# In-vitro Evaluation of Moisture Vapor Transmission Rate of Cyanoacrylate Skin Protectant

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## INTRODUCTION

The skin serves as the primary barrier of the body to the outside world, and protects against caustic fluids and harmful external forces. In order to maintain optimum homeostatic activity and barrier function, the epidermis must remain adequately hydrated so as not to dry, crack, and become ineffective, even beneath a barrier. Resulting skin breakdown from improper hydration can cause significant pain, suffering, and a subsequently increase in morbidity.[1-3]

Skin breakdown in healthcare settings is common and constitutes a massive financial burden on patients and medical institutions alike. Often skin regions become compromised due to moisture imbalances, leaving skin susceptible to degradation. Excessively dry skin, commonly a result of adhesive stripping and dryness beneath a bandage barrier, decreases the dermal protective capacity and cell viability, and may lead to slowed or stalled wound healing. Conversely, overly moist skin, often associated with caustic fluids from wound exudate or incontinence, can cause maceration of dermal regions, and damage previously healthy skin. Dermatitis and bacterial growth can result from maceration, and the excessive softening of skin can lead to a greater risk of mechanical abrasion and tears. Thus, there is a range of hydration that the epidermis needs to maintain in order to ensure ideal cellular activity and barrier functions.[3-8]

Skin protectants are often used to guard at-risk dermal regions from skin breakdown from friction, caustic fluids, and excessive dryness in healthcare settings. There are a variety of protectants that exist in attempts to combat the burdensome effects of skin breakdown. Recently, cyanoacrylate liquid skin protectants have entered the market as a novel class of skin protectants. The cyanoacrylate monomers polymerize *in situ*, to form a barrier film upon contact with the epidermis.[9] Since the cyanoacrylate protectant is not solvent based, it forms an even barrier and does not present with gaps in coverage, which is often seen due to solvent evaporation of pre-polymerized molecules. This novel class of skin protectant has been noted for its significant resistance to friction and wash-off resistant,[10] cost effectiveness,[11] and is a non-sting product.

The importance of moist yet healthy skin is integral in preventing breakdown, especially in healthcare settings. Skin protectants must be effective in their protective capacities, but must not inhibit the native breathability of the epidermis that maintains a homeostatic balance of moisture. MVTR is an accepted parameter used in the evaluation of film and fabric breathability, and has been used to both study medical devices and common clothing materials.[13,14] This study was conducted to determine the breathability of the novel cyanoacrylate liquid skin protectant, assessed through Moisture Vapor Transmission Rate (MVTR).

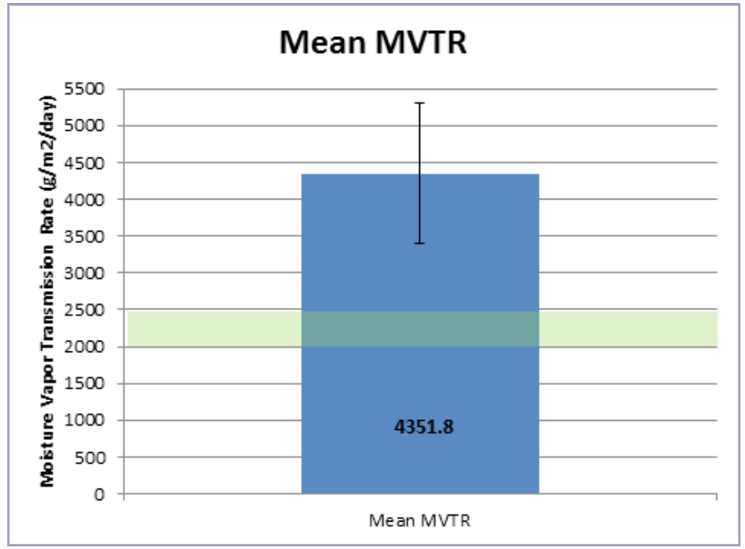
## METHODS

A gelatin solution was created using a warmed phosphate buffer; gelatin powder was then added and the solution was stirred vigorously until homogenized. The solution was allowed to set evenly in multiple weigh boats for one hour until solid. A single layer of the cyanoacrylate liquid skin protectant was evenly applied to the gelatin surfaces using the provided ampule in accordance with manufacturer instructions and allowed to dry for one hour. The coated gelatin was then removed from the weigh boats and placed in heated distilled water, leaving the cyanoacrylate films intact as the gelatin dissolved into solution. The films were allowed to dry at room temperature for 24 hours.

Cylinders were filled with a solution of deionized water and calcium chloride, in order to maintain humidity (below 20%RH) in a heated environment. The dried protectant films were cut into disks to cover the cross section of the cylinders and secured to the cylinders to prevent leakage. The initial weight of the cylindrical systems was taken to establish a baseline, and the systems were inverted so the solution was in contact with the film. Cylinders were heated at 37°C for 4 hours and then reweighed to determine water volume loss. The average Moisture Vapor Transmission Rate (MVTR) was calculated from the water volume losses. A high value is indicative of high breathability of a film.

## RESULTS

The mean MVTR of the cyanoacrylate film was found to be 4351.80 + 948.77 g/m$^2$/day.




## DISCUSSION

An MVTR of 2000–2500 g/m$^2$/day has been suggested to provide adequate moisture levels beneath a dressing without risk of wound dehydration to promote a moist wound healing envrionment.[14] The significantly greater breathability of the cyanoacrylate barrier film, 4351.80 + 948.77 g/m$^2$/day, compared to the established adequate levels likely contributes to its protective properties that prevent the skin from dehydrating out underneath the barrier film while simultaneously allowing for moisture diffusion, thus decreasing the incidence of maceration. With the extremely high cost associated with the treatment of skin breakdown in healthcare settings, such findings may be relevant to decreasing incidence rates, especially among populations observed to be most susceptible to maceration and skin tears. This finding demonstrates an additional benefit of this novel class of skin protectants, thereby augmenting the growing body of research surrounding cyanoacrylates and their clinical efficacy.

## CONCLUSION

This study was conducted to evaluate the MVTR of a novel class of cyanoacrylate based liquid skin protectant. The cyanoacrylate yielded a high MVTR, indicating a high level of breathability. This breathability was higher than the amount suggested by medical literature as adequate for proper skin hydration. These findings may have clinical and financial implications across the healthcare spectrum; further studies are warranted.

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*Marathon Liquid Skin Protectant (Medline Industries, Mundelein, IL)