)
Eggs	12-22%	Bareilly	Agarwal (1997) Kumar (1998)
Goat meat	12%	Bareilly	Kumar (1998)
Various RTE meat products	14%	Bombay	Waskar (2005)

Prevalence in Human

Source	Prevalence	Place	Reference
Diarrhoea	6.5%	Chennai	Komathi <i>et al.</i> , (1998)
Diarrhoea	8%	Kolkata	Chaterjee and Neogy (1972)
Diarrhoea	0.2%	Vellore	Jesudasan and koshi (1990)
Diarrhoea	6.5%	Bareilly	Ghatak (2005)





Clostridium perfringens

- ❖ Meat and poultry : Common pathogen
- ❖ Thermostable spores
- ❖ Post production temperature abuse
- ❖ Large scale production

Inadequately heated meat dishes



Human outbreaks

- ❖ Prevalence in meats
 - ❖ Buffalo: 40 - 85%
 - ❖ Goat: 35 -75%
 - ❖ Poultry: 30-75%
- ❖ RTE meat and poultry products: 20 – 85%



Staphylococcus aureus

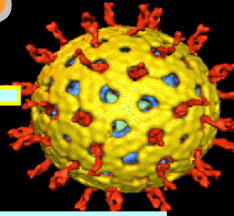
- ❖ Intoxicaton : Thermostable enterotoxin
- ❖ Post-production contamination & favourable storage temperature
- ❖ Meat and poultry: Less frequently associated
- ❖ Milk products : More commonly implicated
- ❖ Animals: Mastitis
- ❖ Human: Foodborne emetic episodes, pyogenic skin infection, post-operative wound
- ❖ Prevalence in meat and poultry products
10 – 100%

Bacillus cereus

- ❖ Diarrhoegenic and Emetic syndrome
- ❖ Emetic : Rice dishes
- ❖ Diarrhoea: Animal products
- ❖ Mild nature of symptoms: Under reported
- ❖ Implicated in some foodborne episodes
- ❖ Prevalence in meat and poultry products:
Variable - 10 -70%



Rotavirus



- Major cause infant and children diarrhoea
- 100,000 to 150,000 deaths in children

(Broor *et al.*, 2003)

- Prevalence in diarrhoeal cases: 5-71%
 - In acute diarrhoea : 20-30%

☛ Incidence in animal diarrhoea: 10 -50%

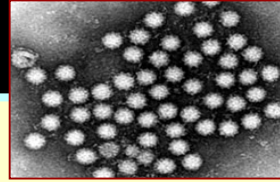
☛ Cattle, goats, sheep, pigs

- **Animal → Human : Evidence of Zoonoses**
 - **Bovine- human reassortants**
 - **Porcine –human reassortants**
 - **Atypical strains**

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Norwalk Virus



- Important emerging viral pathogen
 - ♣ 3 genogroups (GI, GII, and GIII)
- Human diarrhoea in India: Only few reports
8 – 20%
- One outbreak: Food incriminated : Salad sandwiches
 - Genogroup II

No animal studies



Hepatitis A and E Viruses

- Widely prevalent in India
- Several reports from various parts of India
- Regular outbreaks and sporadic cases
- Epidemics : Every year

- Water : Incriminated in outbreaks
- Association of meat and poultry products: Not reported



Parasites

- ❖ Relatively less emphasis given
- ❖ **Cysticercosis:**
 - ❖ Neurocysticercosis: Partial Seizures : 40 %
 - ❖ Taenia: Adult tape worm infection
- ❖ **Toxoplasmosis**
- ❖ **Amoebiasis**
- ❖ **Cryptosporidiosis: Emerging**
- ❖ Animals help in perpetuation of Zoonotic Parasites
 - Frequently reported are
 - **Fasciolosis**
 - **Hydatidosis**
 - **Several nematodes**

Other safety issues

IVRI





IVRI

Trans-boundary Animal Diseases

- Global trade: Significant food safety issue
- ❖ Particularly zoonotic pathogens
 - Contact with animals/foods
 - Avian Influenza
 - BSE
 - RVF





