

African Swine Fever Gap Analysis Workshop

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Epidemiology Report



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The epidemiology of African swine fever (ASF) significantly varies among regions, depending, mainly, on the population characteristics (densities, distribution, contact patterns, etc) of the hosts involved (i.e. domestic pigs, wild suids and/or ticks) and socio-economic factors (farming and trading practices, incentives and constraints, hazard management, etc.). As a consequence, research priorities should ideally be targeted to these determinants of the disease's epidemiology. Here, we aimed to highlight the main knowledge gaps related to the virus-host-environmental and socio-economic aspects of ASF epidemiology in an attempt to synthesize the most relevant aspects that affect different epidemiological scenarios. Note that the traditional triad of disease causation, virus-host-environment, has been re-formulated here to also include also the socio-economic component, which we believe

is crucial to better understand ASF (as well as other diseases) occurrence under different settings (**Figure 1**). We believe that this approach is useful to identify not only gaps but also research priorities in ASF endemic areas (and preparedness in free-countries) and finally potential areas of intervention.

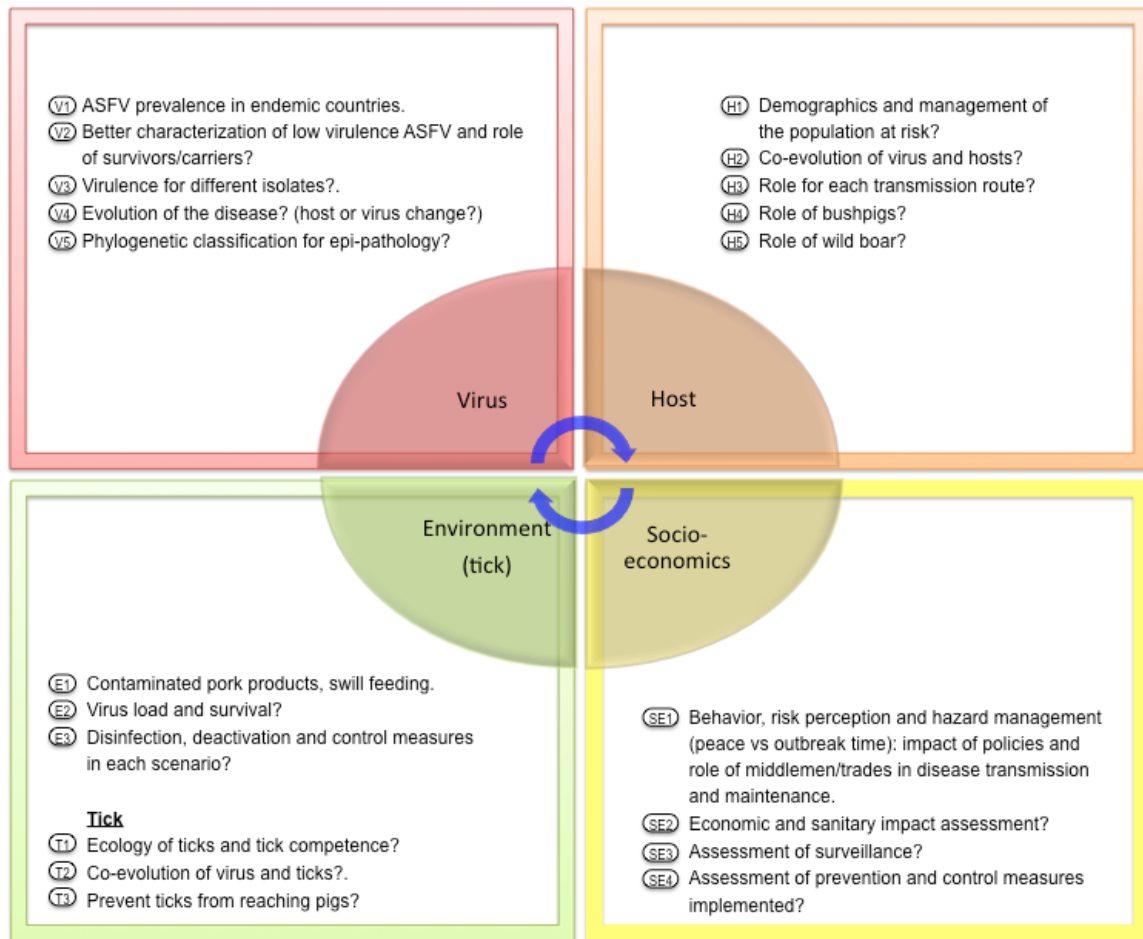


Figure 1. Brief summary of the gaps identified by the working group on ASF epidemiology

Gap identification

In general, as a result of the gap analysis, we observed that there is a need to better understand the **drivers for ASFV transmission**, including the role of different ASFV

isolates under different host, environmental and socio-economic conditions. The specific gaps identified in each compartment (and briefly cited in Figure 1) were the following ones.

Virus (or virus-host interaction) gaps

- V1. There is a lack of adequate knowledge of ASFV prevalence/incidence/distribution in endemic countries.
- V2. There is a need for better characterization of mortality/low virulent cases as well as of the role of survivors/carriers and the different cycles involved in different endemic countries.
- V3. There is a lack of definition/characterization of i) viral virulence for different isolates and circulating strains, ii) clinical forms for different isolates (differentiated by full genome)?, iii) transmission and survival rates for these isolates and iv) duration of shedding for different clinical forms?
- V4. There is a need to identify if the evolution of the disease is due to host or virus adaptation/changes or to both, or to changes in the population structure (linked with gap H2 and T2).
- V5. There is a need for improved phylogenetic classification that better considers the epi-pathology of the disease.

