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Vectors and Vector-Borne Diseases with Special Reference to History and Current Status of LSD in Egypt: A One Health Approach

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ABSTRACT

Infectious diseases known as "vector-borne diseases" (VBDs) are re-emerging and re-emerging, inflicting considerable economic losses due to high mortality rates, decreased productivity in the livestock sector, and effects on both human and animal health. Furthermore, VBDs make for roughly 25% of important vertebrate pathogens for veterinarians. Viruses, bacteria, and parasites cause vector-borne illnesses, which are spread through the bite of hematophagous arthropods (mostly ticks and mosquitoes). Given that most of these diseases are zoonotic, managing them requires a multidisciplinary approach. Insects that feed on disease-causing microorganisms from an infected host (human or animal) and then inject them into their next victim during their next blood meal include mosquitoes, sandflies, ticks, bugs, flies, fleas, lice, and some freshwater aquatic snails. Arthropod populations, such as flea, tick, mosquito, sandfly, and Culicoides populations, are susceptible to quick changes in temperature and humidity. Both the abundance and distribution of vectors can be impacted by climatic changes that go beyond simple increases in mean temperature. The current review throws lights into VBDs and their vectors in Egypt.

Keywords: Vector Borne Diseases, Ticks, Mosquitoes, Egypt.

INTRODUCTION

Egypt is a country in northern Africa that is home to more than one hundred million people and twenty eight million animals. The bulk of the population relies heavily on the cattle industry as their main source of meat, milk, farm work, and subsistence, contributing 40% of the nation's agricultural GDP. Egypt currently has 27 governorates, including 4 city governorates (Alexandria, Cairo, Suez and Port Said), 9 in Lower Egypt, 9 in Upper Egypt, and 5 governorates that cover the Sinai and the eastern and western deserts (Fang et al., 2022).Vectors are living organisms that can transmit infectious diseases from one person to another or between animals. Many of these vectors are bloodsucking insects, such as mosquitoes, sandflies, ticks, bugs, flies, fleas, lice, and some freshwater aquatic snails, that feed on disease-causing microorganisms from an infected host (human or animal) and then inject them into their next victim during their next blood meal (Eassa & Abd El-Wahab, 2022). The most prosperous group of animals in the animal kingdom are arthropods. Since ancient times, they have been recognized as the primary vectors of disease transmission since they may be found in all habitat types and geographical areas of the world, feeding on a wide range of plant and animal materials (Shoukry & Morsy, 2011).Mosquitoes are the primary carrier of human infectious agents among hematophagous arthropod vectors, whereas ticks are the primary carrier of the great majority of zoonotic diseases globally. Furthermore, ticks are the agents that transmit the broadest range of infectious diseases to both animals and people (Álvarez-Hernández, 2018).Birds that are migrating can cover thousands of kilometres while bringing ectoparasites like mites, ticks, fleas, and lice with them. When migratory birds come into touch with local host populations, such arthropod pests have the potential to spread infections to local animals. According to our timing of migration events, the sources and directions of migration of migratory bird species are frequently predictable (Sparagano et al., 2015).

Egypt's geographic location leads to largely dry equatorial climate, with exception of the northern coastal districts, where a fairly warm climate prevails. Egypt experiences hot, dry summers and a mild winter that gets colder and rainier as you get closer to the Red Sea and Mediterranean Sea shores. These conditions result in an ideal conditions for the growth of many species, including ticks and the diseases they carry (Abdelbaset et al., 2022). Despite the fact that global warming is just one of many elements contributing to climate change, the terms "climate change" and "global warming" are frequently used interchangeably. In most cases, when the phrase "global warming" is used, what is meant is the observed rise in average global temperature over the past few decades, both in frequency and intensity. It results from the greenhouse effect, which is brought on by an increase in CO_2 emissions as a result of increased global usage of fossil fuels and simultaneous destruction of trees and forests (El-Sayed & Kamel, 2020). Large rains are also required to provide the standing water surfaces required for egg laying and larval development, despite the fact that mosquitoes can withstand higher temperatures and have longer active seasons. The dynamics of the vector population are improved by high atmospheric humidity. Last but not least, the wind is vital to the growth of mosquitoes and the diseases they spread (Min and Xue 1996; Walsh et al. 2008).