Avian Influenza

- Tremendous loss to poultry Industry
- ❖ Maharashtra and Gujarat 2006
 - 3.45 lakh birds culled
 - 6 lakh eggs & 53 MT feed destroyed
- ❖ West Bengal and Tripura: 2008
 - > 40 lakh birds culled
 - 15 lakh eggs & 80,000 Kg feed destroyed

(10/32008, DAHD, Govt. India Media notification)
- ❖ Controlled: Initiatives and rapid response teams of DAHD, Govt. of India



WHO Food safety information

Avian Influenza

- Conventional cooking ($> 70^{\circ}\text{C}$) safe : Inactivate virus
- In poultry meat: not killed by refrigeration or freezing
- Home slaughtering and preparation is hazardous
- Eggs contain virus both on outside and inside of shell
- No evidence of infection: If consumed properly cooked poultry and eggs
- Greatest risk in handling and slaughter of live infected birds

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Antibiotic Resistance

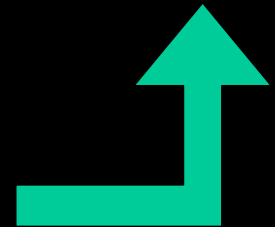
Increased antibiotic resistance of foodborne pathogens

Antibiotics
in feed



Emergence
of resistant
foodborne
pathogens

Irrational /sub-
therapeutic use of
antibiotics in treatment

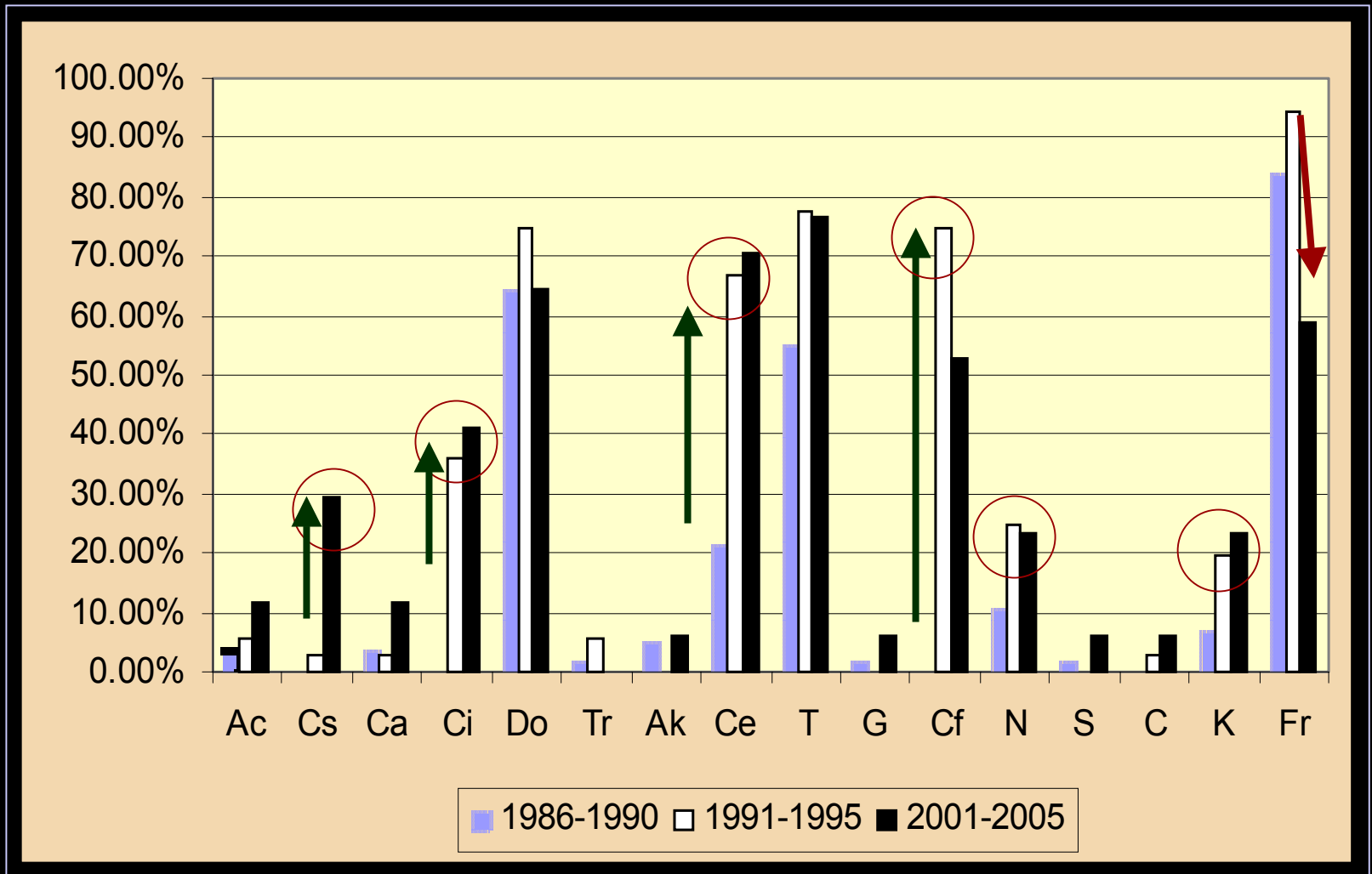


Antibiotic Resistance

- ❖ Health related issues associated with resistant bacteria
 - Treatment failures
 - Reduced therapeutic options
 - Increased severity of symptoms



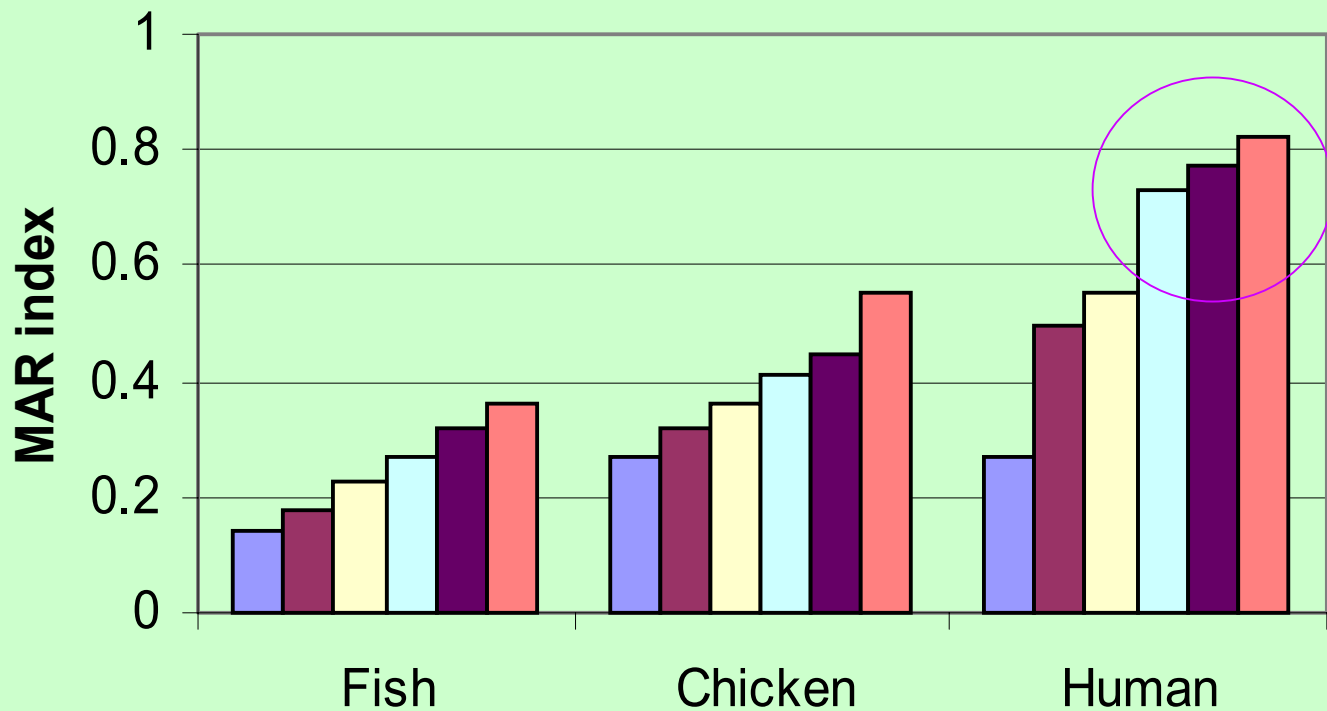
Resistance profile of *Salmonella* Virchow



