TFF Pharmaceuticals Comments on Animal Studies in the Development of High Potency Remdesivir as a Dry Powder for Inhalation by Thin Film Freezing

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Scientists at the University of Texas at Austin report new pharmacokinetics data from the use of Thin Film Freezing technology to deliver remdesivir through dry powder inhalation

Dry powder formulation of remdesivir with leucine found to allow more sustained release of remdesivir from lung to plasma

AUSTIN, Texas--(BUSINESS WIRE)--Sep. 24, 2020-- TFF Pharmaceuticals, Inc. (NASDAQ: TFFP), a clinical-stage biopharmaceutical company focused on developing and commercializing innovative drug products based on its patented Thin Film Freezing (TFF) technology platform, today commented on new animal pharmacokinetics data evaluating the development of remdesivir as a dry powder for inhalation by Thin Film Freezing (TFF).

Top-line results of the study conducted by a team of researchers at the University of Texas at Austin's Division of Molecular Pharmaceutics and Drug Delivery, concluded that, "TFF technology produces high potency remdesivir dry powder formulations for inhalation suitable to treat patients with COVID-19 on an outpatient basis and earlier in the disease course where effective antiviral therapy can reduce related morbidity and mortality."

Results of the study, led by Dr. Robert O. (Bill) Williams III, the inventor of the TFF technology, were published yesterday as a preprint in bioRxiv.

Remdesivir (GS-5734), an investigational broad-spectrum antiviral agent, was developed by Gilead Sciences Inc. Remdesivir exhibits in vitro activity against SARS-CoV-2 and an intravenous formulation was granted Emergency Use Approval by the US FDA for treatment of hospitalized, seriously ill COVID-19 patients. Remdesivir is a prodrug that is intracellularly metabolized in the body into its active form, GS-441524.

The UT Austin research team, in order to maximize drug delivery to the lungs, formulated remdesivir as a dry powder for inhalation using thin film freezing (TFF). TFF produces brittle matrix nanostructured aggregates that are sheared into respirable low-density microparticles upon aerosolization from a passive dry powder inhaler. The study demonstrated that in in vitro aerodynamic testing, remdesivir combined with optimal excipients, exhibited desirable aerosol performance (up to 93.0% FPF; 0.82μm MMAD). Remdesivir was amorphous after the TFF process, which benefitted drug dissolution in simulated lung fluid. TFF remdesivir formulations were shown to be stable after one-month storage at 25^{o}C/60%RH. The study further indicated that TFF formulation of remdesivir combined with optimal excipients, like leucine, delayed the absorption into systemic circulation, allowing remdesivir to remain and be hydrolyzed to the nucleoside analog GS-441524 in the lungs. Consequently, it is believed that levels of GS-441524 can be prolonged at the target site, the lungs.

"This significant new in vitro research continues to build and advance the seminal work done earlier by Dr. Williams and his team on reformulating remdesivir using our Thin Film Freezing technology," said Glenn Mattes, President and CEO of TFF Pharmaceuticals. "This study developed significant new data on the delivery of high drug loads of remdesivir and its active form to the lungs, as well as confirmed the important temperature stability benefits that Thin Film Freezing imparts on drug formulations, a potentially key factor in future vaccine delivery efforts."

"Since remdesivir is a poorly water-soluble drug, its dissolution may be a critical factor in the drug's release in the lung fluid, especially in high drug load formulations. Our data indicates that dry powder administration can deliver high potency remdesivir to the lungs, which is then converted to its nucleoside analog GS-441524 at the target site before entering the system circulation," said Robert O. Williams III, study co-author. "And importantly, new data from the study regarding the formulation of remdesivir with leucine suggest that the TFF formulation can significantly prolong the duration of the remdesivir nucleoside analog GS-441524 in the lung, providing a important therapeutic benefit for lung delivery."

"This is vital work being pursued by Dr. Williams and his team, as it potentially brings us closer to the day when this treatment could be administered to patients earlier in the disease, directly to site of initial infection and in a convenient and accessible dosage form that could be administered outside of a hospital setting" said Mattes. "It's another real-world demonstration of the ability of our Thin Film Freezing platform to adapt to a variety of compounds that may be poorly water soluble and thus may be challenging to deliver therapeutically."

"Remdesivir is the proprietary product of Gilead and, at this time, TFF has no agreements with Gilead concerning a collaboration built around remdesivir and our TFF platform," said Mattes. "And while we intend to pursue meaningful discussions with Gilead regarding the results of Dr. Williams' growing dossier of formulation work, there can be no assurance that this effort would result in a collaboration between our companies."

About TFF Pharmaceuticals' Thin Film Freezing technology platform
TFF Pharmaceuticals' Thin Film Freezing (TFF) platform was designed to improve the solubility and absorption of poorly water-soluble drugs and is particularly suited to generate dry powder particles with properties targeted for inhalation delivery, especially to the deep lung, an area of extreme interest in respiratory medicine. The TFF process results in a "Brittle Matrix Particle," which possesses low bulk density, high surface area, and typically an amorphous morphology. allowing the particles to supersaturate when contacting the target site, such as lung tissue. Based upon laboratory experiments the aerodynamic properties of the particles are such that the portion of a drug deposited to the deep lung has the potential to reach as high as 75 percent.

About TFF Pharmaceuticals
TFF Pharmaceuticals, Inc. is a clinical-stage biopharmaceutical company focused on developing and commercializing innovative drug products based on its patented Thin Film Freezing, or TFF, technology platform. Early testing confirms that the TFF platform can significantly improve the solubility and

absorption of poorly water-soluble drugs, a class of drugs that comprises approximately one-third of the major pharmaceuticals worldwide, thereby improving their pharmacokinetics. TFF Pharmaceuticals has two lead drug candidates: Voriconazole Inhalation Powder and Tac-Lac Inhalation Powder. The Company plans to add to this pipeline by collaborating with large pharmaceutical partners. The TFF Platform is protected by 42 patents issued or pending in the US and internationally. To learn more about TFF Pharmaceuticals and its product candidates, visit the Company's website at https://tffpharma.com.

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This press release contains forward-looking statements regarding TFF Pharmaceuticals, Inc., including the benefits of the Company's TFF platform and the dry powder version of remdesivir and the Company's plans to add to its existing pipeline of product candidates. Those forward-looking statements involve known and unknown risks, uncertainties and other factors that could cause actual results to differ materially. Among those factors are: (i) the risk that the Company may not be able to engage Gilead, the owner of remdesivir, in discussions concerning a collaboration between the two companies or, if it does, that any such discussions will lead to a collaboration, (ii) the risk that the Company may be unable to successfully conclude clinical testing or obtain pre-market approval of its dry powder versions of Voriconazole and Tacrolimus, (ii) no drug product incorporating the TFF platform has received FDA pre-market approval or otherwise been incorporated into a commercial drug product, (iii) the Company has no current agreements or understandings with any large pharmaceutical companies for the development of a drug product incorporating the TFF Platform, (iv) the risk that the Company will not be able to conclude a long-term commercial agreement with any third-party, and (v) those other risks disclosed in the section "Risk Factors" included in the Company's Registration Statement on Form S- filed with the SEC on September 9, 2020. TFF Pharmaceuticals cautions readers not to place undue reliance on any forward-looking statements. TFF Pharmaceuticals does not undertake, and specifically disclaims, any obligation to update or revise such statements to reflect new circumstances or unanticipated events as they occur, except as required by law.

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