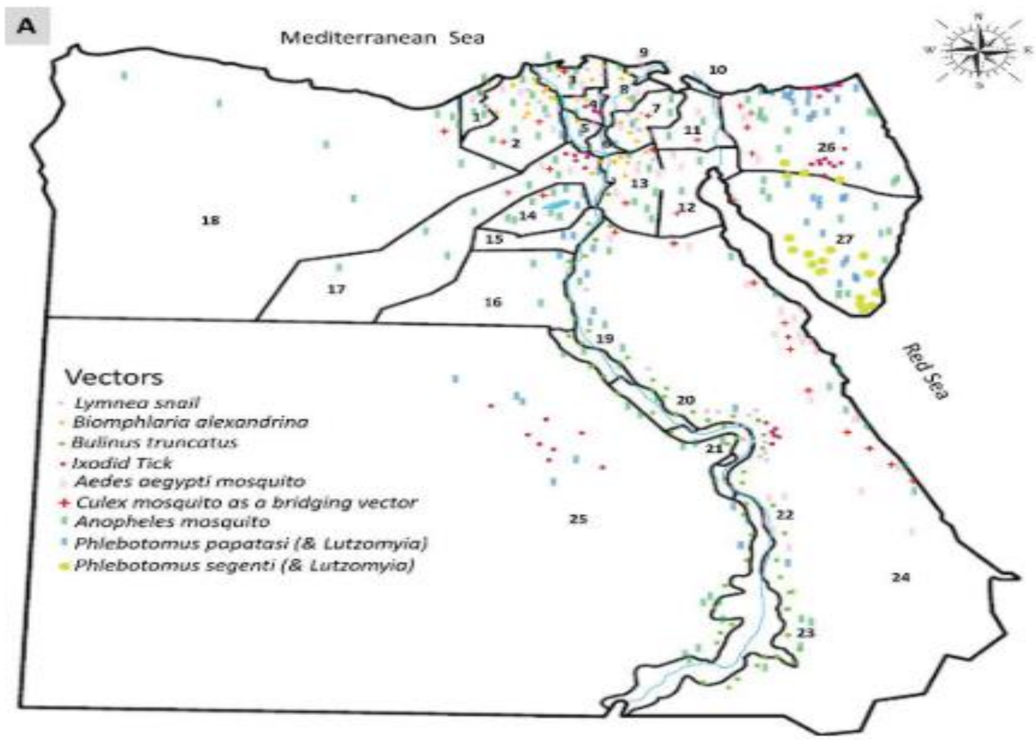

Fig. 1: Distribution of vectors in Egypt. The following provinces are shown on the map of Egypt: Alexandria, El-Behera, Kafr El-Sheikh, El-Gharbia, El-Menofia, El-Qalubia, El-Sharquia, El-Dakahlia, Damietta, and Port Said. El-Ismailia (11) El-Suez (12), Cairo (13), El-Fayoum (15), Bani-Suif (16), El-Menia (17), Giza (18), Marsa Matrouh (19), Assiut (20), Sohag (21), Qena (22), Luxor (23), Aswan (24), Red Sea (25), New Valley (26), North Sinai (27), and South Sinai (27). The distribution of the various vectors is shown as a series of coloured dots (Eassa & Abd El-Wahab, 2022).

Especially in the case of zoonotic illnesses, which pose a direct threat to both animal and human health, vector-borne diseases (VBDs) are of global relevance. These infections are spread by arthropod vectors like ticks, mosquitoes, fleas, and phlebotomine sand flies in communities of both animals and people (Selim et al., 2021).Vector-borne diseases are spread by the bite of hematophagous arthropods, primarily ticks and mosquitoes, and are brought on by parasites, bacteria, or viruses. Their care calls for a multidisciplinary approach, especially given that the majority of these diseases are zoonotic (Parola et al., 2005). One of the biggest risks to human and animal health is arthropod-borne illness transmission (Folly et al., 2020). Numerous VBDs, including piroplasmosis, anaplasmosis, and Q fever, are listed by the World Organization for Animal Health (WOAH). Numerous variables, including urbanization, climate issues for medical professionals and veterinarians, globalization and increased international trade, have an impact on the prevalence and transmission of VBDs(Abdullah et al., 2021).

Due to the non-specific febrile sickness, difficulties in isolation, and cross-reactivity of serological tests, diagnosis of all these diseases is difficult.

Therefore, to improve diagnostics' sensitivity and specificity, find previously undiscovered infections, and tell apart closely related species, new molecular approaches have been applied. The epidemiology and frequency of these illnesses are still poorly studied and neglected in Egypt (Abdullah et al., 2021).

Transmission of vector-borne diseases.

Each element of the vector-borne system, the pathogen, vector, and reservoir must work together effectively for vector transmission to occur. However, it also depends on how these elements interact with one another in their environment, which may have a direct or indirect impact. Since not simply any pathogen can be transmitted by any vector and be harbored by every animal, their genotypes can also affect the success of transmission (Kuleš et al., 2016). The term "horizontal transmission" refers to the spread of viruses between mosquitoes, birds, people, and other vertebrates. However, some vector species also have trans-generational vertical transmission of viruses, which allows the spread of infectious viruses from adult mosquitoes to offspring (Braack et al., 2018).