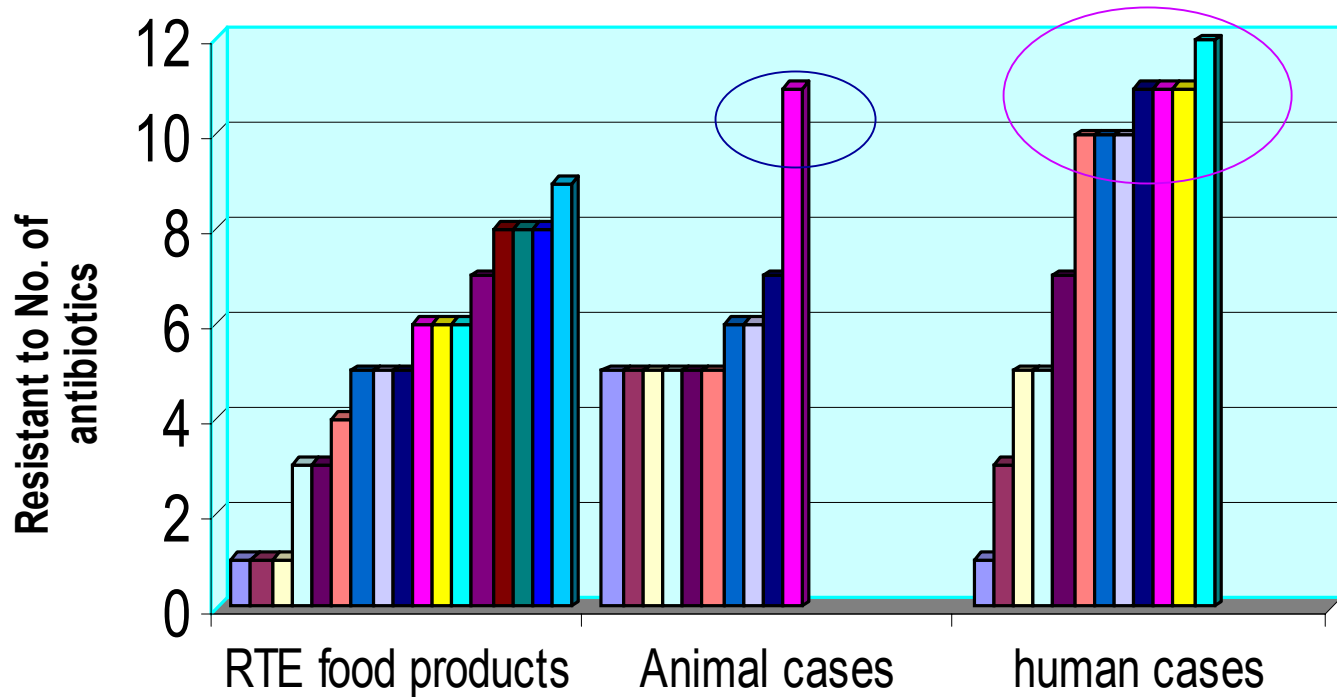
Cs: Cefoperazone; Ci: Ceftriaxone; Do: Doxycycline; Ce: cephotaxime; T: Tetracycline; Cf: Ciprofloxacin; N: Neomycin; K: Knamamycin; Fr: furazolidone