Host gaps

- H1. There is a need for a better characterization of the population at risk (domestic pig and wild suid populations): including pig/wild suid demographics (census, spatial location, etc.), husbandry and farming practices (backyard/feral pigs, etc.), trade patterns, market actors and chains (seasonality and temporal component on trade), hunting practices and strategies, etc.
- H2. There is a need to characterize the co-evolution of virus and hosts (including ticks) (e.g. resistant breeds/genetic characterization), including the genomic basis for ASFV refractoriness (wild suids vs domestic pigs), failure for virus establishment and potential uniqueness of survivors/carriers (linked with gap V4 and T2).
- H3. We need to understand/quantify the role and infectious dose for each transmission route (pork and pork products, swill feeding, direct, vertical, other fomites) on ASF spread.
- H4. There is a lack of knowledge on the role of bushpigs: to what extent are they resistant?, to what extent are they infected (prevalence/incidence) and how do they get infected (warthog-bushpig?/tick-bushpig?/pig-bushpig? in a unidirectional or bidirectional pathway)?, do they transmit ASFV to other pigs directly in natural conditions (not only experimental) or through their products/meat?, what are the contact patterns that may lead to infection of domestic pigs?
- H5. There is a need to better define the wild boar role in ASFV transmission to domestic pigs. Could wild boar populations maintain ASFV infection and

become ASF-endemic without contact with infected domestic pigs? Could wild boar spread ASF over longer distances? If so, what is the minimum population density needed (also for disease persistence)?

Environment (including tick) gaps

- E1. There is a lack of knowledge in the viral load and survival in different food products that end up in swill.
- E2. There is a need to quantify the virus load and survival in different environments and products (mainly in new pork products and in different environments in Africa and Europe) (linked with gaps H3 and SE3).
- E3. Effective cleaning & disinfection measures and proper control protocols for outbreak areas are still missing. There is a need for appropriate deactivation measures for possibly infected pork and pork products for human consumption and for swill feeding for small-scale producers.

What do the communities do, or should do or not do during suspected ASF outbreaks in order to design self help ASF prevention/control strategies?

Knowledge of virus load and survival, and deactivation measures could inform “safe” slaughter and treatment of carcasses in case of outbreaks to avoid full losses for small-scale producers.

Tick gaps

There is a lack of knowledge on the following points:

- T1. Ecology of ticks and tick competence (for each *Ornithodoros*. spp) in ASFV transmission in different regions, including i) the observed association (or frequency) between tick bites to different types of pigs (domestic pig and wild pigs) and ASFV infection, ii) the tick infectious dose for ASFV transmission (for each *O.* spp and isolate and relevant spp of suidae), iii) role of ticks as reservoir of ASFV post-outbreak (time of survival of ticks and of ASFV on ticks) for other (not documented) *O.* spp and their role in ASF endemicity in African countries (The tick-pig cycle has only been demonstrated in a few countries in southern Africa, but might play a role also in countries such as Uganda, Tanzania, Kenya etc.)
- T2. Characterize the co-evolution of virus and ticks. Same virus in ticks as in pigs and wild suids? (linked with gap H2 and T2).
- T3. Measures to prevent ticks from reaching pigs (fencing/water trenching) and to eliminate ticks from already infested areas.

Socio-economic gaps

There is a lack of knowledge on the following points:

- SE1. Risk perception and hazard management (e.g. socio/economic/culture/religion factors) of farmers, butchers, traders, middlemen, consumers, health authorities, politicians and other related actors (e.g. ASF reduces price of pigs and pork, which may be interesting for traders and butchers; imbalance in offer and demand). A better knowledge of the

behavior of different actors during peace vs. outbreak/stress time is needed to inform mitigation strategies (excessive, insufficient or absent compensation as a risk factor?)

SE2. Economic and sanitary impact assessment of the disease in different countries.

SE3. Assessment of surveillance implementation and capabilities, definition of Sensitivity and Specificity for different species and under different field conditions.

SE4. Assessment of prevention (i.e. awareness or trainings of different actors, targeted surveillance) and control measures implemented (cost-effectiveness, negative effect, uptake/ acceptability, etc.)

Note that some of the gaps identified here may be applicable only to particular countries/areas. It would be interesting to conduct more extensive gap analyses or expert consultations similar to the one summarized here, but for particular regions/ scenarios to identify and rank the most relevant research needs to achieve the greatest advance in ASF prevention and control in different epidemiological settings.

Research needs

In general, we observed that there is a need to conduct multi-scale and integrated assessments of ASF epidemiology considering its diverse virus, host, environmental and socio-economic aspects. **Field, experimental and modeling/analytical studies** conducted by multidisciplinary teams (i.e. including epidemiologists, virologists,

immunologists, ecologists, economists, sociologists, anthropologist experts in ASF diagnostic and control, etc.) are highly needed to fill the identified knowledge gaps. Descriptive studies on disease occurrence, pig farming and trading practices, risk perception and behavior, etc. are needed for analytical studies. Novel epidemiological tools and methods such as risk assessment, SIR/spatial disease spread models, Multi-criteria decision analysis (MCDA) and other risk mapping and modeling methods such as Maximum entropy or social network analysis will be particularly useful to identify risk factors and support more cost-effective measures for an improved prevention and control of ASF in different epidemiological settings.