The Mechanical Transmission

Most likely, not long after arthropods became dependent on blood feeding on vertebrate hosts, mechanical gearbox first started to occur through infected mouthparts of the blood-sucking arthropods that switched vertebrate hosts during feeding activities. Among the DNA viruses at work are myxoma virus, cow lumpy skin disease virus, rabbit fibroma virus and African swine fever virus. Among the mechanically transmitted RNA viruses are the rift valley fever virus, bovine viral diarrhea virus, equine infectious anemia virus bovine leukemia virus, and hog cholera virus (Kuno & Chang, 2005).

(Sohier et al., 2019) reported experimental evidence of Haematopota spp. horseflies and Stomoxys calcitrans biting flies transmitting the mechanical lumpy skin disease virus. They came to the conclusion that one experiment demonstrated LSDV transfer by Haematopota spp. The creation of nodules and the discovery of a virus in the acceptor animals' blood supported the LSD evidence. These findings support the idea that these vectors mechanically transmit the viruses.

Biological Transmission

A mosquito must first bite and feed on an amplifying (and infected) host in order to naturally transfer a virus. Following this internal growth, the pathogen must be released into the insect's saliva where it can then infect a fresh receptive non-host by feeding on it. Only a few (or one) mosquito species must be able to biologically transmit a particular mosquito-borne pathogen. "Vector competence" refers to a mosquito's tendency for infection while feeding on blood as well as its ability to spread disease after feeding. Depending on the species, a vector's competence might range from higher to lower to absolutely refractory. Lifespan, host feeding preferences, bite rate, population size, and other ecological and behavioral traits may be more important to the establishment of diseases (Smith et al. 2012).

Tick borne diseases:-

Ticks are hematophagous arthropods that parasitize the majority of vertebrate species worldwide, including people and animals. Ticks are the second-largest vector for human vector-borne diseases, behind mosquitoes, and host and spread a number of diseases that are harmful to both humans and animals. Additionally, tick bites can cause irritation, paralysis, or severe allergies in humans (De La Fuente et al., 2007). Egypt, which is situated on the southern Mediterranean Sea coast, is situated along the African-Eurasian flyway, a significant migration path for avians travelling between their breeding grounds in Eurasia and the wintering sites in Africa. In the spring and autumn, millions of birds, including many migrant birds from Europe, cross the Mediterranean Sea, creating chances for the spread of ticks and the infections that go with them (Abdelbaset et al., 2022).

Twelve bacterial diseases (anaplasmosis, Lyme borreliosis, ehrlichiosis, bovine borreliosis, Mediterranean spotted fever, African tick-bornefever, lymphangitis-associated rickettsiosis, bordetella, and babesiosis) and three protozoal diseases (babesiosis, theileriosis, and hepatozoonosis) have also been reported in Egypt There have also been reports of a number of arboviruses, including Lumpy skin disease (LSD), Alkhurma hemorrhagic fever (AHF), and Crimean-Congo hemorrhagic fever (CCHF). (Table.1) (Abdelbaset et al., 2022).

The use of acaricides has been the main method for controlling tick infestations. Acaricide use, however, has been shown to be unsuccessful in the reduction of tick infestations and is frequently accompanied by significant negative consequences, such as the selection of acaricide-resistant ticks, environmental contamination, and contamination of milk and meat products with acaricide residues (Antunes et al., 2012).

Table (1):- Tick-borne diseases, tick vectors, and their geographical distribution in Egypt (Abdelbaset et al., 2022).

Tick-borne disease	**Species**	**Host**	**tick vector**	**Geographical Distribution**
Babesiosis	Babesia bovis	Buffaloes, camels, cattle, sheep	Rhipicephalus annulatus	Assiut, Cairo,Beheira, Dakahlia, Elminia, Fayoum, Giza, Halayeb, Kafr Elsheikh, Matrouh, Menofia, New Valley, Port Said, Qena, Shalateen, Sharkia, and Sohag
	Babesia bigemina	Buffaloes, camels, cattle	Rhipicephalus annulatus	Behera, Dakahlia, Benisuef, Elminia, Giza, Fayoum,Ismailia, Kafr Elsheikh, Matrouh, Menofia, New valley, Qena, Qualyobia, Sharkia, Sohag,
	Babesia occultans	Buffaloes, cattle	Hyalomma excavatum	Assiut, Elminia, Fayoum, New valley
Theileriosis	Theileria			