N= 109

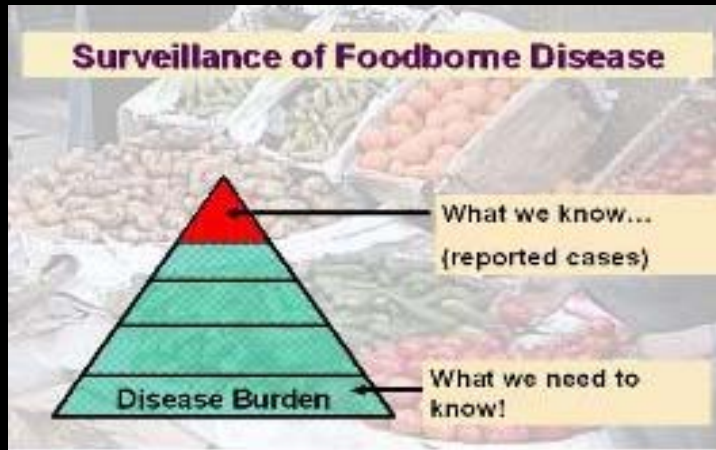
MAR index of Aeromonas isolates from various sources



Antibiotic resistance pattern of *S. aureus* isolates



Other microbial safety issues.....



Non-existent

Needs to be
established

**WHO Initiative
for global FBD
Burden**

Surveillance network
for zoonotic diseases

In
pipeline

Other microbial safety issues.....

- ❖ Traceability of animals
- ❖ Microbial source tracking
 - ❖ Molecular epidemiology of pathogen
 - ❖ Advanced genomic and proteomic tools

- ❖ Improvement and establishment of modern abattoirs
- ❖ Systematic rearing of meat animal

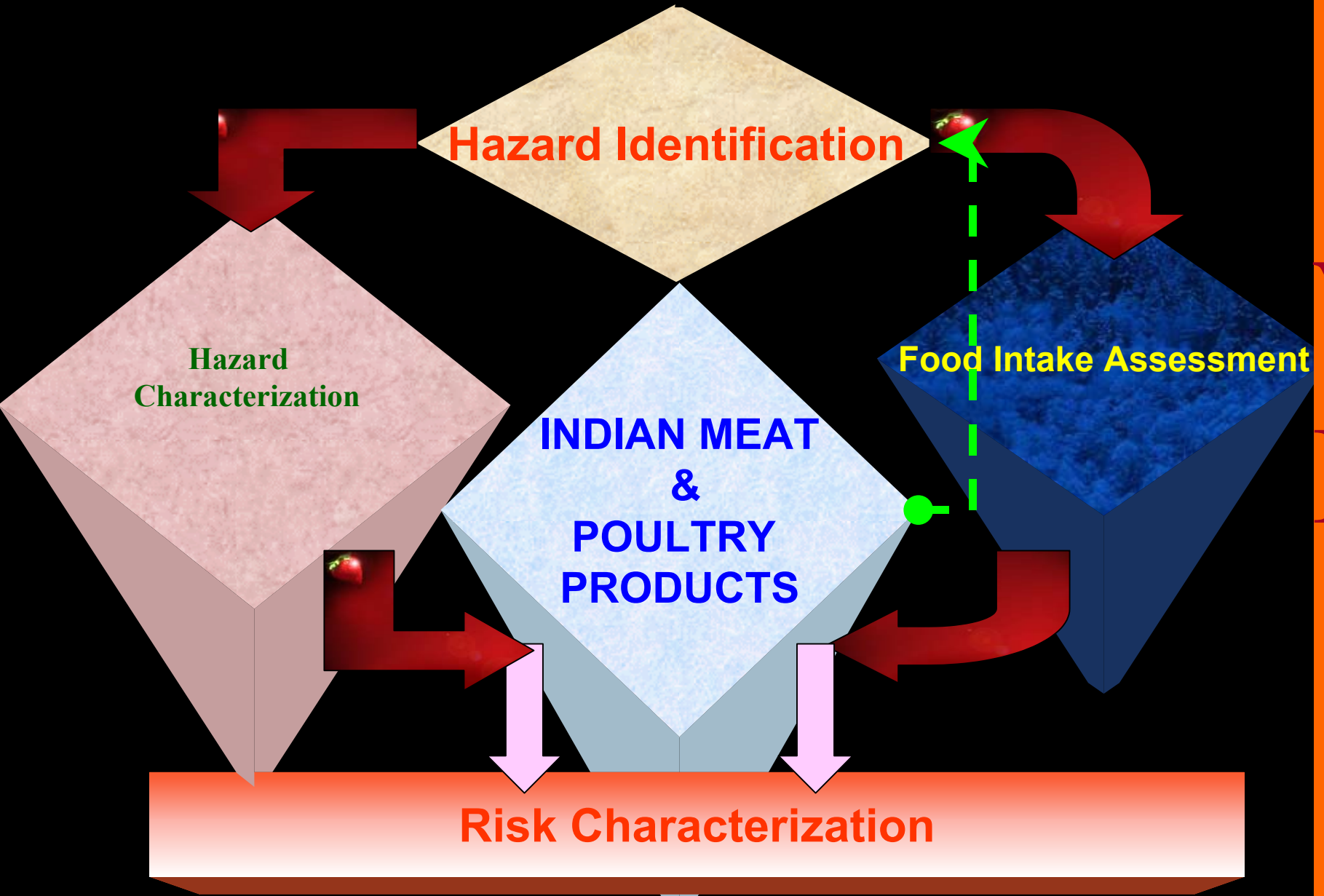


National Meat and Poultry Development Board

Risk Assessment Essential



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Establishment of Microbial Standards

- Standards available for few meat and poultry products

Frozen meats	
Characteristic	Requirements
Total plate count	10000/g
<i>E.coli</i>	100/g
<i>Staph aureus</i>	100/g
<i>Cl. perfringens</i> and <i>Cl. botulinum</i>	30/g
<i>Salmonella</i>	Absent in 25 g
<i>Listeria monocytogenes</i>	Absent in 25 g