	annulata	Buffaloes, camels, cattle, sheep	Hyalomma dromedarii, Hyalomma excavatum	Aswan, Beheira, Benisuef, Dakahlia, Elminia, Fayoum, Giza, Menofia, New valley, Port Said, Qena, Qualyobia, Sharkia, Sohag
	Theileria ovis Anaplasmosis	Buffaloes, camel, cattle, equines, goats, sheep	ND	Aswan, Beheira, Benisuef, Cairo, Giza, Menofia, New valley, Qualyobia, Sinai Alexandria
	Theileria equi	Donkey, horses, mule	Rhipicephalus annulatus	Alexandria, Cairo, Benisuef, Fayoum, Giza, Ismailia, Matrouh, Menofia
	Theileria sp	Camels, cattle	Hyalomma dromedarii	Menofia, Upper Egypt
Anaplasmosis	Anaplasma marginale	Buffaloes, Buffaloes, camels, cattle, equine, sheep	Hyalomma excavatum, Rhipicephalus annulatus	Assiut, Cairo, Beheira, Benisuef, Dakahlia, Damietta, Elminia, Fayoum, Gharbia, Giza, Kafr Elsheikh, Matrouh, Menofia, Qena, New valley, Qualyobia, Sinai, Sohag
	Anaplasma platys	Buffaloes, camel, cattle, dogs	Hyalomma excavatum, Rhipicephalus annulatus, Rhipicephalus sanguineus	Assiut, Benisuef, Cairo, Elminia, Fayoum, Giza, New valley, Qualyobia, Sinai
	Anaplasma phagocytophilum	Dogs, humans, sheep	Rhipicephalus sanguineus	Giza, Nile Delta
Borreliosis Lyme borelliosis	Borrelia burgdorfer	Cattle, dogs, humans	Hyalomma anatolicum excavatum, Rhipicephalus sanguineus	Benisuif, Cairo, Fayoum, Giza, Qualyobia
Bovine borreliosis	Borrelia Theileri Borrelia	Cattle, horses, sheep	Rhipicephalus annulatus	Benisuef, Cairo, Fayoum
Q fever	Coxiella burneti	Camels, cattle, dogs, humans	Amblyomma variegatum, Hyalomma anatolicum, Hyalomma	Alexandria, Cairo, Aswan, Dakahlia, Giza, Ismailia, Matrouh, New valley, Port Said, Sharkia, Sinai

			dromedarii, Rhipicephalus pulchellus,	
Ehrlichiosis	Ehrlichia canis	Buffaloes, cattle, dogs, sheep	Rhipicephalus sanguineus	
	Ehrlichia minasensis	Cattle	Rhipicephalus sanguineus	
African tick-borne fever	Rickettsia africae	Camels	Hyalomma excavatum, Rhipicephalus annulatus	Alexandria, Cairo, Giza, Qualyobia Assiut, Fayoum, New valley
Lumpy skin disease	LSD virus	Cattle	Hyalomma dromedarii, Hyalomma impeltatum, Hyalomma marginatum	Cairo, Giza, Sina
			Rhipicephalus annulatus	Beni-suef

Mosquito vectors of infectious diseases

Mosquitoes are insects of the family Culicidae and order Diptera (two-winged). The Triassic epoch, 200–245 million years ago, is when the earliest mosquito ancestors most likely first arose. Since then, the Culicidae have likely co-evolved throughout the Jurassic period with terrestrial animals. Culicidae fossils were found in the Early Cretaceous, despite the fact that there is a limited fossil record for their inception (Pagès & Cohnstaedt, 2018), Two important subfamilies are Culicinae, which includes the arbovirus-carrying Aedes, Culex, Mansonia, and Haemagogus mosquito genera, and Anophelinae, which includes the malaria-carrying Anopheles mosquito genus. Even though each subfamily has hundreds of species, very few of them can transmit diseases to humans via biting people (El-Bahnasawy et al., 2013).

With significant morbidity and mortality, mosquitoes are insect vectors that spread parasitic and viral illnesses to millions of people worldwide. In order to develop and put into action practical and effective disease management and preventive strategies, disease monitoring requires a thorough grasp of mosquito taxonomy, differentiating characteristics, and insect life cycles (El-Bahnasawy et al., 2013). Except for Antarctica, everywhere has mosquitoes. Although their larval stages (immature stages) require a minimal level of standing water, they can be found in a variety of environments. Thanks to their special adaptation mechanisms, mosquitoes were able to adapt and colonize almost any aquatic ecosystem as breeding grounds, from sea level to elevations greater than 3,000 meters. No matter how big, what kind, or how polluted the water body is, they can be found in both temporary and permanent water sources (Pagès & Cohnstaedt, 2018).