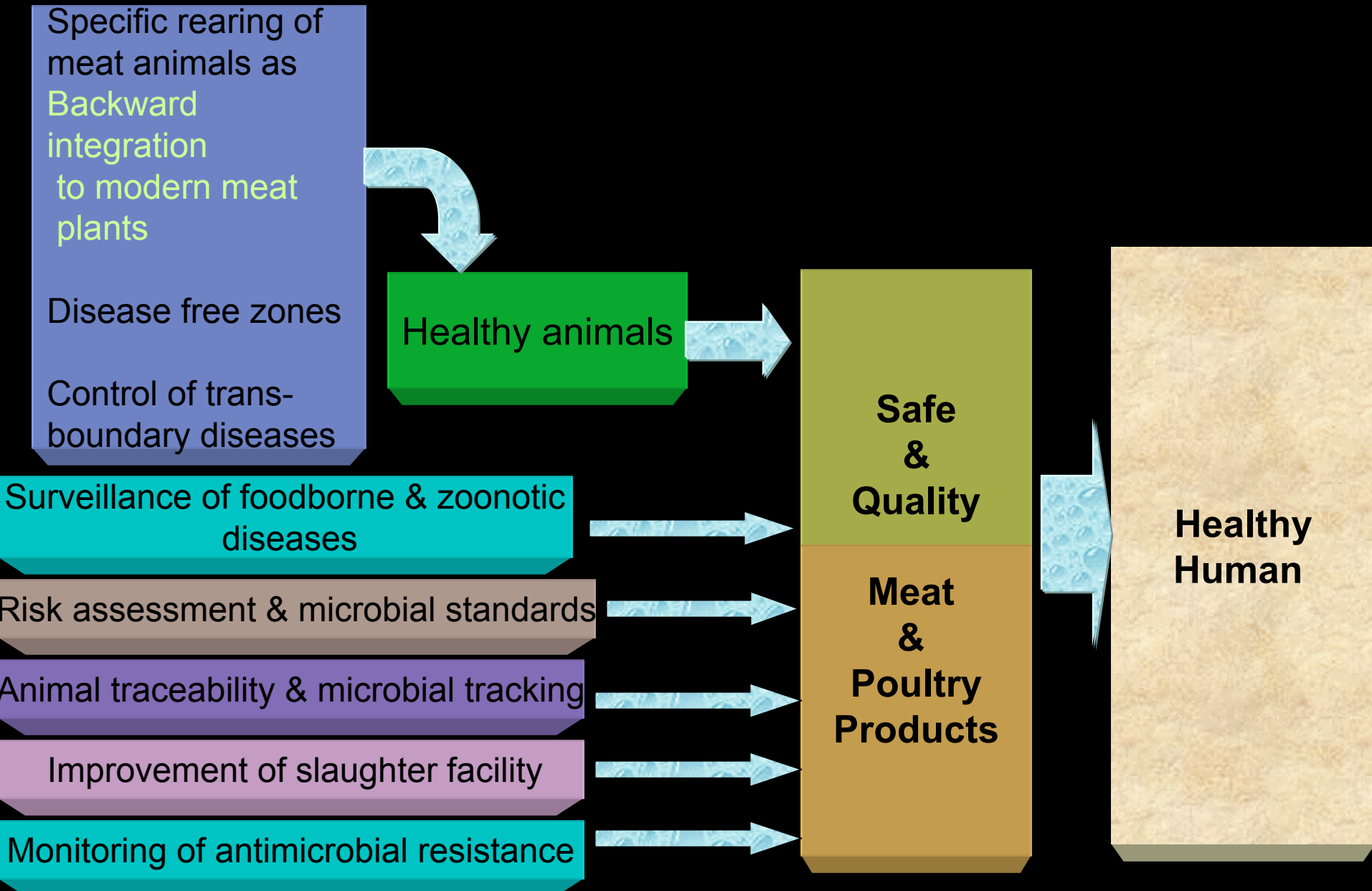
Microbial Standards.....

Corned beef, luncheon meat, cooked ham, canned meat

Characteristic	Requirements
Total plate count	1000/g
<i>E.coli</i>	Absent in 25 g
<i>Staph aureus</i>	Absent in 25 g
<i>Cl. perfringens</i> and <i>Cl. botulinum</i>	Absent in 25 g
<i>Salmonella</i>	Absent in 25 g

Essential to develop standards for
Indian meat and poultry products

Challenges ahead





Advantages /strengths

- Food Safety and Standards Authority- Established
- Excellent veterinary infrastructure
 - 26,717 polyclinics/ dispensaries/hospitals
 - 28,195 Veterinary aid centers
 - 9 Veterinary universities
 - > 40 Veterinary colleges
- Scientific & Trained manpower
 - In Veterinary Public Health and Food Safety
 - In new technologies such as genomics, proteomics

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IVRI

Advantages /strengths.....

- High Security Animal Disease Laboratory, IVRI, Bhopal
 - One of the best in the world
 - Excellent Infrastructure
 - BSL 4 pathogens
 - Exotic animal diseases
- Animal disease surveillance system through
 - Central Disease Diagnostic Laboratory, IVRI
 - Regional Disease Diagnostic Laboratories (each zone)
- Integrated disease surveillance programme (IDSP) by Ministry of health and family welfare
 - Needs strengthening by collaborative efforts i.e. participation of veterinarians for control of meat borne diseases

Commendable
work in avian
influenza



Advantages /strengths.....

- Absence of some important trade and food safety related diseases in Indian livestock
 - BSE, scrapie, CBPP, RP, RVF, etc
- Availability of modern and integrated export oriented meat processing units which are HACCP certified
- A well organized poultry sector.
- Indian eating/cooking habit
 - Fresh meat preferred
 - Meat : Pressure cooked/high temperature

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“To succeed in a mission, you must have single minded devotion to your goal”



Dr. APJ Abdul Kalam



Thank You