Mosquito species in Egypt:

Cx. pipiens, Cx. antennatus, Cx. thelerei, Cx. univittatus, Cx. perexiguus, Cx. poicilipes, and Cx. pusillus were the mosquitoes found in Egypt. Anopheles caspi, An. hispaniola, An. rhodesiensis, An. stephensi, An. coustani, Ae. detritus, An. sergentii, An. pharoensis, An. multicolor, An. detali, An. algeriensis, An. tenebrosus, An. gambiae (previously), An. superpictus, An. tarkhadi, An. Coustani (El-Bahnasawy et al., 2013).

Table 2: Distribution of mosquitoes in Egypt by selected publications:

Genus	**Species**	**Authors**
Anopheles	Algeriensis Detali gambiae (formerly) Hispanioal Multicolor Pharoensis Rhodesiensis Sergentii Stephensi Superpictus Tarkhadi	Kirkpatrick, 1925, Gad, 1963 Kenawy, 1988,1990, Morsy et al, 1995a,b, El-Bahnasawy et al, 2010; 2011b
Culex	Perexiguus Pipiens poicilipes, pusillus quinquefasciatus thelerei univittatus	Kirkpatrick, 1925, Gad, 1963,Harbach et al,1988,Morsy et al, 1990, 2003, 2004 Mostafa, 2002, El-Bashier et al, 2006, Abdel Hamed et al, 2011a,b, 2013, El-Bahnasawy et al, 2013
Aedes	Aegypti Caspius Detritus	Gad, 1963; Mostafa et al, 2002,Morsy et al, 2003, 2004, El-Bahnasawy et al, 2011a
Culiseta (Theobaldia)	Longiareolata	Mostafa et al, 2002, Morsy et al, 2003, 2004

Table 3. Common mosquito vectors, vector-borne diseases (Eassa & Abd El-Wahab, 2022).

Species	**Disease**
Aedes (albopictus, aegypti,triseriatus	Chikungunya, dengue fever,lymphatic filariasis, Rift Valley fever, yellow fever, Zika, La Crosse encephalitis, Jamestown Canyon,Eastern equine encephalitis,Western equine encephalitis
Anopheles (culicifacies,fluviatilis, minimus,philippinensis, stephensisundaicus, leucosphyrus)	Malaria, lymphatic filariasis
Culex (pipiens,quinquefasciatus, nigripalpus,tarsalis)	Japanese encephalitis, St. Louis encephalitis virus, lymphatic filariasis, West Nile fever.

Egypt One Health Approach and vector-borne diseases

The One Health approach has been proposed as a pertinent way to address vector-borne diseases (VBDs) (Düzlüet al, 2020). The concept acknowledges the interconnectedness between human beings, animals, and environmental well-being. It advocates for collaborations that span multiple disciplines and sectors, and it offers a valuable way to addressing vectors and vector-borne diseases. Hence, it is imperative for veterinarians, physicians, ecologists, and public health specialists to engage in collaborative efforts aimed at identifying the vectors and vector-borne infections, with the ultimate goal of formulating effective control methods for vector-borne diseases (VBDs).

The One Health National Strategic Framework 2023–2027 was introduced in Egypt. In collaboration with the World Health Organization (WHO) and the United Nations Food and Agriculture Organization (FAO), the Egyptian ministries of health, agriculture, and the environment developed the framework. This method is crucial for preventing, anticipating, spotting, and responding to pandemic risks to world health. Additionally, it is essential for preventing zoonotic and vector-borne diseases as well as for guaranteeing the safety of food, water, and nutrition.

The establishment of this framework has the potential to augment the understanding of risk factors among all relevant stakeholders and effectively supervise the execution of the most suitable methods aimed at managing and preventing vector-borne zoonotic illnesses. Given the One Health framework, it is imperative to prioritize the advancement of research initiatives led by competent researchers across several scientific disciplines to effectively control vector-borne diseases (VBDs). Furthermore, it is imperative to emphasize the significance of international cooperation and regional collaborations in the prevention and management of vector-borne diseases (VBDs), hence promoting their encouragement. It is recommended that individuals who are accountable should conduct regular surveys in both endemic locations and places that are free from vectors and diseases. The purpose of these surveys is to assess the possible danger of vectors and the infections they carry emerging due to human and animal movement.

Study limitations

The inability to do a meta-analysis was attributed to the constraints posed by the limited quantity, scope, and geographical representation of studies pertaining to vectors and vector-borne diseases (VBDs). Likewise, it is currently challenging to ascertain the comprehensive crude prevalence and the extent of the burden associated with different vectors and vector-borne diseases in the human population and livestock. Furthermore, there has been a lack of research undertaken on the genetic diversity and transmission dynamics of animal vector-borne diseases, as well as an absence of assessment about their economic impact.

LSD was first recorded in Egypt 1988, after that several outbreaks were followed as presented in table (4). The current situation of LSD was focused by WOAH (2020) which described that LSD were 87 notifications with 17 confirmed outbreaks which much higher than 2019 that was 30 notification. Most of cases focus in Delta, Northern east region and Southern west regions in 2020.

Table 4. Prevelance of LSD outbreaks in Egyptian governorates:

Date of Outbreak	**Reference**	**Type of samples**	**Area**	**Diagnosis**
June 2, 1988	James A. House et al.,	Blood samples Skin nodules	Suez, Ismailia, Egypt	IFAT ELIZA PCR
In July, 1989	B.I.Agag, et al., 1992	blood sampling	Dakahlia Governorates.	SNT
March up to September 2006	A. M. El-Sherif et al, 2006	cutaneous nodules	Beni-Suef and Al-Fayium governorates	ELISA PCR passive hemagglutination
2006	S.S.A. Sharawi (1) & I.H.A. Abd El-Rahim (2)(2009)	tissue Milk	Kalubia province, Egypt.	AGPT PCR
2006	Fayez Awadalla Salib* and Ahmed Hassan Osman	Skin nodules	Giza governorate farms	electron microscopy

In 2006	W. Awadinetal ., 2010	skin nodules, lungs, lymph nodes, heart, liver and spleen	in the Damietta	PCR
(January) 2008	Omyma, M. El-Desawy	serum skin nodules	Giza governorate	SNT VNT
2009	Walid, S Awad, et al 2009	Blood sample Skin biopsies	Ismailia governates	PCR DBH IELIZA IFAT
March 2010 to February 2011	Ali Meawad Ahmed and Amina A. Dessouki et al.,2013	skin nodules	**Ismailia**	pathology section of VRC
2011	M. El-Tholoth and A. A. El-Kenway	skin nodules	in Egypt	PCR
during the summer of 2012	Mohamed A. Shalaby et al., 2012	skin nodules	Dakahlia Governorate	PCR
during the 2014	Ahmed N. F. Neamat-Allah et al.,2015	BLOOD SAMPLES skin nodules	Sharkia governorate from Egypt	Hematological and histopathological examination
June to December 2014	Aziza Amin et al.,2015	skin nodules, lymph nodes, lung and liver	Kaluobia governorate	PCR
January 2014 to mid- 2015	Mahmoud M. Elhaig et al.,2016	skin lesions Blood samples	Sharqia Governorate	PCR
Summer of 2016	Fatma M. Abdallah1, et al, 2018,	Skin nodules lymph nodes	Sharkia province	**PCR**
From June 2015 to September 2016	Sherin Reda Ruby 2019 et al1	Skin biopsies	Ismailia, Beni Suef Governorates and.	GPCR)
2016-2017	Mona Dawoud et al 2019	Bloodsamples skin nodules	(Beni Suef, El-Fayoum El Giza, El-Menia, El-Gharbia, El-Qalyubia, and Sharkia)	PCR ELISA

2017	Gamil Sayed Gamil Zeedan et al 2019	blood samples Skin	(Beni Suef, El-Fayoum El Giza, El-Menia, El-Gharbia, El-Qalyubia, and Sharkia)	(FAT) (PCR)- (ELISA) (IFAT) western immunoblotting
2017	Gamil Sayed Gamil Zeedan et al.,2019	uncoagulated blood and Skin biopsies	Different governorates in Egypt	PCR ELIZA IFAT
During 2017–2018	Sherin R. Rouby ET AL.,2021	Skin nodules	Beni Suef, Sohag and Aswan Governorates	PCR
During 2017 to 2018	Lutfi Bakar et al,2021	Skin nodules biopsies	Beni suif governates	PCR
During the summer of 2018	Ahmad M. Allam1 et al 2020	skin biopsies	Upper Egypt	PCR
2018	Ahmad M. Allam et al.,2020	skin biopsies	Upper Egypt	PCR
2018	Mahmoud M. Elhaig etal., 2021	Skin nodule Blood samples	Sharkia Governorate	PCR
August 2019	Hansen et al, 2019	skin biopsies	Dakahlia Governorate, Egypt.	PCR
2019	Hani G. Keshta et al.,2020	blood samples	Shebein El kom villages, Menoufia Governorate, Egypt	PCR
During 2019 and 2020	Dawlat M. Amin et al.,2021	skin nodule	(Menofia, Behira, Gharbia, Ismailia, Kafr El-Sheikh, Damitta, and Sharkia).	PCR IFAT
From January 2019 to January 2020	Abdelmoneim A. Ali et al., 2021	liver, lungs, heart, testes, kidneys, and trachea	Dakahlia, Sharkia, and Kaloubia	PCR
January 2019 to	Abdelmoneim	kidneys, liver,	Sharkia,	PCR

January 2020	A. Ali1 et al., 2021	heart, lungs, testis, trachea, and lymph node	Kaloubia and Dakahlia,) in Nile delta,	
April to November 2018	Mahmoud M. Elhaiget al.,2021	skin nodule	Sharkia Governorate	PCR
2017–2018	(Rouby et al., 2021)	skin nodule	Beni Suef, Sohag and Aswan	PCR, Histopathology
2020	Selim et al., 2021	skin nodule blood sample	Alexandria	PCR
2019 and 2020	(Fawzi et al., 2022)	skin nodule	Menofia, Behira, Gharbia, Ismailia, Kafr El-Sheikh, Damitta, and Sharkia	virus isolation (VI) Molecular detection, Histopathological, and Immunohistochemical
2018 and 2019	(El-Ansary et al., 2022)	skin nodule Ticks	Kafr El-Sheikh Al-Behera	PCR
2018, 2019, and 2020	(Fawzi et al., 2022)	skin nodule oculonasal swabs	Sharkia	(PCR)
January 2019 to January 2020	(Fawzi et al., 2022)	liver, heart, kidneys, lungs, testis, udder and lymph node	Sharkia, Dakahlia, and Kaloubia	PCR
2018	Yassien Badr et al., 2022	skin samples	El-Beheira Governorate	histopathologically and immunohistochemically
Survey between 2006 and 2018	(Azza M. Ezzeldin, 2023)	----------------	All Egypt Governorate	retrospective and survey studies

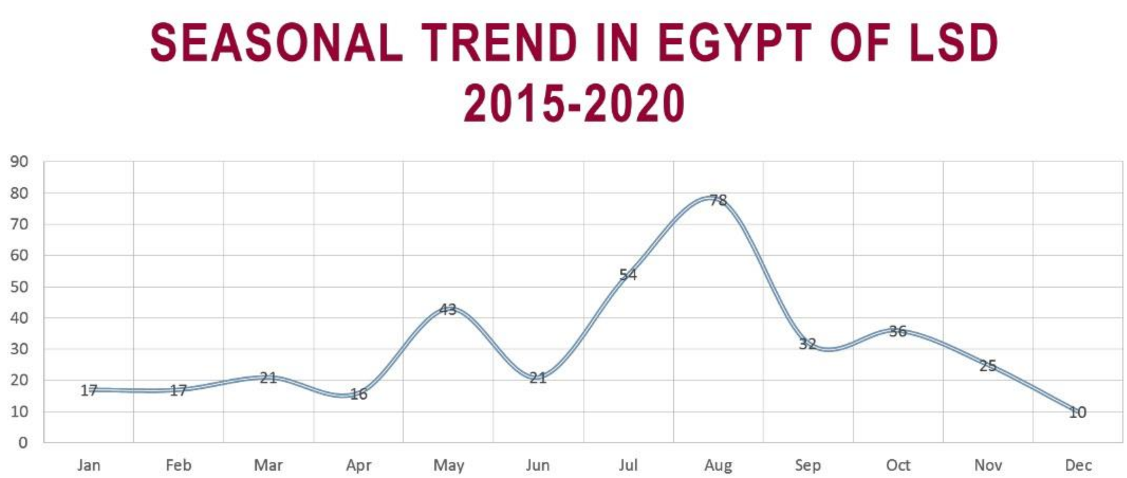

Fig.2. The most predominate season for LSD is Summer season/vector season (WOAH, 2020).

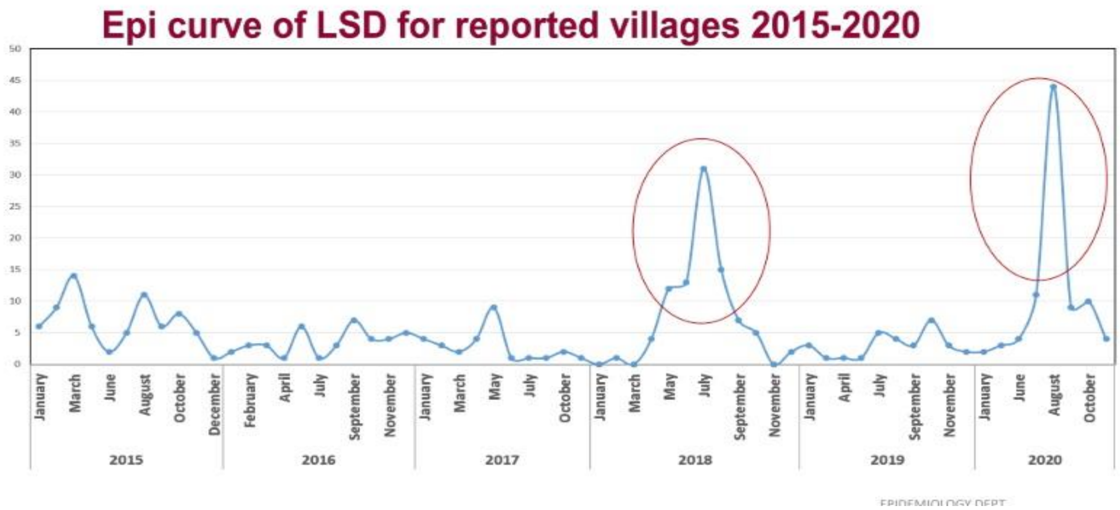

Fig.3. The Epi curve showed that the most notified villages between July and September with highly increase in August (WOAH, 2020).

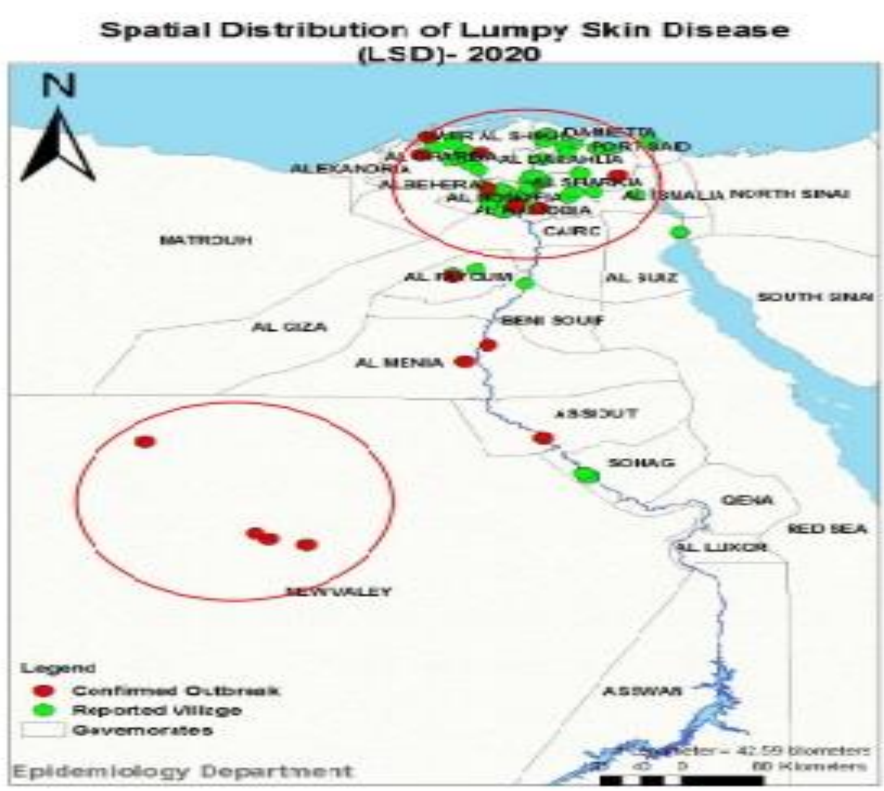

Fig.4. Spatial distribution of lumpy skin disease in Egypt 2020 (WOAH, 2020).

CONCLUSION

This review demonstrates that the majority of the reports concerning vectors and vector-borne diseases (VBDs) pertain to livestock., there is a scarcity of recorded for human vector-borne diseases (VBDs). This poor documentation hinders our ability to accurately assess the real prevalence of VBDs in humans. Hence, there is an urgent need to enhance the laboratory diagnostic capabilities inside healthcare facilities in order to facilitate regular screening for tick-borne illnesses. This improvement is crucial for enhancing diagnostic accuracy and providing valuable insights for policy development in disease prevention. Furthermore, it is imperative that research efforts concentrate on significant knowledge gaps pertaining to the epidemiology of vector-borne diseases (VBDs) in Egypt. The swift adoption of the One Health strategy is required to remove this barrier and to make it easier to carry out investigations looking at humans, animals, and vectors in a particular area. The use of cutting-edge technology, with a focus on Next-Generation Sequencing (NGS), should be used in addition to these investigations. The simultaneous identification of numerous recognized and new diseases will be made easier by these technologies.

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